



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**(Established by Govt. of A.P., Act. No. 30 of 2008)**  
**ANANTHAPURAMU – 515 002 (A.P) INDIA**  
**Course Structure & Syllabus for B.Tech. (Regular)**  
**R13 Regulations**  
**MECHANICAL ENGINEERING**

**B.Tech. I Year**

S.No.	Course code	Subject	Th	Tu/Drg/Lab.	Credits
1.	13A52101	Communicative English	2	- - -	3
2.	13A56101	Engineering Physics	2	- - -	3
3.	13A51101	Engineering Chemistry	2	- - -	3
4.	13A54101	Mathematics - I	3	1 - -	5
5.	13A12101	Programming in C & Data Structures	3	1 - -	5
6.	13A01101	Engineering Mechanics	3	1 - -	5
7.	13A03101	Engineering Drawing *	1	- 5 -	5
8.	13A12102	Programming in C & Data Structures Lab	-	- - 3	4
9.	13A99102	Engineering Physics & Engineering Chemistry Lab **	-	- - 3	4
10.	13A99103	Engineering & IT Workshop #	-	- - 3	4
11.	13A52102	English Language Comm. Skills Lab	-	- - 3	4
Total Credits					45

Th = Theory; Tu = Tutorial, Drg= Drawing & Lab = Laboratory:

\* Engineering Drawing will have University External Exam.

\*\* The students shall attend the Physics lab and Chemistry lab in alternate weeks. The end exam shall be conducted separately and average of the two exams shall be recorded by the University exam section.

# The students shall attend Engineering workshop and IT work shop as a single lab every week and the end exam is conducted as a single lab. Sharing the Maximum marks and time for one task each from Engineering workshop and IT workshop. The sum of the marks awarded shall be recorded

**B.Tech. II - I Semester**

S.No	Course code	Subject	Theory	Tu/Drg/Lab	Credits
1.	13A54301	Mathematics – II	3	1 - -	3
2.	13A01308	Mechanics of Solids	3	1 - -	3
3.	13A99302	Electrical & Electronics Engineering	3	1 - -	3
4.	13A03301	Material Science and Engineering	3	1 - -	3
5.	13A03302	Thermodynamics	3	1 - -	3
6.	13A03303	Machine Drawing		6	3
7.	13A99303	Material Science Lab & Mechanics of Solids Lab		- - 3	2
8.	13A99304	Electrical & Electronics Engineering Lab		- - 3	2
9.	13A52301	Human Values and Professional Ethics(Audit Course)	2	- - - -	-
Total Credits					22

**B.Tech. II - II Semester**

S.No	Course code	Subject	Theory	Tu / Lab	Credits
1.	13A01403	Environmental Science	3	1 -	3
2.	13A54303	Probability and Statistics	3	1 -	3
3.	13A03401	Kinematics of Machinery	3	1 -	3
4.	13A03402	Thermal Engineering – I	3	1 -	3
5.	13A01408	Mechanics of Fluids	3	1 -	3
6.	13A03403	Manufacturing Technology	3	1 -	3
7.	13A03404	Thermal Engineering Lab		- 3	2
8.	13A03405	Manufacturing Technology Lab		- 3	2
Total Credits					22

**NOTE: For Machine Drawing:**

- The End exam will be for 4 hrs in the following format
- All answers should be on the drawing sheet only. Answers on the drawing sheet only will be valued.
- First Angle Projections
  - Q1 Questions set on section I of the syllabus 2 out of 3 or 2 out of 4 to be answered with a weightage of 4 marks each-08 marks.
  - Q2 Questions set on section II of the syllabus 2 out of 3 to be answered with a weightage of 10 marks each-20 mrks.
  - Q3 Drawing of assembled views of section III items of syllabus with a weightage of 42 marks

**B.Tech. III - I Semester**

S.No	Course code	Subject	Theory	Tu /	Lab	Credits
1.	13A03501	Hydraulic Machinery	3	1	-	3
2.	13A03502	Thermal Engineering - II	3	1	-	3
3.	13A03503	Dynamics of Machinery	3	1	-	3
4.	13A03504	Metal Forming Processes	3	1	-	3
5.	13A03505	Design of Machine Members - I	3	1	-	3
6.	13A03506	Heat Transfer	3	1	-	3
7.	13A03507	Heat Transfer Lab	-	-	3	2
8.	13A01509	Fluid Mechanics & Hydraulic Machinery Lab	-	-	3	2
Total Credits						22

**B.Tech. III - II Semester**

S.No	Course code	Subject	Theory	Tu /	Lab	Credits
1.	13A52501	Managerial Economics & Financial Analysis	3	1	-	3
2.	13A03601	CAD/CAM	3	1	-	3
3.	13A03602	Machine Tools	3	1	-	3
4.	13A03603	Refrigeration & Air Conditioning	3	1	-	3
5.	13A03604	Design of Machine Members - II	3	1	-	3
6.	13A03605	Automobile Engineering	3	1	-	3
7.	13A03606	CAD Lab	-	-	3	2
8.	13A03607	Machine Tools Lab	-	-	3	2
9.	13A52502	Advanced English language Comm. skills Lab(Audit course)	2	-	-	-
Total Credits						22

### B.Tech. IV - I Semester

S.No	Course code	Subject	Theory	Tu / Lab	Credits
1.	13A03701	Operations Research	3	1 -	3
2.	13A03702	Automation & Robotics	3	1 -	3
3.	13A03703	Finite Element Methods	3	1 -	3
4.	13A03704	Metrology & Measurements	3	1 -	3
5.		<b>ELECTIVE – I (Open Elective)</b>	3	1 -	3
6.	13A03705 13A03706 13A03707 13A03708	<b>ELECTIVE – II</b> Computational Fluid Dynamics Mechatronics Concurrent Engineering Production & Operations Management	3	1 -	3
7.	13A03709	Metrology & Measurements Lab	-	- 3	2
8.	13A03710	Computer Aided Engineering Lab	-	- 3	2
Total Credits					22

### B.Tech. IV - II Semester

S.No	Course code	Subject	Theory	Tu / Lab	Credits
1.	13A03801	Industrial Engineering & Management	3	1 -	3
2.	13A03802	Power Plant Engineering	3	1 -	3
3.	13A03803 13A03804 13A03805 13A03806	<b>ELECTIVE – III</b> Gas Turbines & Jet Propulsion Tool Design Tribology Composite Materials	3	1 -	3
4.	13A03807 13A03808 13A03809 13A03810	<b>ELECTIVE – IV</b> Modern Manufacturing Methods Design of Heat Transfer Equipment Mechanical Vibrations Product Design	3	1 -	3
5.	13A03811	Seminar & Comprehensive Viva-Voce	-	- -	3
6.	13A03812	Project	-	- -	10
Total Credits					25



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. I Year**

<b>Th</b>	<b>Tu</b>	<b>C</b>
<b>2</b>	<b>0</b>	<b>3</b>

**Common to All Branches**

**(13A52101) COMMUNICATIVE ENGLISH**

**Preamble:**

*English is an international language as well as a living and vibrant one. People have found that knowledge of English is a passport for better career and for communication with the entire world. As it is a language of opportunities in this global age, English is bound to expand its domain of use everywhere. The syllabus has been designed to enhance communication skills of the students of Engineering and Technology. The prescribed books serve the purpose of preparing them for everyday communication and to face global competitions in future.*

*The first text prescribed for detailed study focuses on LSRW skills and vocabulary development. The teachers should encourage the students to use the target language. The classes should be interactive and student-centered. They should be encouraged to participate in the classroom activities keenly.*

*The text for non-detailed study is meant for extensive reading/reading for pleasure by the students. They may be encouraged to read some selected topics on their own, which could lead into a classroom discussion. In addition to the exercises from the texts done in the class, the teacher can bring variety by using authentic materials such as newspaper articles, advertisements, promotional material etc.*

**Course Objective:**

- *To enable the students to communicate in English for academic and social purpose.*
- *To enable the students to acquire structure and written expressions required for their profession.*
- *To develop the listening skills of the students.*
- *To inculcate the habit of reading for pleasure.*
- *To enhance the study skills of the students with emphasis on LSRW skills.*

**Learning Outcome:**

- *The students will get the required training in LSRW skills through the prescribed texts and develop communicative competence.*

**UNIT I**

**Chapter entitled „Humour“ from “Using English”**

**Chapter entitled „Biography - (Homi Jehangir Bhabha)” from “New Horizons”**

Listening - Techniques - Importance of phonetics

L- Meet & Greet and Leave taking, Introducing Oneself and Others (Formal and Informal situations)

R- Reading Strategies -Skimming and Scanning

W- Writing strategies- sentence structures

G-Parts of Speech –Noun-number, pronoun-personal pronoun, verb-

analysis V-Affixes-prefix and suffix, root words, derivatives

**UNIT II**

**Chapter entitled „Inspiration“ from “Using English”**

**Chapter entitled „Biography - (Jagadish Chandra Bose)” from “New Horizons”**

L- Listening to details

S- Apologizing, Interrupting, Requesting and Making polite conversations R- Note making strategies

W- Paragraph-types- topic sentences, unity, coherence, length , linking devices

G-Auxiliary verbs and question tags

V- synonyms-antonyms, homonyms, homophones, homographs, words often confused

### UNIT III

Chapter entitled „Sustainable Development“ from “Using English” Chapter entitled „Short Story - (The Happy Prince)” from “New Horizons”

L- Listening to themes and note taking

S- Giving instructions and Directions, making suggestions, Accepting ideas, fixing a time and Advising

R- Reading for details -1 W-

Resume and cover letter

G- Tenses – Present tense, Past tense and Future

tense V-Word formation and One-Word Substitutes

### UNIT IV

Chapter entitled „Relationships“ from “Using English”

Chapter entitled „Poem - (IF by Rudyard Kipling)” from “New Horizons”

L- Listening to news

S- Narrating stories, Expressing ideas and opinions and telephone skills R- Reading for specific details and Information

W- Technical Report writing-strategies, formats-types-technical report writing

G- Voice and Subject–Verb Agreement

V- Idioms and prepositional Phrases

### UNIT V

Chapter entitled „Science and Humanism“ from “Using English”

Chapter entitled „Autobiography - (My Struggle for an Education by Booker T.Washington)” from “New Horizons”

L- Listening to speeches

S- Making Presentations and Group Discussions

R- Reading for Information

W- E-mail drafting

G- Conditional clauses and conjunctions

V- Collocations and Technical Vocabulary and using words appropriately

#### Text Books:

1. *Using English* published by Orient Black Swan.
2. *New Horizons* published by Pearson.

#### Reference Books:

1. *Raymond Murphy’s English Grammar with CD*, Murphy, Cambridge University Press, 2012.
2. *English Conversation Practice* –Grant Taylor, Tata McGraw Hill, 2009.
3. *Communication Skills*, Sanjay Kumar & Pushpalatha Oxford University Press, 2012.
4. *A Course in Communication Skills*- Kiranmai Dutt & co. Foundation Books, 2012.
5. *Living English Structures*- William Standard Allen-Pearson, 2011.
6. *Current English Grammar and Usage*, S M Guptha, PHI, 2013.
7. *Modern English Grammar*-Krishna SWAMI,McMillan, 2009.
8. *Powerful Vocabulary Builder*- Anjana Agarwal, New Age International Publishers, 2011.

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

**B.Tech. I Year**

<b>Th</b>	<b>Tu</b>	<b>C</b>
<b>2</b>	<b>0</b>	<b>3</b>

**Common to All Branches**

### **(13A56101) ENGINEERING PHYSICS**

#### **Preamble:**

*There has been an exponential growth of knowledge in the recent past opening up new areas and challenges in the understanding of basic laws of nature. This helped to the discovery of new phenomena in macro, micro and nano scale device technologies. The laws of physics play a key role in the development of science, engineering and technology. Sound knowledge of physical principles is of paramount importance in understanding new discoveries, recent trends and latest developments in the field of engineering.*

*To keep in pace with the recent scientific advancements in the areas of emerging technologies, the syllabi of engineering physics has been thoroughly revised keeping in view of the basic needs of all engineering branches by including the topics like optics, crystallography, ultrasonics, quantum mechanics, free electron theory. Also new phenomenon, properties and device applications of semiconducting, magnetic, superconducting and nano materials along with their modern device applications have been introduced.*

#### **Course Objective:**

- To evoke interest on applications of superposition effects like interference and diffraction, the mechanisms of emission of light, achieving amplification of electromagnetic radiation through stimulated emission, study of propagation of light through transparent dielectric waveguides along with engineering applications.*
- To enlighten the periodic arrangement of atoms in crystals, direction of Bragg planes, crystal structure determination by X-rays and also to understand different types of defects in crystals and non-destructive evaluation using ultrasonic techniques.*
- To get an insight into the microscopic meaning of conductivity, classical and quantum free electron model, the effect of periodic potential on electron motion, evolution of band theory to distinguish materials and to understand electron transport mechanism in solids.*
- To open new avenues of knowledge and understanding on semiconductor based electronic devices, basic concepts and applications of semiconductor and magnetic materials have been introduced which find potential in the emerging micro device applications.*
- To give an impetus on the subtle mechanism of superconductors in terms of conduction of electron pairs using BCS theory, different properties exhibited by them and their fascinating applications. Considering the significance of microminiaturization of electronic devices and significance of low dimensional materials, the basic concepts of nanomaterials, their synthesis, properties and applications in modern emerging technologies are elicited.*

#### **Learning Outcome:**

- The different realms of physics and their applications in both scientific and technological systems are achieved through the study of physical optics, lasers and fibre optics.*
- The important properties of crystals like the presence of long-range order and periodicity, structure determination using X-ray diffraction are focused along with defects in crystals and ultrasonic non-destructive techniques.*
- The discrepancies between the classical estimates and laboratory observations of physical properties exhibited by materials would be lifted through the understanding of quantum picture of subatomic world.*
- The electronic and magnetic properties of materials were successfully explained by free electron theory and focused on the basis for the band theory.*
- The properties and device applications of semiconducting and magnetic materials are illustrated.*

- *The importance of superconducting materials and nanomaterials along with their engineering applications are well elucidated.*

## UNIT 1

### PHYSICAL OPTICS, LASERS AND FIBRE OPTICS:

**Physical Optics:** Introduction - Interference in thin films by reflection – Newton’s Rings – Fraunhofer diffraction due to single slit, double slit and diffraction grating.

**Lasers:** Introduction - Characteristics of laser – Spontaneous and stimulated emission of radiation – Einstein’s coefficients - Population inversion – Excitation mechanisms and optical resonator - Ruby laser - He-Ne laser – Applications of lasers.

**Fibre optics:** Introduction– Construction and working principle of optical fiber –Numerical aperture and acceptance angle – Types of optical fibers – Attenuation and losses in fibers - Optical fiber communication system – Applications of optical fibers in communications, sensors and medicine.

## UNIT II

### CRYSTALLOGRAPHY AND ULTRASONICS:

**Crystallography:** Introduction – Space lattice –Unit cell – Lattice parameters –Bravais lattice – Crystal systems – Packing fractions of SC, BCC and FCC - Structures of NaCl and Diamond –Directions and planes in crystals – Miller indices – Interplanar spacing in cubic crystals – X-ray diffraction - Bragg’s law –Laue and Powder methods – Defects in solids: point defects, line defects (qualitative) - screw and edge dislocation, burgers vector.

**Ultrasonics:** Introduction – Production of ultrasonics by piezoelectric method – Properties and detection – Applications in non-destructive testing.

## UNIT III

### QUANTUM MECHANICS AND FREE ELECTRON THEORY:

**Quantum Mechanics:** Introduction to matter waves – de’Broglie hypothesis - Heisenberg’s uncertainty principle and its applications - Schrodinger’s time independent and time dependent wave equation – Significance of wave function - Particle in a one dimensional infinite potential well - Eigen values and Eigen functions.

**Free electron theory:** Classical free electron theory – Sources of electrical resistance - Equation for electrical conductivity - Quantum free electron theory – Fermi-Dirac distribution –Kronig-Penny model(qualitative) – Origin of bands in solids – Classification of solids into conductors, semiconductors and insulators.

## UNIT IV

### SEMICONDUCTORS AND MAGNETIC MATERIALS:

**Semiconductor Physics:** Introduction – Intrinsic and extrinsic semiconductors – Drift & diffusion currents and Einstein’s equation – Hall effect - Direct and indirect band gap semiconductors – Working principle of p-n junction diode, LED, laser diode and photodiode.

**Magnetic materials:** Introduction and basic definitions – Origin of magnetic moments – Bohr magneton – Classification of magnetic materials into dia, para, ferro, antiferro and ferri magnetic materials – Hysteresis - Soft and hard magnetic materials and applications.

## UNIT V

### SUPERCONDUCTIVITY AND PHYSICS OF NANOMATERIALS:

**Superconductivity:** Introduction – Meissner effect - Properties of superconductors – Type I and type II superconductors – Flux quantization – London penetration depth – ac and dc Josephson effects – BCS theory(qualitative) – High  $T_c$  superconductors - Applications of superconductors.

**Physics of Nanomaterials:** Introduction - Significance of nanoscale - Surface area and quantum confinement – Physical properties: optical, thermal, mechanical and magnetic properties – Synthesis of nanomaterials: ball mill, chemical vapour deposition, sol-gel, plasma arcing and thermal evaporation – Properties of Carbon nanotubes – High strength applications – Properties of graphene – Graphene based Field Effect Transistor - Applications of nanomaterials.

**Text Books:**

1. *Engineering physics* – S. ManiNaidu, Pearson Education, I Edition, 2012.
2. *Engineering Physics* – V. Rajendran, MacGraw Hill Publishers, I Edition, 2008.

**Reference Books:**

1. *Engineering Physics* – V. Rajendran, K.Thyagarajan Tata MacGraw Hill Publishers, III Edition, 2012.
2. *Engineering Physics* – RV.S.S.N. Ravi Kumar and N.V. Siva Krishna, Maruthi Publications , 2013
3. *Engineering Physics* - Sanjay D. Jain, D. Sahasrambudhe and Girish University Press, I Edition, 2009.
4. *Engineering Physics* – D K Pandey, S. Chaturvedi, Cengage Learning, I Edition, 2012
5. *Engineering Physics* – Hitendra K Mallik and AK Singh, McGraw Hill Education Pvt. Ltd, New Delhi , I Edition, 2010
6. *Engineering Physics* – M. Arumugam, Anuradha Publications II Edition, 1997.
7. *Engineering physics* – M.N. Avadhanulu and P.G. KshirSagar, Chand and Co, Revised Edition, 2013.
8. *Solid State Physics* – A.J. Dekkar, McMillan Publishers, Latest edition, 2012.
9. *Engineering Physics* – Gaur and Gupta Dhanapati, Rai Publishers , 7<sup>th</sup> Edition, 1992.
9. *Text book of Nanoscience and Nanotechnology:* B S Murthy, P.Shankar, Baldev Raj B B Rath, James Murday, University Press, I Edition, 2012.
10. *Carbon Nanotubes and Graphene Device Physics* – H.S. Philip Wong, Deji Akinwande, Cambridge University Press, 2011.

# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. I Year

Th 2 Tu 0 C 3

Common to All Branches

## (13A51101) ENGINEERING CHEMISTRY

### **Preamble:**

Knowledge in chemistry serves as basic nutrient for the understanding and thereby design of materials of importance in life. Thus the advancement in Engineering is depend on the outcome of basic sciences. Many advances in engineering either produce a new chemical demand as in the case of polymers or wait upon chemical developments for their applications as in the case of implants and alloys. Currently the electronics and computer engineers are looking forward for suitable biopolymers and nano materials for use in miniature super computers, the electrical materials engineers are in search of proper conducting polymers, the mechanical engineers are on lookout for micro fluids and the civil engineers are looking for materials that are environmental friendly, economical but long lasting.

### **Course Objective:**

- The Engineering Chemistry course for undergraduate students is framed to strengthen the fundamentals of chemistry and then build an interface of theoretical concepts with their industrial/engineering applications.
- The course main aim is to impart in-depth knowledge of the subject and highlight the role of chemistry in the field of engineering.
- The lucid explanation of the topics will help students understand the fundamental concepts and apply them to design engineering materials and solve problems related to them. An attempt has been made to logically correlate the topic with its application.
- The extension of fundamentals of electrochemistry to energy storage devices such as commercial batteries and fuel cells is one such example.
- After the completion of the course, the student would understand about the concepts of chemistry in respect of Electrochemical cells, fuel cells, mechanism of corrosion and factors to influence, polymers with their applications, analytical methods, engineering materials and water chemistry.

### **Learning Outcome:**

The student is expected to:

- Understand the electrochemical sources of energy
- Understand industrially based polymers, various engineering materials.
- Differentiate between hard and soft water. Understand the disadvantages of using hard water domestically and industrially. Select and apply suitable treatments domestically and industrially.

### **UNIT 1 ELECTROCHEMISTRY:**

Review of electrochemical cells, Numerical calculations, Batteries: Rechargeable batteries (Lead acid, Ni-Cd, Lithium Ion Batteries). Fuels cells: (Hydrogen-Oxygen and Methanol-Oxygen). **Electrochemical sensors:** Potentiometric Sensors and voltammetric sensors. Examples: analysis of Glucose and urea.

**Corrosion:** Electrochemical Theory of corrosion, Factors affecting the corrosion. Prevention: Anodic and cathodic protection and electro and electroless plating.

### **UNIT II POLYMERS:**

Introduction to polymers, Polymerisation process, mechanism: cationic, anionic, free radical and coordination covalent, Elastomers (rubbers), Natural Rubber, Compounding of Rubber,

Synthetic Rubber: Preparation, properties and engineering applications of Buna-S, buna-N, Polyurethane, Polysulfide (Thiokol) rubbers. Plastomers: Thermosetting and Thermoplastics, Preparation, properties and Engineering applications, PVC, Bakelite, nylons.

**Conducting polymers:** Mechanism, synthesis and applications of polyacetylene, polyaniline. Liquid Crystals: Introduction, classification and applications.

**Inorganic Polymers:** Basic Introduction, Silicones, Polyphosphazins  $(-R)_2-P=N-$  applications.

### UNIT III

#### FUEL TECHNOLOGY:

Classifications of Fuels – Characteristics of Fuels- Calorific Value – Units, Numerical Problems, Solid Fuels–Coal, Coke : Manufacture of Metallurgical Coke by Otto Hoffmann's by product oven processes.

**Liquid Fuels:** Petroleum: Refining of Petroleum, Gasoline: Octane Number, Synthetic Petrol: Bergius Processes, Fischer Tropsch's synthesis.

Power Alcohol: Manufacture, Advantages and Disadvantages of Power Alcohol

**Gaseous Fuels:** Origin, Production and uses of Natural gas, Producer gas, Water gas, Coal gas and Biogas. Flue Gas analysis by Orsat's apparatus, Solving of problems on Combustion.

### UNIT IV

#### CHEMISTRY OF ENGINEERING MATERIALS:

Semiconducting and Super Conducting materials-Principles and some examples, Magnetic materials – Principles and some examples, Cement: Composition, Setting and Hardening (Hydration and Hydrolysis), Refractories: Classification, properties and applications, Lubricants: Theory of lubrication, properties of lubricants and applications, Rocket Propellants: Classification, Characteristics of good propellant

### UNIT V

#### WATER TREATMENT:

Impurities in water, Hardness of water and its Units, Disadvantages of hard water, Estimation of hardness by EDTA method, Numerical problems on hardness, Estimation of dissolved oxygen, Alkalinity, acidity and chlorides in water, Water treatment for domestic purpose (Chlorination, Bleaching powder, ozonisation)

Industrial Use of water: For steam generation, troubles of Boilers: Scale & Sludge, Priming and Foaming, Caustic Embrittlement and Boiler Corrosion.

Treatment of Boiler Feed water: Internal Treatment: Colloidal, Phosphate, Carbonate, Calgon and sodium aluminate treatment. External Treatment: Ion-Exchange and Permutit processes. Demineralisation of brackish water: Reverse Osmosis and Electrodialysis

#### Text Books:

1. *Engineering Chemistry* by KNJayaveera, GVSubba Reddy and C. Ramachandraiah, McGraw Hill Higher Education, New Delhi, Fourth Edition, 2012.
2. *A Text book of Engineering Chemistry* by S.S Dhara, S.S.Umare, S. Chand Publications, New Delhi, 12<sup>th</sup> Edition, 2010.

#### Reference Books:

1. *A Text Book of Engineering Chemistry*, Jain and Jain, Dhanapath Rai Publishing Company, New Delhi, 15<sup>th</sup> Edition, 2010.
2. *Engineering Chemistry* by K.B.Chandra Sekhar, UN.Das and Sujatha Mishra, SCITECH, Publications India Pvt Limited, Chennai, 2<sup>nd</sup> Edition, 2012.
3. *Concepts of Engineering Chemistry-* Ashima Srivastava and N.N. Janhavi, Acme Learning Pvt Ltd, First Edition, 2013.
4. *Text Book of Engineering Chemistry – C. Parameswara Murthy, C.V.Agarwal and Andra Naidu*, BS Publications, Hyderabad, 3<sup>rd</sup> Edition, 2008.
5. *Text Book of Engineering Chemistry*, Shashichawla, Dhanapath Rai Publications, New Delhi, 4<sup>th</sup> Edition, 2011.
6. *Engineering Chemistry*, K. Sesha Maheswaramma and Mrudula Chugh, Pearson Education, First Edition, 2013.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. I Year**

**Th 3 Tu 1 C 5**

**Common to All Branches**

**(13A54101) MATHEMATICS – I**

**Course Objective:**

- To train the students thoroughly in Mathematical concepts of ordinary differential equations and their applications in electrical circuits, deflection of beams, whirling of shafts.
- To prepare students for lifelong learning and successful careers using mathematical concepts of differential, Integral and vector calculus, ordinary differential equations and Laplace transforms.
- To develop the skill pertinent to the practice of the mathematical concepts including the student abilities to formulate the problems, to think creatively and to synthesize information.

**Learning Outcome:**

- The students become familiar with the application of differential, integral and vector calculus, ordinary differential equations and Laplace transforms to engineering problems.
- The students attain the abilities to use mathematical knowledge to analyze and solve problems in engineering applications.

**UNIT I**

Exact, linear and Bernoulli equations, Applications to Newton's law of cooling, law of natural growth and decay, orthogonal trajectories.

Non-homogeneous linear differential equations of second and higher order with constant coefficients with RHS term of the type  $e^{ax}$ ,  $\sin ax$ ,  $\cos ax$ , polynomials in  $x$ ,  $e^{ax} V(x)$ ,  $xV(x)$ , method of variation of parameters. Applications to oscillatory electrical circuits, Deflection of Beams, whirling of shafts.

**UNIT II**

Taylor's and Maclaurin's Series - Functions of several variables – Jacobian – Maxima and Minima of functions of two variables, Lagrange's method of undetermined Multipliers with three variables only.

Radius of curvature, center of curvature, Involute evolutes, envelopes.

**UNIT III**

Curve tracing – Cartesian, polar and parametric curves. Length of curves.

Multiple integral – Double and triple integrals – Change of Variables – Change of order of integration. Applications to areas and volumes, surface area of solid of revolution in Cartesian and polar coordinates using double integral.

**UNIT IV**

Laplace transform of standard functions – Inverse transform – First shifting Theorem, Transforms of derivatives and integrals – Unit step function – Second shifting theorem – Dirac's delta function – Convolution theorem – Laplace transform of Periodic function.

Differentiation and integration of transform – Application of Laplace transforms to ordinary differential equations of first and second order.

**UNIT V**

Vector Calculus: Gradient – Divergence – Curl and their properties; Vector integration – Line integral - Potential function – Area – Surface and volume integrals. Vector integral theorems: Green's theorem – Stoke's and Gauss's Divergence Theorem (Without proof). Application of Green's – Stoke's and Gauss's Theorems.



**Text Books:**

1. *Higher Engineering Mathematics*, B.S.Grewal, Khanna publishers-42 Edition(2012)
2. *Engineering Mathematics, Volume - I*, E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher 1<sup>st</sup> Edition (2010)

**Reference Books:**

1. *Engineering Mathematics Volume-I*, by T.K.V. Iyengar, S.Chand publication-12<sup>th</sup> Edition(2013)
2. *Engineering Mathematics, Volume - I*, by G.S.S.Raju, CENGAGE publisher.(2013)
3. *Advanced Engineering Mathematics*, by Erwin Kreyszig, Wiley India-10<sup>th</sup> Edition(2012)
4. *Higher Engineering Mathematics*, by B.V.Ramana, Mc Graw Hill publishers(2008)
5. *Advanced Engineering Mathematics*, by Alan Jeffrey, Elsevier-1<sup>st</sup> Edition(2001)

AMTUA

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. I Year

Th	Tu	C
3	1	5

### (13A12101) PROGRAMMING IN C & DATA STRUCTURES

#### Course Objective:

- To make the student understand problem solving techniques
- Students will be able to understand the syntax and semantics of C programming language and other features of the language
- Get acquaintance with data structures, searching and sorting techniques

#### Learning Outcome:

- Student can effectively apply problem solving techniques in designing the solutions for a wide-range of problems
- Student can choose appropriate data structure and control structure depending on the problem to be solved
- Student can effectively use existing data structures and design new data structures appropriate to the problem to be solved
- Student can modularize the problem and also solution
- Student can use appropriate searching and sorting technique to suit the application.

#### UNIT I

**Introductory Concepts:** Introduction to computers, What is a Computer, Block diagram of Computer, Computer Characteristics, Hardware Vs Software, How-to develop a program, Software development life cycle, Structured programming, Modes of operation, Types of programming languages, Introduction to C, Desirable program characteristics.

**Introduction to Computer problem solving:** Introduction, The problem solving aspect, Top down design, Implementation of algorithms.

**Introduction to C programming:** The C character set, Writing first program of C, Identifiers and key words, A more useful C program, Entering the program into the computer, Compiling and executing the program, Data types, Constants, Variables and arrays, Declarations, Expressions, Statements, Symbolic Constants.

**Operators and Expressions:** Arithmetic operators, Unary operators, Relational and Logical operators, Assignment operators, Conditional operator, Library functions.

**Fundamental algorithms:** Exchanging the values of two variables, Factorial computation, Sine function computation, Reversing the digits of an integer, Generating prime numbers.

#### UNIT II

**Data Input and Output:** Preliminaries, Single character input-getchar function, Single character output-putchar function, Entering input data-the scanf function, More about the scanf function, Writing output data-The printf function, More about the printf function, The gets and puts functions, Interactive(conversational) programming.

**Preparing and running a complete C program:** Planning a C program, Writing a C program, Error diagnostics, Debugging techniques.

**Control statements:** Preliminaries, Branching: if-else statement, Looping: The while statement, More looping: The do-while statement, Still more looping: The for statement, Nested control structures, The switch statement, Break statement, Continue statement, The comma operator, The goto statement.

**Functions:** A brief overview, Defining a function, Accessing a function, Function prototypes, Passing arguments to a function, Recursion

### UNIT III

**Program Structure:** Storage classes, Automatic variables, External (global) variables, Static variables, Multi file programs, More about library functions.

**Arrays:** Defining an array, Processing an array, Passing arrays to functions, Multi dimensional arrays.

**Array Techniques:** Array order reversal, Removal of duplicates from an ordered array, Finding the K<sup>th</sup> smallest element.

**Merging, Sorting and Searching:** The two way merge, Sorting by selection, Sorting by exchange, Sorting by insertion, Sorting by partitioning, Recursive Quick sort, Binary Search.

**Strings:** Defining a string, NULL character, Initialization of strings, Reading and Writing a string, Processing the strings, Character arithmetic, Searching and Sorting of strings, Some more Library functions for strings

### UNIT IV

**Pointers:** Fundamentals, Pointer Declarations, Passing pointer to a function, Pointers and one dimensional array, Dynamic memory allocation, Operations on pointers, Pointers and multi dimensional arrays, Arrays of pointers, Passing functions to other functions, More about pointer declarations.

**Structures and Unions:** Defining a structure, Processing a structure, User defined data type (typedef), Structures and Pointers, Passing structures to functions, Unions.

**File Handling:** Why files, Opening and closing a data file, Reading and Writing a data file, Processing a data file, Unformatted data files, Concept of binary files, Accessing the file randomly (using fseek).

**Additional Features:** Register variables, Bitwise operations, Bit Fields, Enumerations, Command line parameters, More about Library functions, Macros, The C Preprocessor

### UNIT V

**Introduction to Data Structures:** Data abstraction

**Stacks and Queues:** Stacks, Stacks using dynamic arrays, Queues, Circular Queues using dynamic arrays

**Evaluations of expressions:** Expressions, Evaluating postfix expressions, Infix to Postfix, Multiple Stacks and Queues.

**Linked Lists:** Singly Linked lists and chains, Representing chains in C, Linked Stacks and Queues.

#### **Text Books:**

1. *“Programming with C”, Byron Gottfried, Third Edition, Schaum’s Outlines, Mc Graw Hill.*
2. *“Fundamentals of Data Structures in C”, Horowitz, Sahni, Anderson-freed, Second Edition, Universities Press.*
3. *“How to Solve it by Computer”, R.G. Dromey, Pearson. (Pascal implementations may be considered without loss of generality or Instructors may replace them with C language programs)*

#### **Reference Books:**

1. *“Programming in C”, Pradip Dey, Manas Ghosh, Oxford Higher Education*
2. *“Programming in C and Data Structures”, Hanly, Koffman, Kamthane, Ananda Rao, Pearson.*
3. *“Programming in C”, Reema Thareja, Oxford Higher Education.*
4. *“Computer Fundamentals and C Programming”, First Edition, Dr.P.Chenna Reddy, Available at: [www.pothi.com](http://www.pothi.com).*
5. *“Data Structure and Program Design in C”, Second Edition, Kruse, Tondo, Leung, Mogalla, Pearson.*
6. *“Programming with C”, R.S. Bichkar, University Press.*
7. *“Computer Science A Structured Programming Approach Using C”, Third Edition, Fourouzan & Gilberg, Cengage Learning.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. I Year**

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<b>3</b>	<b>1</b>	<b>5</b>

**(13A01101) ENGINEERING MECHANICS**

**Course Objective:**

*This course will serve as a basic course by introducing the concepts of basic mechanics which will help as a foundation to various courses.*

**UNIT I**

**Introduction of Engineering Mechanics** – Basic concepts - System of Forces – Moment of Forces and its Application – Couples and Resultant of Force System – Equilibrium of System of Forces - Degrees of Freedom – Free body diagrams –Types of Supports – Support reactions for beams with different types of loading – concentrated, uniformly distributed and uniformly varying loading.

**UNIT II**

**Friction:** Types of friction– laws of Friction – Limiting friction- Cone of limiting friction– static and Dynamic Frictions – Motion of bodies – Wedge, Screw jack and differential Screw jack.

**UNIT III**

**Centroid and Center of Gravity:** Centroids of simple figures – Centroids of Composite figures – Centre of Gravity of bodies – Area moment of Inertia - Parallel axis and perpendicular axis theorems - Moments of Inertia of Composite Figures.

**Mass Moment of Inertia:** Moment of Inertia of Simple solids – Moment of Inertia of composite masses.( Simple problems only)

**UNIT IV**

**Kinematics:** Rectilinear and Curvilinear motion – Velocity and Acceleration – Motion of A Rigid Body – Types and their Analysis in Planar Motion.

**Kinetics:** Analysis as a particle and Analysis as a Rigid Body in Translation – Central Forces of motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies – Work Energy Method – Equation for Translation – Work Energy application to Particle Motion, Connection System – Fixed axis Rotation and Plane Motion.

**UNIT V**

**Analysis of Perfect Frames:** Types of frames – cantilever frames and simply supported frames – Analysis of frames using method of joints, method of sections and tension coefficient method for vertical loads, horizontal loads and inclined loads.

**Mechanical Vibrations:** Definitions, Concepts-Simple Harmonic motion-Free vibrations-Simple Compound and Torsional pendulum- Numerical problems

**Text Books:**

1. *Engineering Mechanics by Shames & Rao – Pearson Education.*
2. *Engineering Mechanics by Dr.R.k.Bansal, Lakshmi Publications.*
3. *Engineering Mechanics – B. Bhattacharyya, Oxford University Publications.*

**Reference Books:**

1. *Engineering Mechanics by Fedrinand L.Singer – Harper Collings Publishers.*
2. *Engineering Mechanics by Seshigiri Rao, Universities Press, Hyderabad.*
3. *Engineering Mechanics by Rajsekharan, Vikas Publications.*
4. *Engineering Mechanics (Statics and Dynamics) by Hibler and Gupta; Pearson Education.*
5. *Engineering Mechanics by S.Timoshenko, D.H.Young and J.V.Rao, Tata McGraw-Hill Company.*
6. *Engineering Mechanics by Chandramouli, PHI publications.*
7. *Engineering Mechanics –Arthur P. Boresi and Richard J. Schmidt. – Brooks/Cole – Cengage Learning.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. I Year**

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**(13A03101) ENGINEERING DRAWING**

**Course Objective:**

- *By studying the engineering drawing, a student becomes aware of how industry communicates technical information. Engineering drawing teaches the principles of accuracy and clarity in presenting the information necessary about objects.*
- *This course develops the engineering imagination i.e., so essential to a successful design, By learning techniques of engineering drawing changes the way one things about technical images.*
- *It is ideal to master the fundamentals of engineering drawing first and to later use these fundamentals for a particular application, such as computer aided drafting. Engineering Drawing is the language of engineers, by studying this course engineering and technology students will eventually be able to prepare drawings of various objects being used in technology.*

**UNIT I**

**Introduction to Engineering Drawing:** Principles of Engineering Graphics and their Significance- Conventions in Drawing-Lettering – BIS Conventions. Curves used in Engineering Practice.

- a) Conic Sections including the Rectangular Hyperbola- General method only,
- b) Cycloid, Epicycloids and Hypocycloid
- c) Involute
- d) Helices

**UNIT II**

**Projection of Lines:** Inclined to one or both planes, Problems on projections, Finding True lengths & traces only.

**Projections of Planes:** Projections of regular plane surfaces/figures, Projection of lines and planes using auxiliary planes.

**UNIT III**

**Projections of Solids:** Projections of Regular Solids inclined to one or both planes-Auxiliary Views.

**Sections and Developments of Solids:** Section Planes and Sectional View of Right Regular Solids- Prism, cylinder, Pyramid and Cone. True shapes of the sections. Development of Surfaces of Right Regular Solids-Prism, Cylinder, Pyramid, Cone and their Sectional Parts.

**UNIT IV**

**Isometric and Orthographic Projections:** Principles of isometric projection- Isometric Scale-Isometric Views- Conventions- Isometric Views of lines, Planes Figures, Simple and Compound Solids-Isometric Projection of objects having non-isometric lines. Isometric projections of spherical parts. Conversion of isometric Projections/Views of Orthographic Views-Conventions.

**UNIT V**

**Interpenetration of Right Regular Solids:** Projections of Curves of intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone, Square Prism Vs Square Prism.

**Perspective Projections:** Perspective Vice of Plane Figures and simple Solids, Vanishing point method ( General Methods only).

**Text Books:**

1. *Engineering Drawing, N.D. Bhat, Charotar Publishers*
2. *Engineering Drawing, K.L. Narayana& P. Kannaih, Scitech Publishers, Chennai*

**Reference Books:**

1. *Engineering Drawing, Johle, Tata McGraw-Hill Publishers*
2. *Engineering Drawing, Shah and Rana,2/e, Pearson Education*

3. *Engineering Drawing and Graphics, Venugopal/New age Publishers*
4. *Engineering Graphics, K.C. John, PHI,2013*
5. *Engineering Drawing and Graphics, Venugopal / New age Publishers*
6. *Engineering Drawing, B.V.R. Guptha, J.K. Publishers*

**Suggestions:**

1. *Student is expected to buy a book mentioned under „Text books“ for better understanding.*
2. *Students can find the applications of various conics in engineering and application of involute on gear teeth. The introduction for drawing can be had on line from:*
  - *Introduction to engineering drawing with tools – youtube*
  - *Http-sewor. Carleton.ca /- g kardos/88403/drawing/drawings.html*
  - *Conic sections-online. red woods.edu*
3. *This subject also paves the way for learning Auto Cad, CAD / CAM, CATIA and Pro E which are advanced software packages needed for every mechanical engineer (To be taught & examined in First angle projection). The skill acquired by the student in this subject is very useful in conveying his ideas to the layman easily.*

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. I Year**

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**(13A12102) PROGRAMMING IN C & DATA STRUCTURES LAB**

**Course Objective:**

- To make the student learn C Programming language.
- To make the student solve problems, implement them using C language.
- To strengthen the ability to identify and apply the suitable data structure for the given real world problem.

**Learning Outcome:**

- Apply problem solving techniques to find solutions to problems.
- Able to use C language features effectively and implement solutions using C language.
- Be capable to identify the appropriate data structure for a given problem or application.
- Improve logical skills.

**LIST OF EXPERIMENTS/TASKS**

1. Practice DOS and LINUX Commands necessary for design of C Programs.
2. Study of the Editors, Integrated development environments, and Compilers in chosen platform.
3. Write, Edit, Debug, Compile and Execute Sample C programs to understand the programming environment.
4. Practice programs: Finding the sum of three numbers, exchange of two numbers, maximum of two numbers, to read and print variable values of all data types of C language, to find the size of all data types, to understand the priority and associativity of operators using expressions, to use different library functions of C language.
5. Write a program to find the roots of a quadratic equation.
6. Write a program to compute the factorial of a given number.
7. Write a program to check whether the number is prime or not.
8. Write a program to find the series of prime numbers in the given range.
9. Write a program to generate Fibonacci numbers in the given range.
10. Write a program to find the maximum of a set of numbers.
11. Write a program to reverse the digits of a number.
12. Write a program to find the sum of the digits of a number.
13. Write a program to find the sum of positive and negative numbers in a given set of numbers.
14. Write a program to check for number palindrome.
15. Write a program to evaluate the sum of the following series up to 'n' terms e  
$$x=1+x+x^2/2!+x^3/3!+x^4/4!+-----$$
16. Write a program to generate Pascal Triangle.
17. Write a program to read two matrices and print their sum and product in the matrix form.
18. Write a program to read matrix and perform the following operations.
  - i. Find the sum of Diagonal Elements of a matrix.
  - ii. Print Transpose of a matrix.
  - iii. Print sum of even and odd numbers in a given matrix.
19. Write a program to accept a line of characters and print the count of the number of Vowels, Consonants, blank spaces, digits and special characters.
20. Write a program to insert a substring in to a given string and delete few characters from the string. Don't use library functions related to strings.
21. Write a program to perform the operations addition, subtraction, multiplication of complex numbers.
22. Write a program to split a 'file' in to two files, say file1 and file2. Read lines into the 'file' from standard input. File1 should consist of odd numbered lines and file2 should consist of even numbered lines.

23. Write a program to merge two files.
24. Write a program to implement numerical methods Lagrange's interpolation, Trapezoidal rule.
25. Write a program to read a set of strings and sort them in alphabetical order.
26. Write a program to sort the elements of an array using sorting by exchange.
27. Write a program to sort the elements of an array using Selection Sort.
28. Write a program to perform Linear Search on the elements of a given array.
29. Write a program to perform Binary Search on the elements of a given array.
30. Write a program to find the number of occurrences of each number in a given array of numbers.
31. Write a program to read two strings and perform the following operations without using built-in string Library functions and by using your own implementations of functions.
  - i. String length determination
  - ii. Compare Two Strings
  - iii. Concatenate them, if they are not equal
  - iv. String reversing
32. Write programs using recursion for Factorial of a number, GCD, LCM, Towers of Hanoi.
33. Write a program to convert infix expression to postfix expression and evaluate postfix expression.
34. Write a program to exchange two numbers using pointers.
35. Write a program to implement stack, queue, circular queue using array and linked lists.
36. Write a program to perform the operations creation, insertion, deletion, and traversing a singly linked list
37. Write a program to read student records into a file. Record consists of rollno, name and marks of a student in six subjects and class. Class field is empty initially. Compute the class of a student. The calculation of the class is as per JNTUA rules. Write the first class, second class, third class and failed students lists separately to another file.
38. A file consists of information about employee salary with fields employeedid, name, Basic, HRA, DA, IT, other-deductions, Gross and Net salary. Initially only employeedid, name, and basic have valid values. HRA is taken as 10% of the basic, DA is taken as 80% of basic, IT is 20% of the basic, other deductions is user specified. Compute the Gross and Net salary of the employee and update the file.
39. Write a program to perform Base (decimal, octal, hexadecimal, etc) conversion.
40. Write a program to find the square root of a number without using built-in library function.
41. Write a program to convert from string to number.
42. Write a program to generate pseudo random generator.
43. Write a program to remove duplicates from ordered and unordered arrays.
44. Write a program to sort numbers using insertion sort.
45. Write a program to implement quick sort using non-recursive and recursive approaches. Use randomized element as partitioning element.
46. Write a program to search a word in a given file and display all its positions.
47. Write a program to generate multiplication tables from 11 to 20.
48. Write a program to express a four digit number in words. For example 1546 should be written as one thousand five hundred and forty six.
49. Write a program to generate a telephone bill. The contents of it and the rate calculation etc should be as per BSNL rules. Student is expected to gather the required information through the BSNL website.
50. Write a program for tic-tac-toe game.
51. Write a program to find the execution time of a program.
52. Design a file format to store a person's name, address, and other information. Write a program to read this file and produce a set of mailing labels

*Note: The above list consists of only sample programs. Instructors may choose other programs to illustrate certain concepts, wherever is necessary. Programs should be there on all the concepts studied in the Theory on C programming and Data structures. Instructors are advised to change atleast 25% of the programs every year until the next syllabus revision.*



**References:**

1. *“Programming with C”, Byron Gottfried, Third Edition, Schaum’s Outlines, Mc Graw Hill.*
2. *“Fundamentals of Data Structures in C”, Horowitz, Sahni, Anderson-freed, Second Edition, Universities Press.*
3. *“How to Solve it by Computer”, R.G. Dromey, Pearson.*
4. *“The C Programming Language”, Brian W. Kernighan, Dennis M. Ritchie, Pearson.*
5. *“Classic Data Structures”, Samantha, PHI*
6. *“Let us C”, Yeswant Kanetkar, BPB publications*
7. *“Pointers in C”, Yeswant Kanetkar, BPB publications*

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## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. I Year

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### Common to All Branches (13A99102) ENGINEERING PHYSICS & ENGINEERING CHEMISTRY LAB

#### ENGINEERING PHYSICS LAB

##### LIST OF EXPERIMENTS

Any 10 of the following experiments has to be performed:

1. Determination of wavelengths of various colours of mercury spectrum using diffraction grating in normal incidence method
2. Determination of dispersive power of the prism
3. Determination of thickness of thin object by wedge method
4. Determination of radius of curvature of lens by Newton's Rings
5. Laser : Diffraction due to single slit
6. Laser : Diffraction due to double slit
7. Laser: Determination of wavelength using diffraction grating
8. Determination of Numerical aperture of an optical fiber
9. Melde's experiment: Determination of the frequency of tuning fork
10. Sonometer: Verification of the three laws of stretched strings
11. Energy gap of a material using p-n junction diode
12. Electrical conductivity by four probe method
13. Determination of thermistor coefficients ( $\alpha$ ,  $\beta$ )
14. Hall effect : Determination of mobility of charge carriers in semiconductor
15. B-H curve
16. Magnetic field along the axis of a current carrying coil – Stewart and Gee's method.
17. Determination of lattice constant using X-ray spectrum.

#### ENGINEERING CHEMISTRY LAB

##### Preamble:

*The experiments are designed in a manner that the students can validate their own theory understanding in chemistry by self involvement and practical execution. Thus the execution of these experiments by the student will reinforce his/her understanding of the subject and also provide opportunity to refine their understanding of conceptual aspects. As a result, the student gets an opportunity to have feel good factor at the laboratory bench about the chemical principles that he/she learned in the classroom.*

##### Course Objective:

- Will learn practical understanding of the redox reaction
- Will able to understand the function of fuel cells, batteries and extend the knowledge to the processes of corrosion and its prevention
- Will learn the preparation and properties of synthetic polymers and other material that would provide sufficient impetus to engineer these to suit diverse applications
- Will also learn the hygiene aspects of water would be in a position to design methods to produce potable water using modern technology

##### Learning Outcome:

- Would be confident in handling energy storage systems and would be able combat chemical corrosion
- Would have acquired the practical skill to handle the analytical methods with confidence.
- Would feel comfortable to think of design materials with the requisite properties
- Would be in a position to technically address the water related problems.

## LIST OF EXPERIMENTS

**Any 10 of the following experiments has to be performed:**

1. Determination of total hardness of water by EDTA method.
2. Determination of Copper by EDTA method.
3. Estimation of Dissolved Oxygen by Winkler's method
4. Determination of Copper by Iodometry
5. Estimation of iron (II) using diphenylamine indicator (Dichrometry – Internal indicator method).
6. Determination of Alkalinity of Water
7. Determination of acidity of Water
8. Preparation of Phenol-Formaldehyde (Bakelite)
9. Determination of Viscosity of oils using Redwood Viscometer I
10. Determination of Viscosity of oils using Redwood Viscometer II
11. Conductometric titration of strong acid Vs strong base (Neutralization titration).
12. Conductometric titration of Barium Chloride vs Sodium Sulphate (Precipitation Titration)
13. Determination of Corrosion rate and inhibition efficiency of an inhibitor for mild steel in hydrochloric acid medium.
14. Estimation of Chloride ion using potassium Chromite indicator (Mohrs method)

### **References:**

1. *Vogel's Text book of Quantitative Chemical Analysis, J. Mendham et al, Pearson Education, Sixth Edition, 2012.*
2. *Chemistry Practical – Lab Manual by K.B.Chandra Sekhar, G.V. Subba Reddy and K.N.Jayaveera, SM Publications, Hyderabad, 3<sup>rd</sup> Edition, 2012.*

B.Tech. I Year

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Common to All Branches  
(13A99103) ENGINEERING & I.T. WORKSHOP

ENGINEERING WORKSHOP

**Course Objective:**

*The budding Engineer may turn out to be a technologist, scientist, entrepreneur, practitioner, consultant etc. There is a need to equip the engineer with the knowledge of common and newer engineering materials as well as shop practices to fabricate, manufacture or work with materials. Essentially he should know the labour involved, machinery or equipment necessary, time required to fabricate and also should be able to estimate the cost of the product or job work. Hence engineering work shop practice is included to introduce some common shop practices and on hand experience to appreciate the use of skill, tools, equipment and general practices to all the engineering students.*

**1. TRADES FOR EXERCISES:**

- a. Carpentry shop– Two joints (exercises) involving tenon and mortising, groove and tongue: Making middle lap T joint, cross lap joint, mortise and tenon T joint, Bridle T joint from out of 300 x 40 x 25 mm soft wood stock
- b. Fitting shop– Two joints (exercises) from: square joint, V joint, half round joint or dove tail joint out of 100 x 50 x 5 mm M.S. stock
- c. Sheet metal shop– Two jobs (exercises) from: Tray, cylinder, hopper or funnel from out of 22 or 20 gauge G.I. sheet
- d. House-wiring– Two jobs (exercises) from: wiring for ceiling rose and two lamps (bulbs) with independent switch controls with or without looping, wiring for stair case lamp, wiring for a water pump with single phase starter.
- e. Foundry– Preparation of two moulds (exercises): for a single pattern and a double pattern.
- f. Welding – Preparation of two welds (exercises): single V butt joint, lap joint, double V butt joint or T fillet joint.

**2. TRADES FOR DEMONSTRATION:**

- a. Plumbing
- b. Machine Shop
- c. Metal Cutting

Apart from the above the shop rooms should display charts, layouts, figures, circuits, hand tools, hand machines, models of jobs, materials with names such as different woods, wood faults, Plastics, steels, meters, gauges, equipment, CD or DVD displays, First aid, shop safety etc. (though they may not be used for the exercises but they give valuable information to the student). In the class work or in the examination knowledge of all shop practices may be stressed upon rather than skill acquired in making the job.

**References:**

1. *Engineering Work shop practice for JNTU*, V. Ramesh Babu, VRB Publishers Pvt. Ltd., 2009
2. *Work shop Manual* / P.Kannaiah/ K.L.Narayana/ SciTech Publishers.
3. *Engineering Practices Lab Manual*, Jeyapoovan, SaravanaPandian, 4/e Vikas
4. *Dictionary of Mechanical Engineering*, GHF Nayler, Jaico Publishing House.

## **I.T. WORKSHOP**

### **Course Objective:**

- To provide Technical training to the students on Productivity tools like Word processors, Spreadsheets, Presentations
- To make the students know about the internal parts of a computer, assembling a computer from the parts, preparing a computer for use by installing the operating system
- To learn about Networking of computers and use Internet facility for Browsing and Searching.

### **Learning Outcome:**

- Disassemble and Assemble a Personal Computer and prepare the computer ready to use.
- Prepare the Documents using Word processors
- Prepare Slide presentations using the presentation tool
- Interconnect two or more computers for information sharing
- Access the Internet and Browse it to obtain the required information
- Install single or dual operating systems on computer

### **Preparing your Computer ( 5 weeks)**

**Task 1: Learn about Computer:** Identify the internal parts of a computer, and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.

**Task 2: Assembling a Computer:** Disassemble and assemble the PC back to working condition. Students should be able to trouble shoot the computer and identify working and non-working parts. Student should identify the problem correctly by various methods available (eg: beeps). Students should record the process of assembling and trouble shooting a computer.

**Task 3: Install Operating system:** Student should install Linux on the computer. Student may install another operating system (including proprietary software) and make the system dual boot or multi boot. Students should record the entire installation process.

**Task 4: Operating system features:** Students should record the various features that are supported by the operating system(s) installed. They have to submit a report on it. Students should be able to access CD/DVD drives, write CD/DVDs, access pen drives, print files, etc. Students should install new application software and record the installation process.

### **Networking and Internet (4 weeks)**

**Task 5: Networking:** Students should connect two computers directly using a cable or wireless connectivity and share information. Students should connect two or more computers using switch/hub and share information. Crimping activity, logical configuration etc should be done by the student. The entire process has to be documented.

**Task 6: Browsing Internet:** Student should access the Internet for Browsing. Students should search the Internet for required information. Students should be able to create e-mail account and send email. They should get acquaintance with applications like Facebook, skype etc.

If Intranet mailing facility is available in the organization, then students should share the information using it. If the operating system supports sending messages to multiple users (LINUX supports it) in the same network, then it should be done by the student. Students are expected to submit the information about different browsers available, their features, and search process using different natural languages, and creating e-mail account.

**Task 7: Antivirus:** Students should download freely available Antivirus software, install it and use it to check for threats to the computer being used. Students should submit information about the features of the antivirus used, installation process, about virus definitions, virus engine etc.

### **Productivity tools (6 weeks)**

**Task 8: Word Processor:** Students should be able to create documents using the word processor tool. Some of the tasks that are to be performed are inserting and deleting the characters, words and lines,

Alignment of the lines, Inserting header and Footer, changing the font, changing the color, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Students should be able to prepare project cover pages, content sheet and chapter pages at the end of the task using the features studied. Students should submit a user manual of the word processor considered.

**Task 9: Spreadsheet:** Students should be able to create, open, save the application documents and format them as per the requirement. Some of the tasks that may be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells. Students should submit a user manual of the Spreadsheet application considered.

**Task 10: Presentations :** creating, opening, saving and running the presentations, Selecting the style for slides, formatting the slides with different fonts, colors, creating charts and tables, inserting and deleting text, graphics and animations, bulleting and numbering, hyperlinking, running the slide show, setting the timing for slide show. Students should submit a user manual of the Presentation tool considered.

#### **Optional Tasks:**

**Task 11: Laboratory Equipment:** Students may submit a report on specifications of various equipment that may be used by them for the laboratories in their curriculum starting from I B.Tech to IV. B.Tech. It can vary from department to department. Students can refer to their syllabus books, consult staff members of the concerned department or refer websites. The following is a sample list. Instructors may make modifications to the list to suit the department concerned.

- Desktop computer
- Server computer
- Switch (computer science related)
- Microprocessor kit
- Micro controller kit
- Lathe machine
- Generators
- Construction material
- Air conditioner
- UPS and Inverter
- RO system
- Electrical Rectifier
- CRO
- Function Generator
- Microwave benches

**Task 12: Software:** Students may submit a report on specifications of various software that may be used by them for the laboratories in their curriculum starting from I B.Tech to IV. B.Tech. The software may be proprietary software or Free and Open source software. It can vary from department to department. Students can refer to their syllabus books, consult staff members of the concerned department or refer websites. The following is a sample list. Instructors may make modifications to the list to suit the department concerned.

- Desktop operating system
- Server operating system
- Antivirus software
- MATLAB
- CAD/CAM software
- AUTOCAD

**References:**

1. *Introduction to Computers, Peter Norton, Mc Graw Hill*
2. *MOS study guide for word, Excel, Powerpoint & Outlook Exams”, Joan Lambert, Joyce Cox, PHI.*
3. *Introduction to Information Technology, IITL Education Solutions limited, Pearson Education.*
4. *Networking your computers and devices, Rusen, PHI*
5. *Trouble shooting, Maintaining & Repairing PCs”, Bigelows, TMH*

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. I Year**

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**Common to All Branches**

**(13A52102) ENGLISH LANGUAGE COMMUNICATION SKILLS (ELCS) LAB**

The Language Lab focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations and contexts.

**Course Objective:**

- *To train students to use language effectively in everyday conversations.*
- *To expose the students to a varied blend of self-instructional learner-friendly modes of language learning through computer-aided multi-media instruction.*
- *To enable them to learn better pronunciation through stress on word accent, intonation, and rhythm.*
- *To help the second language learners to acquire fluency in spoken English and neutralize mother tongue influence*
- *To train students to use language appropriately for interviews, group discussion and public speaking*

**Learning Outcome:**

- *Becoming active participants in the learning process and acquiring proficiency in spoken English of the students*
- *Speaking with clarity and confidence thereby enhancing employability skills of the students*

**PHONETICS**

Importance of speaking phonetically correct English  
Speech mechanism-Organs of speech

Uttering letters-Production of vowels sounds  
Uttering letters -Production of consonant sounds  
Uttering words-Stress on words and stress rules  
Uttering sentences-Intonation-tone group

**LISTENING**

Listening as a skill  
Listening activities

**PRESENTATIONAL SKILLS**

Preparation  
Prepared speech  
Impromptu speech  
topic originative techniques  
JAM (Just A Minute)  
Describing people/object/place  
Presentation-

Stage dynamics  
Body language

**SPEAKING SKILLS**

Telephone skills  
Role plays  
Public Speaking

**GROUP ACTIVITIES**

Debates  
Situational dialogues



## **MINIMUM REQUIREMENT FOR ELCS LAB:**

The English Language Lab shall have two parts:

### **Computer Assisted Language Learning (CALL) Lab:**

- The Computer aided Language Lab for 60 students with 60 systems, one master console, LAN facility and English language software for self- study by learners.
- The Communication Skills Lab with movable chairs and audio-visual aids with a P.A. system, Projector, a digital stereo-audio & video system and camcorder etc.

### **System Requirement (Hardware component):**

- Computer network with LAN with minimum 60 multimedia systems with the following specifications:
  - P – IV Processor
  - Speed – 2.8 GHZ
  - RAM – 512 MB Minimum
  - Hard Disk – 80 GB
  - Headphones of High quality

### **SUGGESTED SOFTWARE:**

- Clarity Pronunciation Power – Part I (Sky Pronunciation)
- Clarity Pronunciation Power – part II
- K-Van Advanced Communication Skills
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- *DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.*
- Lingua TOEFL CBT Insider, by Dreamtech
- English Pronunciation in Use (Elementary, Intermediate, Advanced) CUP
- Cambridge Advanced Learners' English Dictionary with CD.
- Oxford Advanced Learner's Compass, 8<sup>th</sup> Edition
- Communication Skills, Sanjay Kumar & Pushp Lata. 2011. OUP

### **References:**

1. *Strengthen Your Steps, Maruthi Publications, 2012.*
2. *A Course in Phonetics and Spoken English, [Dhamija Sethi](#), Prentice-Hall of India Pvt.Ltd.*
3. *A Textbook of English Phonetics for Indian Students 2<sup>nd</sup> Ed T. Balasubramanian. (Macmillan),2012.*
4. *Speaking English Effectively, 2<sup>nd</sup> Edition Krishna Mohan & NP Singh, 2011. (Mcmillan).*
5. *Listening in the Language Classroom, John Field (Cambridge Language Teaching Library),2011*
6. *A Hand Book for English Laboratories, E.Suresh Kumar, P.Sreehari, Foundation Books,2011*
7. *English Pronunciation in Use. Intermediate & Advanced, Hancock, M. 2009. CUP.*
8. *Basics of Communication in English, Soundararaj, Francis. 2012.. New Delhi: Macmillan*
9. *Spoken English (CIEFL) in 3 volumes with 6 cassettes, OUP.*
10. *English Pronouncing Dictionary, Daniel Jones, Current Edition with CD.Cambridge, 17<sup>th</sup> edition, 2011.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B.Tech. II - I Sem.

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**(13A54301) MATHEMATICS – II**

**Course Objective:**

- *This course aims at providing the student with the concepts of Matrices, Fourier series, Fourier transforms and partial differential equations which find the applications in engineering.*
- *Our emphasis will be more on the logical and problem solving development in the Numerical methods and its applications.*

**Learning Outcome:**

- *The student becomes familiar with the application of Mathematical techniques like Fourier series and Fourier transforms.*
- *The student gains the knowledge to tackle the engineering problems using the concepts of Partial differential equations and Numerical methods.*

**UNIT I**

Rank – Echelon form, normal form – Consistency of System of Linear equations. Linear transformations  
Complex Matrices:- Hermitian, Skew-Hermitian and Unitary matrices and their properties. Eigen Values, Eigen vectors for both real and complex matrices. Cayley – Hamilton Theorem and its applications – Diagonalization of matrix. Calculation of powers of matrix. Quadratic forms – Reduction of quadratic form to canonical form and their nature.

**UNIT II**

Solution of Algebraic and Transcendental Equations: Introduction – The Method of False Position – Newton-Raphson Method.  
Interpolation:-Introduction – Newton’s forward and backward interpolation formulae – Lagrange’s Interpolation formula.  
Curve fitting: Fitting a straight line – Second degree curve – Exponential curve-Power curve by method of least squares.

**UNIT III**

Numerical Differentiation and Integration – Trapezoidal rule – Simpson’s 1/3 Rule – Simpson’s 3/8 Rule.  
Numerical solution of Ordinary Differential equations: Solution by Taylor’s series-Picard’s Method of successive Approximations-Euler’s Method-Runge-Kutta Method – Predictor-Corrector Method – Milne’s Method.

**UNIT IV**

Fourier Series: Determination of Fourier coefficients – Fourier series – Even and odd functions – Fourier series in an arbitrary interval – Even and odd period, continuation – Half-range Fourier sine and cosine expansions.  
Fourier integral theorem – Fourier sine and cosine integrals. Fourier transforms – Fourier sine and cosine transforms – Properties – Inverse transforms – Finite Fourier transforms.

**UNIT V**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Method of separation of variables – Solutions of one dimensional wave equation, heat equation and two-dimensional Laplace’s equation under initial and boundary conditions.

**Text Books:**

1. *Higher Engineering Mathematics*, B.S.Grewal, Khanna publishers.
2. *Introductory Methods of Numerical Analysis*, S.S. Sastry, PHI publisher.

**Reference Books:**

1. *Engineering Mathematics, Volume - II*, E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher.
2. *Engineering Mathematics, Volume - II*, by G.S.S.Raju, CENGAGE publisher.
3. *Mathematical Methods* by T.K.V. Iyengar, S. Chand publication.
4. *Higher Engineering Mathematics*, by B.V.Ramana, Mc Graw Hill publishers.
5. *Advanced Engineering Mathematics*, by Erwin Kreyszig, Wiley India.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. II - I Sem.

Th	Tu	C
3	1	3

(13A01308) MECHANICS OF SOLIDS

**Course Objective:**

The objective of the subject is to learn the fundamental concepts of stress, strain and deformation of solids with applications to bars and beams. The students shall understand the theory of elasticity including strain/displacement and hooks law relationships. To access stresses and deformations through the mathematical models of beams for bending and bars for twisting or combination of both. The knowledge of this subject will help in the design & Theory of machines courses.

**UNIT I**

**SIMPLE STRESSES & STRAINS:** Elasticity and plasticity – Types of stresses & strains – Hooke’s law – stress & strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson’s ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings. Principle stresses and strains-computation of principle stresses and strains on inclined planes-theory of failures- minimum principle stress, strain, shear stress and strain energy theories.

**Learning Outcome & Suggested Student Activities:**

This unit gives the student how to measure the strength of materials based on calculating stresses, strains and deformations for basic geometries subjected to axial loading and thermal effects. Students are advised to visit the URL [http://nptel.iitm.ac.in/courses/IIT-MADRAS/Strength\\_of\\_Materials/Pdfs/1\\_1.pdf](http://nptel.iitm.ac.in/courses/IIT-MADRAS/Strength_of_Materials/Pdfs/1_1.pdf).

**UNIT II**

**SHEAR FORCE AND BENDING MOMENT :** Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, U.D.L., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

**Learning outcome & Suggested Student Activities:**

This unit gives awareness for the students how to draw shear force and bending moment diagrams for calculating maximum shear force and maximum bending moment for different types of beams with different lateral loadings conditions. This topic can be downloaded from the URL [http://vedyadhara.ignou.ac.in/wiki/images/a/ad/BME-017\\_B-1\(Unit\\_4\).pdf](http://vedyadhara.ignou.ac.in/wiki/images/a/ad/BME-017_B-1(Unit_4).pdf)

**UNIT III**

**FLEXURAL STRESSES:** Theory of simple bending – Assumptions – Derivation of bending equation:  $M/I = f/y = E/R$  Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

**SHEAR STRESSES:** Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

**Learning outcome & Suggested Student Activities:**

This unit gives knowledge to the students about the strength of the beams with different sections by bringing the relationship between the bending stress and maximum bending moment, bringing the relationship between the shear stress and maximum shear force which are calculated from previous unit. This topic can be downloaded from the following URL [http://web.mit.edu/emech/dontindex-build/full-text/emechbk\\_7.pdf](http://web.mit.edu/emech/dontindex-build/full-text/emechbk_7.pdf).

**UNIT IV**

**TORSION OF CIRCULAR SHAFTS-** Theory of pure torsion- Derivation of torsion equations;  $T/J=q/r=N\theta/L$  – Assumptions made in the theory of pure torsion- torsional moment of resistance- polar section modulus.

**DEFLECTION OF BEAMS:** Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay’s methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point

loads, - U.D.L uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams.

**Learning outcome & Suggested Student Activities:**

*This unit gives awareness to the students how to calculate the shear strength of the solid and hollow shafts which are subjected to torsional loading in power transmitting. This topic related to torsion can be download from the following URLs*

*[http://www.mae.ncsu.edu/zhu/courses/mae314/lecture/Lecture4\\_Torsion.pdf](http://www.mae.ncsu.edu/zhu/courses/mae314/lecture/Lecture4_Torsion.pdf), and also gives better knowledge for students how to calculate deflections of beam using different methods under different boundary and loading conditions. Notes for this topic can be download from the web site [http://nptel.iitm.ac.in/courses/IIT-MADRAS/Strength\\_of\\_Materials/Pdfs/5\\_1.pdf](http://nptel.iitm.ac.in/courses/IIT-MADRAS/Strength_of_Materials/Pdfs/5_1.pdf).*

**UNIT V**

**THIN CYLINDERS:** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in diameter, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells.

**THICK CYLINDERS:** Lamé's equation – cylinders subjected to inside & outside pressure - compound cylinders.

**Learning outcome & Suggested Student Activities:**

*This unit gives application to mechanics of solids for students in which how to calculate different stresses and strains for the thin and thick cylinders in identifying safe design for boiler shells and thick shells as such in like domestic cylinders, air compressor and high pressure vessels used in thermal plants etc. Notes for this topic can be download from the site*

*[http://www.ewp.rpi.edu/hartford/users/papers/engr/ernesto/poworp/Project/4.%20Supporting\\_Material/Books/32658\\_09 & 10.pdf](http://www.ewp.rpi.edu/hartford/users/papers/engr/ernesto/poworp/Project/4.%20Supporting_Material/Books/32658_09%20&10.pdf).*

**Text Books:**

1. *Mechanics of Materials by Gere and Timoshenko, C B S Publishers & Distributors, 2<sup>nd</sup> Edition, 2004.*
2. *Strength of Materials by R.K. Bansal, Laxmi Publishers, 5<sup>th</sup> Edition, 2012.*

**Reference Books:**

1. *Strength of Materials by S. Ramamrutham, Dhanpat Rai Publishers*
2. *Strength of Materials by R.K. Rajput, S.Chand & Company, 5<sup>th</sup> Edition, 2012.*
3. *Strength of Materials by Dr. Sadhu Singh, Khanna Publishers, 10<sup>th</sup> Edition, 2013.*
4. *Strength of Materials by M.Chakraborti, S.K.Kataria & Sons, 2<sup>nd</sup> Edition, 2011.*
5. *Strength of Materials by S S Rattan, The McGraw-Hill Companies, 2<sup>nd</sup> Edition, 2011.*

**Suggestions:**

- *Students are advised to buy a text book for understanding problems then they may buy Strength of materials by R.K.Bansal, Laxmi Publishers & For further more problems Strength of Materials by R.K. Rajput, S.Chand & Company*
- *Students may go around some of the small scale industries and domestic orientated jobs gives better knowledge on to check strength of materials.*
- *Some basic knowledge regarding Engineering mechanics, Mathematics and Physics are required for understanding this subject.*

**Web Resources:**

<http://nptel.iitm.ac.in/>  
[www.learnerstv.com/Free-Engineering-video-lecture-courses.htm](http://www.learnerstv.com/Free-Engineering-video-lecture-courses.htm)  
[http://en.wikibooks.org/wiki/Strength\\_of\\_Materials](http://en.wikibooks.org/wiki/Strength_of_Materials)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. II - I Sem.**

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**(13A99302) ELECTRICAL AND ELECTRONICS ENGINEERING**

**PART – A ELECTRICAL ENGINEERING**

**Course Objective:**

- *In this course the different types of DC generators and motors, Transformers, 3 Phase AC Machines which are widely used in industry are covered and their performance aspects will be studied.*

**UNIT I DC MACHINES**

**D.C.GENERATOR:** Principles of Operation –Constructional Details-Expression for Generated Emf-Types of Generators-Losses in D.C.Generator – Characteristics of D.C.Generators-Applications of D.C.Generators.

**D.C. MOTOR:** Principles of Operation –Constructional Details-Back EMF-Types of Motors-Armature Torque of a D.C. Motor - Characteristics of D.C.Motors -Applications of D.C.Motors-3 Point Starter-Speed Control of Shunt Motors

**UNIT II TRANSFORMERS**

Principles of Operation- Constructional Details- Types of Transformers- Emf Equation of a Transformer –Voltage Transformation Ratio-Equivalent Circuit- Equivalent Resistance- Equivalent Reactance-Losses in the Transformer-Copper Loss, Iron Loss-Transformer Tests-Open Circuit, Short Circuit Test-Efficiency of a Transformer –Regulation of Transformer

**UNIT III 3 PHASE AC MACHINES**

**INDUCTION MACHINES:**

Introduction to 3-Phase Induction Motor- Principle of Operation- Constructional Details-Slip, Frequency of Rotor Current-Expression for Torque -Torque-Slip Characteristics- Applications of 3 Phase Induction Motors

**ALTERNATORS:**

Principle of Operation-Constructional Details-EMF Equation-Voltage Regulation by Synchronous Impedance Method

**Text Books:**

1. *Basic Electrical Engineering by D P KOTHARI & I J NAGRATH, Tata McGraw Hill, Second Edition, 2007.*
2. *Electrical Circuit Theory and Technology by JOHN BIRD, Routledge publisher, 4<sup>Th</sup> Edition, 2011.*

**Reference Books:**

1. *Electrical & Electronic Technology by Edward Hughes, 10<sup>th</sup> Edition, Pearson, 2008.*

## **PART – B ELECTRONICS ENGINEERING**

### **UNIT I**

**SEMICONDUCTOR DEVICES:** Intrinsic semiconductors-Electron-Hole Pair Generation, Conduction in Intrinsic Semiconductors, Extrinsic Semiconductors-N-Type and P-Type Semiconductors, Comparison of N-Type and P-Type Semiconductors. The p-n Junction - Drift and Diffusion Currents, The p-n Junction Diode-Forward Bias, Reverse Bias, Volt-Ampere Characteristics- Diode Specifications, Applications of Diode, Diode as a Switch. Diode as a Rectifier-Half-wave Rectifier, Full-Wave Rectifier, Full-Wave Bridge Rectifier, Rectifiers with Filters, Zener Diode- Volt-Ampere Characteristics, Zener Diode as Voltage Regulator. Silicon Controlled Rectifier- Two Transistor Analogy of an SCR, Characteristics, Applications of SCR, DIAC, TRIAC.

### **UNIT II**

**BJT and FETs:** Bipolar Junction Transistor (BJT) – Types of Transistors, Operation of NPN and PNP Transistors, Input-Output Characteristics of BJT-CB, CE and CC Configurations, Relation between  $I_C$ ,  $I_B$  and  $I_E$ . Transistor Biasing- Fixed Bias, Voltage Divider Bias, Transistor Applications- Transistor as an Amplifier, Transistor as a Switch,. Junction Field Effect Transistor (JFET)- Theory and Operation of JFET, Output Characteristics, Transfer Characteristics, Configurations of JFET-CD, CS and CG Configurations, JFET Applications- JFET as an Amplifier, JFET as a Switch. Comparison of BJT and JFET, MOSFET-The Enhancement and Depletion MOSFET, Static Characteristics of MOSFET, Applications of MOSFET.

### **UNIT III**

**DIGITAL ELECTRONICS:** Number Systems-Decimal System, Binary System, Octal System, Hexadecimal System, Code Conversions, Binary Arithmetic- Binary Addition, Binary Subtraction, Logic Gates and Truth Tables-NOT, OR, AND, EX-OR, EX-NOR, Universal Gates- NAND, NOR Gates. Boolean algebra and De Morgan's Theorems, Combinational Circuits-Adders and Subtractors.

#### **Text Books:**

1. *Basic Electrical and Electronics Engineering*, M.S.Sukhija, T.K.Nagsarkar, Oxford University Press, 1<sup>st</sup> Edition, 2012.
2. *Basic Electrical and Electronics Engineering*, S.K Bhattacharya, Pearson Education, 2012.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. II - I Sem.

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(13A03301) MATERIAL SCIENCE AND ENGINEERING

**Course Objective:**

To gain and understanding of the relationship between the structure, properties, processing, testing, heat treatment and applications of metallic, non metallic, ceramic and composite materials so as to identify and select suitable materials for various engineering applications.

**UNIT I**

STRUCTURE OF METALS: Bonds in Solids – Metallic bond - crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size. CONSTITUTION OF ALLOYS: Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds.

**Learning outcome & Suggested Student Activities:**

Students will get knowledge on bonds of solids and knowing the crystallization of metals. By knowing the grain size and shape through the crystallization, he may understand the effect of grain boundaries on the properties of metals and finally he determines the grain size that is very essential for analyzing the microstructures of metals.

Students are advised to refer the following websites [www.physics.rutgers.edu/meis/pubs/BB\\_thesis.pdf](http://www.physics.rutgers.edu/meis/pubs/BB_thesis.pdf) [www.ce.berkeley.edu/~paulmont/CE60New/alloys-steel.pdf](http://www.ce.berkeley.edu/~paulmont/CE60New/alloys-steel.pdf) for better understanding of this topic.

**UNIT II**

EQUILIBRIUM OF DIAGRAMS: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni-, Al-Cu, and Fe-Fe<sub>3</sub>C

**Learning outcome & Suggested Student Activities:**

Students will be able to construct the equilibrium diagrams by experimental methods and knowing all types of equilibrium diagrams isomorphs alloy systems, electric systems, peritectic systems solid-state transformations etc. while studying all these diagrams he may able to know about lever rule and phase rule.

Students are advised to visit the following URLs website [www.freelance-teacher.com/videos.htm](http://www.freelance-teacher.com/videos.htm) [www.susqu.edu/brake/aux/downloads/papers/foamcomp.pdf](http://www.susqu.edu/brake/aux/downloads/papers/foamcomp.pdf) for better understanding of this topic.

**UNIT III**

CAST IRONS AND STEELS: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

NON-FERROUS METALS AND ALLOYS: Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium and its alloys.

**Learning Outcome & Suggested Student Activities:**

Students will be able to learn the structure and properties of all cast irons, steels and Non-ferrous metal alloys of copper, Al and Titanium. Students are advised to visit any Machine shop in the industries like SAIL, Visakhapatnam steel plant etc., Students are advised to visit the following website. [www.buzzle.com](http://www.buzzle.com), [www.mhprofessional.com](http://www.mhprofessional.com) [www.eng.sut.ac](http://www.eng.sut.ac) for better understanding of this topic.



## UNIT IV

HEAT TREATMENT OF ALLOYS: Effect of alloying elements on Iron – Iron carbon system, Annealing, normalizing, Hardening, TTT diagrams, tempering, Hardenability, surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys. Heat treatment of plastics

### **Learning outcome & Suggested Student Activities:**

Students will be able to learn the methods of different heat treatments i.e. annealing, normalizing and hardening. He also learns the different of alloying elements on Iron-Iron carbon system, the importance of TTT diagrams, Harden ability that are very essential for melting science. Finally, he learn about the heat treatment of cryogenic environment as an advance topic.

Students are advised to go through the URLs <http://www.nptel.iitm.ac.in/> and [iisc.ernet.in](http://www.iisc.ernet.in/) for video lectures, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv180-Page1.htm>

## UNIT V

CERAMIC MATERIALS: Crystalline ceramics, glasses, cermets.

COMPOSITE MATERIALS: Classification of composites, various methods of component manufacture of composites, particle – reinforced materials, fiber reinforced materials, polymer composites, metal ceramic mixtures, metal – matrix composites and Carbon – Carbon composites.

### **Learning Outcome & Suggested Student Activities:**

This unit helps the students to understand the importance of advanced composite materials in application to sophisticated machine and structure of components, These composite materials helps to develop the components with required properties which we cannot attain using the metals & metal alloys.

Examples of products maybe of composite materials are air cooler bodies, fiber reinforced hose pipes, boat bodies some automobile body frames etc. Students may refer the following website for better understanding [www.susqu.edu/brake/aux/downloads/papers/foamcomp.pdf](http://www.susqu.edu/brake/aux/downloads/papers/foamcomp.pdf); [www.asmenternational.org](http://www.asmenternational.org) [www.princeton.edu/~achaney/tmve/wiki100k/doc/metal\\_matrix\\_composite.html](http://www.princeton.edu/~achaney/tmve/wiki100k/doc/metal_matrix_composite.html)

### **Text Books:**

1. *Introduction to Physical Metallurgy*, Sidney H. Avner, US, 2<sup>nd</sup> Edition, 2007 Tata McGraw-Hill, Noida, 1985.
2. *Essential of Materials Science and Engineering*, Donald R. Askeland, USA, 3<sup>rd</sup> Edition, Cengage Publisher, 2013.

### **Reference Books:**

1. *Material Science and Metallurgy*, U.C. Jindal, pearson educations, 2011,
2. *Elements of Materials Science and Engineering*, Lawrance H. Van Vlack, pearson educations, 6<sup>th</sup> Edition, 2002.
3. *Material Science and Metallurgy*, kodgire V.D, 12<sup>th</sup> Edition, Everest Publishing House, 2002.
4. *Engineering Mechanics of Composite Materials-* Isaac and M Daniel, Oxford University Press, 1994, 2<sup>nd</sup> Edition 2013.
5. *Mechanics of Composite Materials*, R. M. Jones, McGraw Hill Company, New York, 1975.
6. *Science of Engineering Materials*, Agarwal, TMH.
7. *Materials Science and Engineering*, William D. Callister, 8<sup>th</sup> Edition, 2010.
8. *Elements of Material science*, V. Rahghavan, PHI, 5<sup>th</sup> Editon.
9. *Engineering Materials and Their Applications – R. A Flinn and P K Trojan*, Jaico Books.
10. *Engineering materials and metallurgy*, R.K.Rajput, S.Chand, 1<sup>st</sup> Editon, 2008.

### **Web References:**

[www.asminternational.org](http://www.asminternational.org)  
[www.henry.wells.edu](http://www.henry.wells.edu)  
[www.ce.berkeley.edu](http://www.ce.berkeley.edu)  
[www.sjsu.edu](http://www.sjsu.edu)

**Note: Separate Answer Booklets should be supplied**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. II - I Sem.

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(13A03302) THERMODYNAMICS

**Course Objective:**

*By this subject students will get the awareness on basic thermodynamic principles, skills to perform the analysis and design of thermodynamic systems, First law and second law of thermodynamics and its applications to a wide variety of systems, principles of psychrometry and properties of pure substances. And also understand the concept of various air standard cycles with the help of P-v and T-s Diagrams.*

**UNIT I**

**BASIC CONCEPTS:** Macroscopic and Microscopic Approaches, Thermodynamic System, State, Property, Process and Cycle, Quasi Static Process, Thermodynamic Equilibrium, Quasi-static Process, Zeroth Law of Thermodynamics,

**WORK & HEAT TRANSFER:** Work transfer, types of work transfers, Point and Path Functions, Heat transfer, Comparison of Work and Heat transfers.

**Learning Outcome & Suggested Student Activities:**

*Students can able to understand thermodynamic property, cycle, constraints of equilibrium, reversibility and energy transfer in the form of Work and Heat with various applications. Students are advised to collect different types of thermometers, measure the temperature of a given room/substance and compare the values. Following URL is very useful for better understanding <http://www.nptel.iitm.ac.in>. Students may refer text book of Fundamentals of Engineering Thermodynamics By Michael J. Moran, Howard N. Shapiro.*

**UNIT II**

**FIRST LAW OF THERMODYNAMICS:** First Law applied to a process and a cycle, Energy - a property, Forms and transformation of Energy, Internal Energy and Enthalpy, PMM I.

**FLOW SYSTEMS:** Control Volume, Steady Flow Process, Mass balance and Energy Balance, Applications of Steady Flow Processes.

**Learning Outcome & Suggested Student Activities:**

*Student will learn how energy transformation occurs from one form into another form in open and closed systems and applying steady flow energy equation and mass balance equation to various applications. Student is advised to observe the Nozzle, Diffuser, Throttling device, Turbine and compressor in laboratories or local industries and understand their working principles practically. Notes of First law of thermodynamics can be downloaded from the website <http://nptel.iitm.ac.in/courses/103101004/downloads/chapter-3.pdf>.*

**UNIT III**

**Second Law of Thermodynamics:** Heat Engine, Statements of Second law and their equivalence, Refrigeration and Heat Pump, Reversibility and Irreversibility, Carnot cycle and Carnot's Theorem, Thermodynamic Temperature Scale, Efficiency of Heat Engine, PMM II

**Entropy:** Clausius' Theorem, Entropy as a property, T-s Plot, Clausius Inequality, Principle of Entropy Increase and its applications. Available Energy, Quality of Energy, definitions of Dead state, Availability.

**Learning Outcome & Suggested Student Activities:**

*Student will identify the major difference in working of a heat engine, refrigerator and heat pump. to calculate the maximum efficiency of a cycle. Also student can learn calculating entropy change for a process, maximum available energy. Student is advised to visit laboratories of Heat Engines, Refrigeration and Air conditioning and observe how they work. Student may refer text book Fundamentals of Classical Thermodynamics - G.J.VanWylen & Sonntag*

#### UNIT IV

Pure Substances: P-v, P-T, T-s diagrams of Pure Substances, Mollier Diagram, Dryness Fraction, Use of Steam Tables for Thermodynamic Properties

Thermodynamic Relations: Maxwell's equations, TDS equations, Joule-Kelvin Effect, Clausius-clapeyron equation.

##### **Learning Outcome & Suggested Student Activities:**

*After the completion of the unit, student will be able to understand the method drawing phase equilibrium diagrams like P-v, h-s, T-s and P-T of a pure substance. Student can learn the usage of steam tables and mollier diagrams in solving problems. Also, the student will learn the cooling / heating effect of throttling process. Thermodynamic relations.*

*Student is advised to do the experiment on water (To cool / heat water) from atmospheric conditions and observe freezing / boiling point temperatures, changes in volume etc. Repeat the same experiment under different pressure.*

#### UNIT V

Properties of Gases and Gas Mixtures: Ideal Gas, Equation of State, Avogadro's Law, Internal Energy and Enthalpy of Ideal Gas, Entropy Change of Ideal Gas, Mixture of Gases- Dalton's Law of Partial Pressure, Specific Heats, Internal Energy and Enthalpy of Gas Mixtures

Gas Power Cycles: Carnot Cycle, Sterling Cycle, Ericson Cycle, Otto Cycle, Diesel Cycle, Dual Cycle, their applications, comparison of Otto, Diesel and Dual cycles, Second Law Analysis of Gas Power Cycles

##### **Learning Outcome & Suggested Student Activities:**

*Student will learn basic laws of ideal gas and gas mixtures. After studying Gas Power Cycles, student will understand the concept of ideal cycles for different engines and their working principle. Student can know drawing P-V and T-S diagrams for various air standard cycles and calculating work output, efficiency, mean effective pressure of each cycle.*

*Student is advised to conduct experiments in I.C Engines lab to find out the actual thermal efficiencies of Diesel and Petrol Engines and compare them with respect to ideal cycles.*

##### **Text Books:**

1. *Engineering Thermodynamics, P.K Nag, TMH Publishers, New Delhi, 5<sup>th</sup> Edition, 2013.*

##### **Reference Books:**

1. *Engineering Thermodynamics by P. Chattopadhyam, Oxford, 1<sup>st</sup> Revised, 2011.*
2. *Fundamentals of Thermodynamics – Sonntag, Borgnakke and van wylen, John Wiley & sons (ASIA) Pte Ltd, 7<sup>th</sup> Edition, 2009.*
3. *Thermodynamics – An Engineering Approach – YunusCengel & Boles, TMH, 7<sup>th</sup> Edition 2011.*
4. *Thermodynamics – J.P.Holman, McGrawHill, 2<sup>nd</sup> Edition company New York 1975.*
5. *An introduction to Thermodynamics, YVC Rao, Universities press, 2009 Revised Edition,*
6. *Engineering Thermodynamics – J.B. Jones & R.E.Dugan, PHI, 1<sup>st</sup> Edition, 2009.*

**NOTE:** Steam tables, Mollier Diagrams should be supplied

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. II - I Sem.**

**Drg  
6**

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**(13A03303) MACHINE DRAWING**

**Course Objective:**

*To make the students to understand the concepts of I.S. conventions, methods of dimensioning, the title boxes, to draw the machine elements and simple parts.*

*To make the students to understand and draw assemblies of machine parts and to draw their sectional views*

**UNIT I**

Machine Drawing Conventions: Need for drawing conventions- introduction to IS conventions  
Conventional representation of material, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs. Parts not usually sectioned.

Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.

Title boxes, their size, location and details-common abbreviations & their liberal usage

**Learning Outcome & Suggested Student Activities:**

*This unit is useful to prepare the students for representing their ideas at International standards and will be able to convey in without much effort globally with ease. Students will acquire skills to draft on a drawing sheet without much effect. Students are advised to visit machine shop.*

**UNIT II**

Drawing of Machine Elements and simple parts: Selection of Views, additional views for the following machine elements and parts with drawing proportions:

Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws, Keys, cottored joints and knuckle joint, Rivetted joints for plates, flanged & protected flanged joint. Shaft coupling, spigot and socket pipe joint. Journal, and foot step bearings.

**Learning Outcome & Suggested Student Activities:**

*Students can represent various details of an object quickly without much time and ambiguity. These drawings can be easily prepared and understood by both the people in a manufacturing industry and the consumers too. Students are advised to visit machine shop.*

**UNIT III**

Assembly Drawings: Drawings of assembled views for the part drawings of the following.

Engine parts- stuffing boxes, cross heads, Eccentrics, Petrol Engine-connecting rod, piston assembly. Other machine parts- Screw jack, Machine Vice, single tool post.

Valves: Steam stop valve, feed check valve. Non return valve.

**Learning Outcome & Suggested Student Activities:**

*Students can understand the working principles of an assembly or subassembly so that he/she will be able to produce the final product by procuring the units from various sources/suppliers and still produce any useful product serving effectively. It is not necessary that all the components to be made locally only. Students are advised to visit body building and assembly unit.*

*Note: First angle projection to be adopted. The student should be able to provide working drawings of actual parts.*

**Text Books:**

1. Machine Drawing- K.L. Narayana, P.Kannaiah & K.Venkata Reddy, New Age Publishers, 4<sup>th</sup> Edition, 2012.
2. Machine Drawing- Dhawan, S.Chand Publications, 1<sup>st</sup> Revised Edition, 1998.

**Reference Books:**

1. *Machine Drawing- P.S. Gill, S.K. Kataria & Sons, 17<sup>th</sup> Edition, 2012.*
2. *Machine Drawing- Luzzader, PHI Publishers, 11<sup>th</sup> Edition.*
3. *Machine Drawing – Rajput, S. Chand Pub.*
4. *Textbook of Machine Drawing-K.C.John, 2009, PHI learning, 1<sup>st</sup> Edition.*

**NOTE:**

- *The End exam will be for 4 hrs in the following format*
- *All answers should be on the drawing sheet only. Answers on the drawing sheet only will be valued.*
- *First Angle Projections*
  - Q1 Questions set on section I of the syllabus 2 out of 3 or 2 out of 4 to be answered with a weightage of 4 marks each-08 marks.*
  - Q2 Questions set on section II of the syllabus 2 out of 3 to be answered with a weightage of 10 marks each-20 marks.*
  - Q3 Drawing of assembled views of section III items of syllabus with a weightage of 42 marks*

**Suggestions:**

*Student should buy a book mentioned under Text books and study all the exercises given at the end of each chapter to equip him/her with the required ammunition.*

*Student should visit an automobile shop while the unit is being disassembled / assembled.*

*Student should go through the exercises given under assembly drawings referring to various books in the library to improve his assimilation capacity.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. II - I Sem.**

**L      C**  
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**(13A99303) MATERIAL SCIENCE LAB AND MECHANICS OF SOLIDS LAB**

**(A) MATERIAL SCIENCE LAB:**

1. Preparation and study of the Micro Structure of pure metals like Iron, Cu and Al.
2. Preparation and study of the Microstructure of Mild steels, low carbon steels, high – C steels.
3. Study of the Micro Structures of Cast Irons.
4. Study of the Micro Structures of Non-Ferrous alloys.
5. Study of the Micro structures of Heat treated steels.
6. Hardeneability of steels by Jominy End Quench Test.
7. To find out the hardness of various treated and untreated steels.

**(B) MECHNICS OF SOLIDS LAB**

1. Direct tension test beam
2. Bending test on
  - a) Simply supported beam
  - b) Cantilever beam
3. Torsion test
4. Hardness test
5. Brinells hardness test
6. Rockwell hardness test
7. Test on springs
8. Compression test on cube
9. Impact test
10. Punch shear test

**NOTE:**

- *Minimum of 4 from (A) and 6 from (B) experiments need to be performed*
- *Internal and End examinations evaluation will be done separately and the average will recorded.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. II - I Sem.**

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**(13A99304) ELECTRICAL & ELECTRONICS ENGINEERING LAB**

**PART- A: ELECTRICAL LAB**

1. Verification of Superposition Theorem.
2. Verification of Thevenin's Theorem.
3. Open Circuit Characteristics of D.C.Shunt Generator.
4. Swinburne's Test on DC Shunt Machine (Predetermination of Efficiency of a Given DC Shunt Machine Working as Motor and Generator).
5. Brake Test on DC Shunt Motor. Determination of Performance Characteristics.
6. OC & SC Tests on Single-Phase Transformer (Predetermination of Efficiency and Regulation at Given Power Factors).
- 7.

**PART- B : ELECTRONICS LAB**  
**(Any Six Experiments)**

1. P-N Junction Diode and Zener Diode Volt-Ampere Characteristics.
2. Bipolar Junction Transistor in CB Configuration-Input and Output Characteristics, Computation of  $\alpha$ .
3. Half-Wave Rectifier- a) Without Filter b) With Capacitor Filter.
4. Full-Wave Rectifier- a) Without Filter b) With Capacitor Filter.
5. Bipolar Junction Transistor in CE Configuration-Input and Output Characteristics, Computation of  $\beta$ .
6. Junction field effect Transistor in Common Source Configuration Output and Transfer Characteristics.
7. Verification of Logic Gates- AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. II – I Sem.**

**(13A52301) HUMAN VALUES & PROFESSIONAL ETHICS (AUDIT COURSE)**

**Course Objective:**

*This course deals with professional ethics which includes moral issues and virtues, social responsibilities of an engineer, right, qualities of Moral Leadership.*

**UNIT I**

**ENGINEERING ETHICS**

Senses of 'Engineering Ethics' – Variety of Moral Issues – Types of Inquiry – Moral Dilemmas – Moral Autonomy – Kohlberg's Theory – Gilligan's Theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories

**UNIT II**

**ENGINEERING AS SOCIAL EXPERIMENTATION**

Engineering as Experimentation – Engineers as Responsible Experimenters – Research Ethics – Codes of Ethics – Industrial Standards – A Balanced Outlook on Law – The Challenger Case Study

**UNIT III**

**ENGINEER'S RESPONSIBILITY FOR SAFETY**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk – Chernobyl Case Studies and Bhopal

**UNIT IV**

**RESPONSIBILITIES AND RIGHTS**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

**UNIT V**

**GLOBAL ISSUES**

Multinational Corporations – Business Ethics – Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

**Text Books:**

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York 2005.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.

**Reference Books:**

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, 2004.
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, 2003.



# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

**B.Tech. II - II Sem.**

<b>Th</b>	<b>Tu</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>3</b>

## (13A01403) ENVIRONMENTAL SCIENCE

### **Course Objective:**

- *To make the students to get awareness on environment, to understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life to save earth from the inventions by the engineers.*

### **UNIT I**

**MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES:** – Definition, Scope and Importance – Need for Public Awareness.

**NATURAL RESOURCES :** Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

### **UNIT II**

**ECOSYSTEMS:** Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

- Forest ecosystem.
- Grassland ecosystem
- Desert ecosystem
- Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**BIODIVERSITY AND ITS CONSERVATION:** Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-soports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

### **UNIT III**

**ENVIRONMENTAL POLLUTION:** Definition, Cause, effects and control measures of :

- Air Pollution.
- Water pollution
- Soil pollution
- Marine pollution
- Noise pollution
- Thermal pollution
- Nuclear hazards

**SOLID WASTE MANAGEMENT:** Causes, effects and control measures of urban and industrial wates – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

### **UNIT IV**

**SOCIAL ISSUES AND THE ENVIRONMENT:** From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management –

Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

#### UNIT V

**HUMAN POPULATION AND THE ENVIRONMENT:** Population growth, variation among nations. Population explosion – Family Welfare Programme. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

**FIELD WORK:** Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, birds – river, hill slopes, etc..

#### **Text Books:**

1. *Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press, 2005.*
2. *Environmental Studies by Palanisamy, Pearson education, 2012.*
3. *Environmental Studies by R.Rajagopalan, Oxford University Press, 2<sup>nd</sup> edition, 2011.*

#### **Reference Books:**

1. *Textbook of Environmental Studies by Deeksha Dave and E.Sai Baba Reddy, Cengage Publications, 2<sup>nd</sup> edition, 2012.*
2. *Text book of Environmental Science and Technology by M.Anji Reddy, BS Publication, 2009.*
3. *Comprehensive Environmental studies by J.P.Sharma, Laxmi publications, 2<sup>nd</sup> edition, 2006.*
4. *Environmental sciences and engineering – J. Glynn Henry and Gary W. Heinke – Printice hall of India Private limited, 2<sup>nd</sup> edition, 1996.*
5. *Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P. Ela - Printice hall of India Private limited, 3<sup>rd</sup> editton, 2007.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. II - II Sem.**

<b>Th</b>	<b>Tu</b>	<b>C</b>
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**(13A54303) PROBABILITY AND STATISTICS**

**Course Objective:**

- *To help the students in getting a thorough understanding of the fundamentals of probability and usage of statistical techniques like testing of hypothesis, ANOVA, Statistical Quality Control and Queuing theory.*

**Learning Outcome:**

- *The student will be able to analyze the problems of engineering & industry using the techniques of testing of hypothesis, ANOVA, Statistical Quality Control and Queuing theory and draw appropriate inferences.*

**UNIT I**

Conditional probability – Baye’s theorem. Random variables – Discrete and continuous Distributions – Distribution functions. Binomial and poison distributions Normal distribution – Related properties.

**UNIT II**

Test of Hypothesis: Population and Sample - Confidence interval of mean from Normal distribution - Statistical hypothesis - Null and Alternative hypothesis - Level of significance - Test of significance - Test based on normal distribution - Z test for means and proportions; Small samples - t- test for one sample and two sample problem and paired t-test, F-test and Chi-square test (testing of goodness of fit and independence).

**UNIT III**

Analysis of variance one way classification and two way classification (Latic square Design and RBD)

**UNIT IV**

Statistical Quality Control: Concept of quality of a manufactured product -Defects and Defectives - Causes of variations - Random and assignable - The principle of Shewhart Control Chart-Charts for attribute and variable quality characteristics- Constructions and operation of X- bar Chart, R-Chart, P-Chart and C-Chart.

**UNIT V**

Queuing Theory: Pure Birth and Death process, M/M/1 & M/M/S & their related simple problems.

**Text Books:**

1. *Probability & Statistics for engineers by Dr. J. Ravichandran WILEY-INDIA publishers.*
2. *Probability & Statistics by T.K.V. Iyengar, S.Chand publications.*

**Reference Books:**

1. *Probability & Statistics by E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher.*
2. *Statistical methods by S.P. Gupta, S.Chand publications.*
3. *Probability & Statistics for Science and Engineering by G.Shanker Rao, Universities Press.*
4. *Probability and Statistics for Engineering and Sciences by Jay L.Devore, CENGAGE.*
5. *Probability and Statistics by R.A. Jhonson and Gupta C.B.*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. II - II Sem.

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(13A03401) KINEMATICS OF MACHINERY

**Course Objective:**

The objective of this course is to cover the kinematics and dynamics of planar single degree of freedom mechanisms. After this course the student should have general mathematical and computational skills to enable the kinematics and dynamics analysis of machine elements including linkages, cams and gears and also becomes familiar with gear terminology and drawing of the cam profiles.

**UNIT I**

MECHANISMS AND MACHINES: Elements or Links – Classification – Rigid Link, flexible and fluid link. Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained. Mechanisms and machines – classification of mechanisms and machines – kinematic chain – inversion of mechanisms – inversions of quadric cycle chain – single and double slider crank chain. Mobility of mechanisms. Straight Line Motion Mechanisms- Exact and approximate, copiers and generated types –Peaucellier, Hart and Scott Russel – Grasshopper, Watt, Tchebicheff and Robert Mechanisms. Pantograph.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are in a position to identify different mechanisms, inversions of different kinematic chains and also to find mobility of mechanisms. To get more clarity on mechanisms and machines, the following URLs will be highly useful to the students to understand various concepts of mechanisms and machines. <http://www.cs.cmu.edu/~rapidproto/mechanisms/chpt2.html>, <http://www.mhprofessional.com/downloads/products/0071704426/0071704426-ch01.pdf>

**UNIT II**

STEERING MECHANISMS: Conditions for correct steering – Davis Steering gear, Ackermanns steering gear. Hooke’s Joint (Universal coupling) -Single and double Hooke’s joint — applications – Simple problems.

Belt, Rope and Chain Drives : Introduction, Belt and rope drives, selection of belt drive- types of belt drives, materials used for belts and ropes, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains- length, angular speed ratio, classification of chains.

**Learning outcome & Suggested Student Activities:**

After completion of this chapter students are able to understand the mechanism of Hooke’s joint, steering mechanisms and belt friction. And are also able to solve numerical problems on Hooke’s joint, belt and rope drives. Students can go through the textbooks for the problems on Hooke’s joint, belt and rope drives. The following URLs will be highly useful to the students to understand various concepts of steering mechanisms and belt friction.

<http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/pdf/mod13les1.pdf>  
<http://www.youtube.com/watch?v=YzGM8Uc2HB0>

**UNIT III**

**KINEMATICS**

Velocity and Acceleration Diagrams- Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method – Slider crank mechanism, four bar mechanism. Acceleration diagrams for simple mechanisms, Coriolis acceleration, determination of Coriolis component of acceleration. Kleins construction. Analysis of slider crank mechanism for displacement, velocity and acceleration of slider using analytical method

Instantaneous Centre Method: Instantaneous centre of rotation, centrode and axode – relative motion between two bodies – Three centres in-line theorem – Locating instantaneous centres for simple mechanisms and determination of angular velocity of points and links.

**Learning outcome & Suggested Student Activities:**

After completion of this unit student are able to draw velocity and acceleration diagrams of simple plane mechanisms by using relative velocity method and instantaneous center method. Students can go through the textbooks given for the problems on analysis of mechanisms. The following URLs will be highly useful to the students to understand various concepts of velocity and acceleration diagrams.

<http://www.freestudy.co.uk/dynamics/velaccdiag.pdf>,

[http://ebooks.library.cornell.edu/k/moddl/pdf/013\\_005.pdf](http://ebooks.library.cornell.edu/k/moddl/pdf/013_005.pdf)

#### UNIT IV

GEARS: Higher pairs, friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Forms of tooth- cycloidal and involute profiles. Velocity of sliding – phenomena of interference – Methods to avoid interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact. Introduction to Helical, Bevel and worm gearing.

GEAR TRAINS: Introduction – Types of gears – Simple, compound, reverted and Epicyclic gear trains. Train value – Methods of finding train value or velocity ratio – Tabular column method for Epicyclic gear trains. Torque in epicyclic gear trains. Differential gear of an automobile.

**Learning outcome & Suggested Student Activities:**

After completion of this unit student are able to know gears terminology, types of gears, length of path of contact, contact ratio and interference in gears. Further students are also able to design the gears to avoid interference and to calculate train value for different gear trains. Students may go through text books given for more number of problems on gears and gear trains. Students may also refer the books authored by R.L. Norton and also by J.E. Shigley in addition to the textbooks for this unit to get more clarity on this unit. The following URLs will be highly useful to the students to understand various concepts of gears and gear trains [http://www.nptel.iitm.ac.in/courses/IIT-MADRAS/Machine\\_Design\\_II/pdf/2\\_1.pdf](http://www.nptel.iitm.ac.in/courses/IIT-MADRAS/Machine_Design_II/pdf/2_1.pdf), [http://vedyadhara.ignou.ac.in/wiki/images/e/e8/BME-020\\_B-3\(Unit\\_10\).pdf](http://vedyadhara.ignou.ac.in/wiki/images/e/e8/BME-020_B-3(Unit_10).pdf)

<http://www.youtube.com/watch?v=qLVwXZ2sS48>

#### UNIT V

CAMS: Definitions of cam and follower – uses – Types of followers and cams – Terminology. Types of follower motion - Uniform velocity – Simple harmonic motion and uniform acceleration. Maximum velocity and maximum acceleration during outward and return strokes. Drawing of cam profiles.

ANALYSIS OF MOTION OF FOLLOWERS: Tangent cam with roller follower – circular arc (Convex) cam with flat faced and roller follower.

**Learning outcome & Suggested Student Activities:**

After completion of this unit the students are able to draw displacement diagram and cam profile for different types of motions of the follower. And also to find the displacement, velocity and acceleration of the follower at different positions of cam with specified contours. The following URLs will be highly useful to the students to understand various concepts of drawing the cam profile for different followers. <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-Delhi/Kinematics%20of%20Machine/site/coursecontent/cntmod10.htm>, <http://www.youtube.com/watch?v=UpS8OjdXSow>

<http://www.youtube.com/watch?v=UpS8OjdXSow>

**Text Books:**

1. *Theory of Machines*, S.S. Rattan, Tata McGraw Hill Publishers, 3<sup>rd</sup> Edition, 2013.
2. *Kinematics and dynamics of machinery*, R.L Norton, Tata McGraw Hill Publishers, 1<sup>st</sup> Edition, 2009.

**Reference Books:**

1. *Theory of Machines and Mechanisms*, 3<sup>rd</sup> Edition, J.E. Shigley et. al, Oxford International Student Edition.
2. *Theory of Machines*, Thomas Bevan, Pearson (P) 3<sup>rd</sup> Edition, 2012.

**NOTE :** Exam should be conducted in Drawing Hall

**Suggestions:**

Students may visit nearby machine tool shops and automobile workshops to know about different mechanisms, gears, gear trains, flexible drives and cams. Students are suggested to search the web and identify different URLs which provide animations of mechanisms for better visualization and understanding purpose.

**WEB References:**

<http://nptel.iitk.ac.in>

<http://ptumech.loremate.com/tom1/node/1>

<http://www.youtube.com/watch?v=6coD3oOuhr8>

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. II - II Sem.

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(13A03402) THERMAL ENGINEERING – I

**Course Objective:**

The objective of this subject is to impart the knowledge of engine components, working principles of IC engines, auxiliary systems, the combustion aspects of SI and CI engines in addition to the methods of improving performance. The students shall become aware on the latest developments in the field of IC engines like MPFI, CRDI etc. and also shall become familiar about the working of Reciprocating and Rotary Compressors. The student also shall apply the thermodynamic concepts in IC engines and compressors.

**UNIT I**

I.C. ENGINES: Definition of Engine And Heat Engine, I.C Engine Classification – Parts of I.C.Engines, Working of I.C. Engines, Two Stroke & Four Stroke I.C.Engines SI & CI Engines, Valve and Port Timing Diagrams.

**Learning Outcome & Suggested Student Activities:**

After completion of the unit, student can know working of both S.I and C.I engines with the help of indicator diagrams. Student can differentiate the working of 2-S and 4-S engines and also can draw valve and port timing diagrams. Student can know applications of IC engine in the automobile industry. Students are advised to visit nearby automobile service center/station and engines laboratory for knowing the various engines and engine components. Student can also see various types of engines fitted to two wheelers, four wheelers, and diesel power plants. The following URLs will be highly useful to the students to understand various aspects of I.C.Engines <http://www.youtube.com/watch?v=XfJvRTOP3M>, [http://www.youtube.com/watch?v=MNrVYG\\_NdD4](http://www.youtube.com/watch?v=MNrVYG_NdD4), [http://www.youtube.com/watch?v=W8oWq2Iv\\_W4](http://www.youtube.com/watch?v=W8oWq2Iv_W4), [www.youtube.com/user/Techtrixinfo](http://www.youtube.com/user/Techtrixinfo).

**UNIT II**

Fuel System: S.I. Engine: Fuel Supply Systems, carburetor types Air Filters, Mechanical and Electrical Fuel Pump – Filters– Gasoline Injection Systems..

Cooling & Lubrication Systems: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo Siphon, Water And Forced Circulation System; Lubrication Systems-Flash, Pressurized and Mist Lubrication.

Ignition System: Function Of An Ignition System, Battery coil Ignition System, Magneto Coil Ignition System, Electronic Ignition System using Contact Breaker, Electronic Ignition using Contact Triggers – Spark Advance And Retard Mechanism.

**Learning Outcome & Suggested Student Activities:**

Student can understand the fuel supply systems, cooling, lubrication and ignition systems. Student can understand how auxiliary systems play key role in increasing the performance of an I.C engine.

Student is advised to visit nearby automobile service center/station for getting practical knowledge about various auxiliary systems. Student can find the radiator (air cooling and water cooling) in front of heavy vehicles and stationary engines and air cooling for two wheelers and three wheelers.

The following URLs will be highly useful to the students to understand various aspects of fuel supply systems, filters, cooling, lubrication systems and Ignition systems.

<http://www.youtube.com/watch?v=ksG4ypoMEaM>; <http://www.youtube.com/watch?v=LwrL-Cn9HT8>; [http://www.youtube.com/watch?v=O\\_Y3dM8ZApo](http://www.youtube.com/watch?v=O_Y3dM8ZApo); <http://www.youtube.com/watch?v=mmmj53TNic>

**UNIT III**

Fuels and Combustion:

S I engine :Normal Combustion and Abnormal Combustion – Importance of Flame Speed and Effect of Engine Variables – Type of Abnormal Combustion, Pre-Ignition and Knocking (Explanation) – Fuel Requirements and Fuel Rating, Anti Knock Additives, Combustion Chambers.



C.I. Engines: Stages Of Combustion – Delay Period And Its Importance – Effect Of Engine Variables – Diesel Knock– Combustion Chambers (DI And IDI), Fuel Requirements And Fuel Rating.

**Learning Outcome & Suggested Student Activities:**

Student can understand the flame propagation inside the cylinder, stages of combustion in S.I and C.I engines. Student can understand the knocking phenomenon. Student can know about Octane number and Cetane number of fuels and properties of fuel. Combustion Process is very typical process practically students can't see but student can understand the combustion process by visiting following URLs.

Students are suggested to know various losses occurred through combustion chamber, at least theoretically.

<http://www.youtube.com/watch?v=ep1NhANcCL4>; <http://www.youtube.com/watch?v=pqa4zCo4erY>

**UNIT IV**

Testing and Performance : Parameters of Performance - Measurement of Cylinder Pressure, Fuel Consumption, Air Intake, Exhaust Gas Composition, Brake Power – Determination of Frictional Losses And Indicated Power – Performance Test – Heat Balance Sheet and Chart.

**Learning Outcome & Suggested Student Activities:**

Student can be familiar with indicated power, brake power and friction power and their methods of measurement. Student can understand the methods to increase the engine performance. Also, student can know calculating specific fuel consumption, A/F ratio and mean effective pressure and estimating heat losses etc. Students are advised to visit heat engines laboratory for analyzing the effect of various parameters on engine performance.

To better understand the above following URLs are useful.

<http://web.iitd.ac.in/~ravimr/courses/mel345/ignou-notes.pdf>;

**UNIT V**

Air Compressors: Reciprocating Compressors, Effect of Clearance volume in Compressors, Volumetric Efficiency, Single Stage and Multi Stage Compressors, Effect of Inter cooling and Pressure Drop in Multi - Stage Compressors, Problems Related to Reciprocating Compressors, Working principles of Roots blower, Vane type Blower, Centrifugal Compressor - Axial Flow Compressors.

**Learning Outcome & Suggested Student Activities:**

Student can differentiate the working of reciprocating and rotary air compressors. Student can calculate work done by single and multistage reciprocating air compressors. Student can understand how intercooling reduces the work done / kg of air.

To gain further practical knowledge students are advised to visit laboratory/automobile workshop to see different types of compressors. The following URLs will be highly useful to the students to understand the air compressors.

<http://www.usstudy.in/node/5106> ; <http://www.youtube.com/watch?v=Ue7BkzBARXw>

<http://www.youtube.com/watch?v=6zYHUXSG3HE>; <http://www.youtube.com/watch?v=OuK6nGibFqY>

**Students are advised to refer the text book of “Internal Combustion Engine Fundamentals” by John B. Heywood.**

**Text Books:**

1. *Internal Combustion Engines* / V. Ganesan- TMH, 4<sup>th</sup> Edition, 2012
2. *Thermal Engineering* / Rajput / Lakshmi Publications, 9<sup>th</sup> Edition, 2013

**Reference Books:**

1. *IC Engines – Mathur & Sharma – Dhanpath Rai & Sons, , 2010*
2. *Engineering fundamentals of IC Engines – Pulkrabek, Pearson, PHI, 2<sup>nd</sup> Edition, 2009*
3. *Thermal Engineering, Rudramoorthy – TMH, 10<sup>th</sup> Edition, 2010*
4. *Thermodynamics & Heat Engines, B. Yadav, Central publishing house., Allahabad, 2002*
5. *I.C. Engines fundamentals, Heywood, McGrawHill, 1<sup>st</sup> Edition, 2011*
6. *Thermal Engineering – R.S. Khurmi & J.K. Gupta – S.Chand, 15<sup>th</sup> Edition, 2012*

**WEB Resources:**

<http://autoclub.rso.siuc.edu/frange.html>

<http://www.howstuffworks.com/engine1.htm>

<http://inventors.about.com/library/inventors/blinternalcombustion.htm> <http://www.animatedengines.com/>



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. II - II Sem.

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3	1	3

(13A01408) MECHANICS OF FLUIDS

**Course Objective:**

*In essence, this course introduces the fundamentals of fluid mechanics for engineers. The emphasis is on basis of fluid statics and fluid motion with application in a variety of engineering fields. This subject will introduce to study the various fluid properties and their significance in engineering problems and the basic concepts of fluid flow, both kinematics and dynamics, including the derivation of equation needed for the analysis of fluid flow problems. Students shall become familiar on different types of flow in pipes, theory of boundary layer, derivation of the equations associated with it and fundamentals of forces on submerged bodies like drag and lift and their significance.*

**UNIT I**

**FLUID STATICS:** Dimensions and units, physical properties of fluids – mass density, specific weight, specific gravity, viscosity, surface tension, vapor pressure, compressibility, elasticity and their influence on fluid motion – atmospheric, gauge and vacuum pressure, measurement of pressure – piezometer, U-tube and differential manometers – hydro static forces on plane and curved surfaces.

**Learning Outcome & Suggested Student Activities:**

*At the end of this unit the student shall learn the fundamental fluid properties and their engineering significance. The student is able to differentiate between different pressures and study the methods of fluid pressure measurement. Calculation of forces on different surfaces is also known to the student.*

*The students are advised to visit the following websites for video lectures on these topics*

*<http://nptel.iitm.ac.in/courses> <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv078-Page1.htm>*

**UNIT II**

**FLUID KINEMATICS:** Introduction – velocity and acceleration - Stream line, path line and streak line - stream tube - classification of flows – equation of continuity for one dimensional flow and three dimensional flow – circulation and vorticity – velocity potential and stream function – flow net.

**FLUID DYNAMICS:** Surface and body forces – Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend.

**Learning Outcome & Suggested Student Activities:**

*At the end of this unit the student shall have basic idea about the fundamentals of fluid flow and its description. The student is exposed to the fundamental equations, used in the analysis of fluid flow problems like continuity, energy and momentum equations.*

*The students are advised to visit the following websites for video lectures on these topics*

*<http://nptel.iitm.ac.in/courses/105101082/> <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv078-Page1.htm>*

**UNIT III**

**PIPE FLOW:** Reynold's experiment – types of flow - Darcy Weisbach equation – Hagen Poiseuille equation Minor losses in pipes – pipes in series and pipes in parallel – total energy line hydraulic gradient line.

**MEASUREMENT OF FLOW:** Velocity measurement - Pitot tube, venturi meter, and orifice meter, Flow nozzle, Turbine flow meter – flow through orifices and mouth pieces – notches and weirs

**Learning Outcome & Suggested Student Activities:**

*At the end of this unit the student shall know the different types of pipe flow and the conditions governing them. Equations related to different flows are derived and the student gets to understand the working of the different devices used for measurement of fluid flow under different conditions.*

*The students shall browse the following websites for video lectures on these*

*topics <http://nptel.iitm.ac.in/courses/105101082/> <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv078-Page1.htm>*

## UNIT IV

Boundary Layer Theory: Boundary gap layer – definition – growth over a flat plate – boundary layer thickness – nominal, displacement, momentum and energy thickness – laminar sub layer –Momentum integral equation of boundary layer - separation of boundary layer- methods of controlling the boundary layer.

### **Learning Outcome & Suggested Student Activities:**

*At the end of this unit the student shall have understanding of the boundary layer and its significance along with the various concepts of boundary layer like its growth, thickness and separation. The student is able to appreciate the engineering significance of the boundary layer in this unit.*

*The students are advised to visit the following websites for video lectures on these topics*

*<http://nptel.iitm.ac.in/courses/105101082/> <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv078-Page1.htm>*

## UNIT V

**FORCES ON SUBMERGED BODIES:** Introduction – types of drag – drag on a sphere – drag on a cylinder – drag on flat plate – drag on airfoil – effect of compressibility on drag – development of lift on circular cylinder – Magnus effect – lift on an airfoil.

### **Learning Outcome & Suggested Student Activities:**

*At the end of this unit the student shall be able to learn about the importance of the forces exerted by the fluid on the body and vice versa. These concepts will be helpful to the student in understanding the effect of these forces on flatplate, sphere, cylinder and airfoil. The student is also exposed to engineering applications of the concepts of drag and lift*

*The students are advised to visit the following websites for video lectures on these topics*

*<http://nptel.iitm.ac.in/courses/105101082/> <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv078-Page1.htm>*

### **Text Books:**

1. *Hydraulics, fluid mechanics including hydraulic machines by Modi and Seth, Standard Publishers, 19<sup>th</sup> Edition,2013*
2. *Fluid Mechanics and Fluid Power Engineering by D. S. Kumar, Kotaria& Sons, 7<sup>th</sup> Edition,2011*

### **Reference Books:**

1. *Fluid Mechanics and hydraulic Machines by R.K. Bansal, Laxmi Publications,9<sup>th</sup> Edition,2010*
2. *Fluid Mechanics and Hydraulic Machines by R.K. Rajput, S.Chand,5<sup>th</sup> Edition,2013*
3. *Fluid Mechanics and Machinery by D. Rama Durgaiyah, New Age International, 1<sup>st</sup> Edition*
4. *Hydraulic Machines by Banga& Sharma, Khanna Publishers, 7<sup>th</sup> Edition,2007*
5. *Instrumentation for Engineering Measurements by James W. Dally, William E. Riley, John Wiley & Sons Inc. 2004 (Chapter 12 – Fluid Flow Measurements), 2<sup>nd</sup> Edition.*

### **Suggestions:**

1. *The students are advised to buy a text book, he/she may go in for Modi & Seth which covers the syllabus prescribed completely and effectively.*
2. *Students are supposed to have basic knowledge of calculus to grasp the various concepts of the subject.*
3. *Students are advised to solve as many numerical problems as possible to understand and apply the various concepts related to fluid flow. For this, student may refer to text books, by R.K. Bansal and R.K. Rajput.*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. II - II Sem.

Th 3  
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C 3

(13A03403) MANUFACTURING TECHNOLOGY

**Course Objective:**

*By this subject the students will understand how manufacturers use technology to change raw materials into finished products. The students shall also introduce the basic concepts of casting, pattern preparation, gating system and knowledge on basic features of various welding and cutting processes. And also to study the concepts of surface treatment process, their characteristics and applications*

**UNIT I**

**CASTING:** Definition, elements, Steps involved in making a casting– Types of patterns - Patterns and Pattern making — Materials used for patterns, pattern allowances and their Construction. Principles of Gating, Gating ratio and design of Gating systems, time of filling the cavity. Design of core prints, buoyancy principle. Moulds: definition, mould materials, types of moulds, moulding methods, moulding machines, tests. Solidification of casting – Concept – Solidification of pure metal and alloys, short & long freezing range alloys.

**Learning Outcome & Suggested Student Activities:**

*Students can understand the elements of casting, construction of patterns and gating systems, moulds, methods of moulding, moulding machines and solidification of castings of various metals. Students are advised to visit URLs <http://www.nptel.iitm.ac.in/> and [iitr.ac.in](http://iitr.ac.in), [www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm](http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm).*

**UNIT II**

**SPECIAL CASTING PROCESSES:** Process Mechanics, characteristics, parameters and applications of Centrifugal, Die, and Investment casting.

**RISERS** – Types, function and design, casting design considerations, Design of feeding systems i.e., sprue, runner, gate and riser, moulding flasks

**METHODS OF MELTING:** Crucible melting and cupola operation, steel making processes. Casting inspection and defects

**Learning Outcome & Suggested Student Activities:**

*Students can understand the different types of special casting methods and their applications, design of risers and feeding systems, crucible melting, cupola operation and steel making process. The students may also be able to design a casting process on his own. The students are also advised to visit a Casting Industry nearby to get practical exposure.*

**UNIT III**

A) **WELDING** : Classification of welding processes types of welds and welded joints and their characteristics, design of welded joints, Gas welding, ARC welding, Forge welding, resistance welding, Thermit welding and Plasma (Air and water ) welding.

B) **CUTTING OF METALS:** Oxy – Acetylene Gas cutting, water plasma. Cutting of ferrous, non-ferrous metals

**Learning Outcome & Suggested Student Activities:**

*Students can understand the different types of welding processes, welds and weld joints, their characteristics, cutting of ferrous and non-ferrous metals by various methods. The students are advised to visit nearby welding shop for better understanding of welding process.*

**UNIT IV**

Mechanics, characteristics, process parameters, applications of Inert Gas welding, TIG & MIG welding, Friction welding, Induction welding, Explosive welding, Laser welding, Soldering & Brazing and adhesive bonding. Heat affected zones in welding; welding defects – causes and remedies – destructive and nondestructive testing of welds

**Learning Outcome & Suggested Student Activities:**

Students can understand about advanced welding process, heataffected zone(HAZ), Defects and Identification Methods. The students are advised to visit nearby welding shop and MFT Lab in the college.

**UNIT V**

**SURFACE ENGINEERING:** Surface treatment processes and their characteristics and applications. (a) Overlay coatings (b) Diffusion coatings (c) Thermal or mechanical modification of surfaces

**Learning Outcome & Suggested Student Activities:**

Students can understand the various surface treatment processes. Student is advised to visit the nearby surface coating industry.

**Text Books:**

1. *Manufacturing Technology, Vol I P.N. Rao, Tata Mc Graw Hill, 4<sup>th</sup> Edition, 2013*
2. *Manufacturing Technology, Kalpakjain, Pearson education, 4<sup>th</sup> Edition, 2002*

**Reference Books:**

1. *Production Technology, K.L Narayana, I.K. International Pub, 3<sup>rd</sup> Edition, 2013*
2. *Manufacturing Process Vol. I, H.S.Shah Pearson, 2013,*
3. *Principles of Metal Castings, Rosenthal, Tata Mc Graw Hill ,2<sup>nd</sup> Edition, 2001*
4. *Welding Process, Parmar.*
5. *Manufacturing Technology, R.K. Rajput, Laxmi Pub, 1<sup>st</sup> Edition, 2007*
6. *Workshop Technology – B.S.RaghuVamshi – Vol I.*

**WEB References:**

NPTEL Lectures

[http://teacher.buet.ac.bd/shabnam/14250\\_ch3.pdf](http://teacher.buet.ac.bd/shabnam/14250_ch3.pdf) [http://me.emu.edu.tr/majid/MENG364/2\\_casting.pdf](http://me.emu.edu.tr/majid/MENG364/2_casting.pdf)

<http://en.wikipedia.org/wiki/Metalworking>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. II – II Sem.**

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**(13A03404) THERMAL ENGINEERING LAB**

1. Valve / Port Timing Diagrams of an I.C. Engines
2. Performance Test on a 4 -Stroke Diesel Engines
3. Performance Test on 2-Stroke Petrol engine
4. Evaluation of Engine friction by conducting Morse test on 4-Stroke Multi cylinder Engine
5. Retardation and motoring test on 4- stroke engine
6. Heat Balance of an I.C. Engine.
7. Air/Fuel Ratio and Volumetric Efficiency of an I.C. Engines.
8. Performance Test on Variable Compression Ratio Engines, economical speed test.
9. Performance Test on Reciprocating Air – Compressor Unit
10. Study of Boilers
11. Dismantling / Assembly of Engines to identify the parts and their position in an engine.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. II - II Sem.**

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**(13A03405) MANUFACTURING TECHNOLOGY LAB**

**Minimum of 12 Exercises need to be performed**

**I. METAL CASTING LAB:**

- a. Pattern Design and making - for one casting drawing.
- b. Sand properties testing - Exercise -for strengths, and permeability – 1
- c. Moulding: Melting and Casting - 1 Exercise

**II. WELDING LAB:**

- a. Arc Welding: Lap & Butt Joint - 2 Exercises
- b. Spot Welding - 1 Exercise
- c. TIG Welding - 1 Exercise
- d. Plasma welding and Brazing - 2 Exercises (Water Plasma Device)

**III. MECHANICAL PRESS WORKING:**

- a. Blanking & Piercing operation and study of simple, compound and progressive press tool.
- b. Hydraulic Press: Deep drawing and extrusion operation.
- c. Bending and other operations

**IV. PROCESSING OF PLASTICS:**

- a. Injection Moulding
- b. Blow Moulding

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. III-I Sem.**

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**(13A03501) HYDRAULIC MACHINERY**

**Course Objective:**

*The aim of this course is to make the students familiar with the different components of a hydroelectric power plant and understand the basic concepts of power production using energy of water along with estimation of potential of power generation. And also to make the students to study the working of hydraulic machines, their features of design and working proportions.*

**UNIT I**

**HYDROELECTRIC POWER STATIONS:** Elements of hydro electric power station – types – concept of pumped storage plants – storage requirements, mass curve (explanation only) estimation of power developed from a given catchment area; heads and efficiencies.

**Learning Outcome & Suggested Student Activities:**

*At the end of this unit the student shall have an overview of different aspects of hydro power generation. The student gets an idea about the different types of power plant and estimation of power that can be generated from these plants besides the study of different heads and efficiencies.*

*The students are advised to visit the following websites for video lectures on these topics*  
<http://nptel.iitm.ac.in/courses/105101082/>; <http://ga.water.usgs.gov/edu/hyhowworks.html>

**UNIT II**

**BASICS OF TURBO MACHINERY:** Hydrodynamic force of jets on stationary and moving flat, inclined, curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

**Learning Outcome & Suggested Student Activities:**

*At the end of this unit the student shall learn about the different cases of impact and the work done in all these cases. The student shall be able to draw the velocity triangles and analyse the same to arrive at the required quantities. Different cases of flow are made known to the student.*

*The students are advised to visit the following websites for video lectures on these topics*  
<http://nptel.iitm.ac.in/courses/105101082/>; <http://ga.water.usgs.gov/edu/hyhowworks.html>

**UNIT III**

**HYDRAULIC TURBINES:** Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine – working proportions, work done, efficiencies, hydraulic design – draft tube theory – functions and efficiency.

**Learning Outcome & Suggested Student Activities:**

*At the end of this unit the student shall be able to understand the features and working of different hydraulic turbines and their use. The student is also exposed to the aspects of hydraulic design of the turbines along with the calculation of various quantities like work done and efficiency. The students are advised to visit the following websites for video lectures on these topics*

<http://nptel.iitm.ac.in/courses/105101082/>; [http://www.youtube.com/watch?v=vwXUZf4lvGw&feature=player\\_detailpage](http://www.youtube.com/watch?v=vwXUZf4lvGw&feature=player_detailpage)

**UNIT IV**

**PERFORMANCE OF HYDRAULIC TURBINES:** Geometric similarity - unit quantities – performance under specific conditions – specific speed - characteristic curves - Governing of turbines - Selection of type of turbine – model testing of turbines – cavitation - surge tank - water hammer.

**Learning Outcome & Suggested Student Activities:**

*At the end of this unit the student shall know about the evaluation of the performance of the various hydraulic turbines. The student shall also have idea about the calculation of different quantities used for predicting the behavior and performance of turbines besides knowing the importance of different effects of cavitation and water hammer. The students are advised to visit the following websites for video lectures on these topics*



<http://nptel.iitm.ac.in/courses/105101082/> <http://www.mech.uq.edu.au/courses/mech7350/lecture-notes-in-pdf/mech7350-10-hydraulic-turbines.pdf>

## UNIT V

PUMPS-Centrifugal pumps: Classification, working, work done – manometric head – losses and efficiencies specific speed – pumps in series and parallel - performance – characteristic curves, NPSH. Reciprocating pumps: Working, Discharge, slip, indicator diagrams.

### **Learning Outcome & Suggested Student Activities:**

*At the end of this unit the student shall have an opportunity to understand the various types and purposes of hydraulic machines (pumps). The student is exposed to different types of pumps, their working and applications. This makes the student capable of selecting the suitable pump according to the requirement.*

*The students are advised to visit the following websites for video lectures on these topics*  
<http://nptel.iitm.ac.in/courses/105101082/>; [http://www.youtube.com/watch?v=FENCiA-EfaA&feature=player\\_detailpage](http://www.youtube.com/watch?v=FENCiA-EfaA&feature=player_detailpage)

### **Text Books:**

1. *Hydraulics, fluid mechanics and hydraulic machinery* by Modi and Seth, Standard Publishers, 19<sup>th</sup> Edition, 2013.
2. *Fluid Mechanics and Hydraulic Machines* by R.K Rajput. 5<sup>th</sup> Edition, 2013.

### **Reference Books:**

1. *Fluid Mechanics and Hydraulic Machinery* by R.K. Bansal, Laxmi Publicaitons (P) Ltd. 9<sup>th</sup> Edition, 2012.
2. *Fluid Mechanics and Machinery* by D. Rama Durgalah, New Age International. 1<sup>st</sup> Edition,
3. *Hydraulic Machines* by Banga & Sharma, Khanna Publishers.  
Jagadish Lal, Hydraulic Machines, Metropolitan Book Company Pvt. Ltd.

### **Suggestions:**

1. *Students are advised to buy a text book, he/she may go in for Modi & Seth which covers the syllabus prescribed completely and effectively.*
2. *Students are supposed to have prerequisite knowledge of various equations of fluid flow*
3. *Students are advised to practice the solution of the different cases of problems involving velocity triangles. For this, student may refer to text books, by R.K. Bansal and R.K. Rajput.*
4. *Students are advised to visit hydal power plant*



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. III-I Sem.

Th 3  
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(13A03502) THERMAL ENGINEERING – II

**Course Objective:**

*This subject is designed to provide a sound knowledge in various aspects of thermal equipments. This subject has an increasingly dominant role to play in the vital areas of power generation, Automobiles, R&AC and energy sector. The course contents aims at developing the necessary analytical and technical contents among engineers in these areas. The students shall become familiar with steam power plant, boilers, function of nozzle, gas turbines and jet propulsions.*

**UNIT I**

**BASIC CONCEPTS:** Rankine Cycle - Schematic Layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat Addition, Methods to Improve Cycle Performance – Regeneration – Reheating- Combined- Cycles.

**Learning Outcome & Suggested Student Activities:**

*Student can be able to illustrate the power generation through Rankine cycle. Student can able understand efficiency enhancement methods of Reheating and regeneration. Student can able to understand the key role of quality of steam after evaporation.*

*Students are advised to be acquainted with the terms related to steam, steam tables and mollierchart. Also, students are advised to visit the thermal power station to get real expose.*

**UNIT II**

**BOILERS:** Classification Based on Working Principles & Pressures of Operation - L.P & H.P. Boilers – Mountings and Accessories.

**DRAUGHT:** Classification – Height Of Chimney for Given Draught and Discharge, Condition for Maximum Discharge, Efficiency of Chimney – Artificial Draught, Induced and Forced Draught.

**Learning Outcome & Suggested Student Activities:**

*Student can able to understand the working of different high pressure and low pressure boilers. Student can distinguish mountings and accessories. The student can calculate the chimney height for maximum discharge. Student can know the draughts and its application in the steam generator. Students are advised to visit the Boilers in the power generation units to get better expose. And visit the following URLs will be highly useful to the students to understand various aspects of thermal power plants and boilers.*

*[https://www.youtube.com/watch?v=Ota2\\_LUuar0](https://www.youtube.com/watch?v=Ota2_LUuar0), <https://www.youtube.com/watch?v=8GSUgwombdE>*

**UNIT III**

**STEAM NOZZLES:** Function of Nozzle – Applications - Types, Flow through Nozzles, Thermodynamic Analysis – Assumptions - Velocity of Nozzle at Exit-Ideal And Actual Expansion in Nozzle, Velocity Coefficient, Condition for Maximum Discharge, Critical Pressure Ratio.

Criteria for Design of Nozzle Shape: Super Saturated Flow and its Effects, Degree of Super Saturation and Degree of Under Cooling - Wilson Line – Shock at The Exit.

**CONDENSERS:** Classification, Air Leakage Vacuum Efficiency, condenser efficiency, problems.

**Learning Outcome & Suggested Student Activities:**

*Student can be able to distinguish the ideal flow and actual flow through nozzle. Student can know the importance of maximum discharge through nozzle. Student can able to entail the concept of Critical pressure ratio in calculations. Student can able to understand the effect of meta stable flow/ super saturation flow through nozzle.*

*Students are advised to visit the thermal power stations to acquire the practical expose and visit URL <http://www.youtube.com/watch?v=cdUNmzcu2rA>*

## UNIT IV

**IMPULSE TURBINE:** Mechanical Details – Velocity Diagram – Effect of Friction – Power Developed, Axial Thrust Blade or Diagram Efficiency – Condition for Maximum Efficiency. De-Laval Turbine - Its Features. Methods To Reduce Rotor Speed - Velocity Compounding And Pressure Compounding, Velocity And Pressure Variation Along The Flow – Combined Velocity Diagram For A Velocity Compounded Impulse Turbine.

**REACTION TURBINE:** Mechanical Details – Principle of Operation, Thermodynamic Analysis of A Stage, Degree of Reaction –Velocity Diagram – Parson's Reaction Turbine – Condition for Maximum Efficiency.

### **Learning Outcome & Suggested Student Activities:**

*At the end of unit, student can able to distinguish the working of impulse and reaction turbines. Student can able to construct the velocity triangle and combined velocity triangle and can learn its importance in determining the power produced by the turbine. Student can know why to reduce the rotor speed and methods to reduce.*

*Students are advised to visit thermal power stations for better understanding the working of turbines. Students are suggested to participate in science exhibitions based on the concept of thermal power plants. Student is advised to visit following URLs*  
<http://www.youtube.com/watch?v=y2dOmpZgYW8&list=PLBD7B1EEF7CCB7D9D> ,  
[https://www.youtube.com/watch?v=1bl1Q3V\\_79I](https://www.youtube.com/watch?v=1bl1Q3V_79I)

## UNIT V

**GAS TURBINES:** Simple Gas Turbine Plant – Ideal Cycle, Essential Components – Parameters of Performance – Actual Cycle – Regeneration, Inter Cooling and Reheating – Closed And Semi-Closed Cycles – Merits and Demerits, Brief Concepts of Compressors, Combustion Chambers and Turbines used in Gas Turbine Plants

**JET PROPULSION:** Principle of Operation – Classification of Jet Propulsive Engines – Working Principles with Schematic Diagrams and Representation on T-S Diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo Jet, Turbo Prop, Pulse Jet Engines – Schematic Diagram, Thermodynamic Cycle. Introduction to Rocket Propulsion.

### **Learning Outcome & Suggested Student Activities:**

*After the study of the unit, Student can be familiar with the basic components of a gas turbine power plant. Student can illustrate the power generation using Joule Cycle. Student can know the methods to increase the specific power output and efficiency of the cycle. Also, Student can able to know the working of various propulsive devices. Student can aware of using thrust equations in solving problems. Students advised to visit Gas power generation plants.*

<http://www.youtube.com/watch?v=hnVWpOV5chs>, <http://www.youtube.com/watch?v=p1TqwAKwMuM> ,  
<http://www.youtube.com/watch?v=MUXP3PCDRTE>

### **Text Books:**

1. Thermal Engineering, R.K. Rajput, 9/e, Lakshmi Publications, 2013
2. Basic and Applied Thermodynamics, P.K. Nag, TMH, 2<sup>nd</sup> Edition, 2012.

### **Reference Books:**

1. Gas Turbines, V. Ganesan, TMH
2. Thermodynamics and Heat Engines, R.Yadav, Central Publishing House, Allahabad, 2002.
3. Gas Turbines and Propulsive Systems, P.Khajuria & S.P.Dubey, Dhanpatrai
4. Thermal Engineering, R.S Khurmi & JS Gupta, S.Chand, 2012.
5. Thermal Engineering-M.L.Mathur & F.S.Mehta, Jain bros, 2006.
6. Thermal Engineering Data Book, B.S. Reddy and K.H. Reddy, I.K. International, 2007.
7. Steam Tables SI Units- Dr.B.Umamaheswar Gowd and A. Nagraju, Siri Publ.

**NOTE:** Steam tables and Mollier charts to be supplied for exam.

### **Web References:**

<http://www.iscid.org/encyclopedia/Tthermodynamics>. <http://www.transtutors.com/>

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. III-I Sem.

Th 3  
Tu 1  
C 3

(13A03503) DYNAMICS OF MACHINERY

**Course objective:**

To understand the method of static force analysis and dynamic force analysis of mechanism, undesirable effects of unbalance in rotors and engines. To understand the concept of vibratory systems and their analysis and also the principles of governors.

**UNIT I**

FRICITION: Inclined plane, friction of screws and nuts, pivot and collar, uniform pressure, uniform wear. Friction circle and friction axis, lubricated surfaces, boundary friction, film lubrication.

CLUTCHES: Friction clutches- Single Disc or plate clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch.

BRAKES AND DYNAMOMETERS: Simple block brakes, Band brake, internal expanding brake, braking of vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to understand the basic concepts of friction in pivots and collars with uniform pressure and uniform wear, and also to solve the numerical problems on brakes, clutches and dynamometers.

Students may go through text books given for more number of problems on friction, brakes and clutches. The following URLs will be highly useful to the students to understand various concepts of friction and its application.

<http://nptel.iitm.ac.in/video.php?subjectId=112104121>, <http://www.youtube.com/watch?v=FA04XFpJgwE>

**UNIT II**

PRECESSION: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aeroplanes and ships.

TURNING MOMENT DIAGRAMS AND FLY WHEELS: Turning moment diagrams for steam engine, IC Engine and multi cylinder engine. Crank effort - coefficient of Fluctuation of energy, coefficient of Fluctuation of speed – Fly wheels and their design, Fly wheels for Punching machines.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students can apply gyroscopic principles on Aeroplane, ship, four wheel and two wheel vehicles. Students are able to design a flywheel for IC engine. Students may go through text books given for more number of problems on gyroscopic effects and flywheels. The following URLs will be highly useful to the students to understand various concepts of gyroscopic couple and turning moment diagrams.

<http://www.youtube.com/watch?v=FydJu1A1oeM&list=PL46AAEDA6ABAFCA78&index=7>

<http://www.youtube.com/watch?v=swgvKwyOnYk&list=PL46AAEDA6ABAFCA78&index=16>

**UNIT III**

GOVERNORS: Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung governors with auxiliary springs. Sensitiveness, isochronism and hunting. Effort and power of a governor.

**Learning outcome & Suggested Student Activities:**

The outcome of this unit is to study the basics and definitions related to governors and forces acting on various governors. After completion of this unit students are able to solve numerical problems on different governors.

Students may go through text books given for more number of problems on governors. The following URLs will be highly useful to the students to understand various concepts on governors.

<http://nptel.iitm.ac.in/video.php?subjectId=112104121>, <http://www.youtube.com/watch?v=OG1AiaNTT6s>

## UNIT IV

**BALANCING:** Balancing of rotating masses - single and multiple – single and different planes.

**BALANCING OF RECIPROCATING MASSES:** Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples – V-engine, multi cylinder in-line and radial engines for primary and secondary balancing.

### **Learning outcome & Suggested Student Activities:**

*After completion of this unit students can solve numerical problems on balancing of rotating masses and reciprocating masses in V-engine and multi cylinder engines.*

*Students may go through text books given for more number of problems on balancing of rotating masses and balancing of reciprocating masses in locomotives and IC engines. The following URLs will be highly useful to the students to understand various concepts of balancing of masses.*

*<http://www.youtube.com/watch?v=aRulDXMuNDc&list=PL46AAEDA6ABAFCA78&index=8>*

*<http://nptel.iitm.ac.in/video.php?subjectId=112104121>*

## UNIT V

**VIBRATION:** Free and forced vibration of single degree of freedom system, Role of damping, whirling of shafts and critical speeds. Simple problems on free, forced and damped vibrations. Vibration Isolation & Transmissibility. Transverse vibrations of beams with concentrated and distributed loads. Dunkerly's method, Raleigh's method. Torsional vibrations - two and three rotor systems.

### **Learning outcome & Suggested Student Activities:**

*Upon completion of this unit, the student will perform detailed analysis of the response of one degree of freedom systems with free and forced vibrations, evaluate the critical speed of the shaft and simple vibration calculations of rotor systems. Students may go through text books given for more number of problems on single degree of freedom system, transverse and torsional vibrations. The following URLs will be highly useful to the students to understand various concepts on vibrations.*

*<http://nptel.iitm.ac.in/video.php?subjectId=112104121>*

*<http://www.youtube.com/watch?v=irudCaBrij0&list=PL46AAEDA6ABAFCA78&index=30>*

### **Text Books:**

1. *Theory of Machines, S.S. Rattan, MGH Publishers, 3<sup>rd</sup> Edition, 2013.*
2. *Kinematics and Dynamics of Machinery R.L. Norton, Tata McGraw Hill.*

### **Reference Books:**

1. *Theory of Machines, Thomas Bevan, Pearson, 3<sup>rd</sup> Edition, 2012.*
2. *The theory of Machines, J.E. Shigley, McGraw Hill .*
3. *Theory of Machines and Mechanisms of Shigley et.al. Oxford International Student Edition.*

**NOTE:** End Exam Should be conducted in Drawing Hall

### **Suggestions:**

*Students may visit near by machine tool shops and automobile work shops to know about clutches, bearings, brakes, dynamometers, flywheel, centrifugal governors and balancing equipment like wheel balancing. Students are suggested to search the web and identify different URLs which provide animations of mechanisms for better visualization and understanding purpose.*

### **Web References:**

*Machine Dynamics by Prof. Amitabha Ghosh, IITK, Kanpur - <http://nptel.iitm.ac.in/video.php?subjectId=112104114>*

*Machine Dynamics by Prof. C. Amarnath, Prof. K. Kurien Issac, Prof. P. Seshu of IITB, Mumbai <http://www.cdeep.iitb.ac.in/nptel/Mechanical/Dynamics%20of%20Machines/TOC.html>*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. III-I Sem.

Th 3  
Tu 1  
C 3

(13A03504) METAL FORMING PROCESSES

**Course Objective:**

*Metal forming processes are highly non linear because they involve geometric, material and contact non linearity. And so this subject introduce the concepts of one, two and three dimensional stress analysis, theory of plasticity, strain hardening, hot and cold working process. The students also will get the awareness on various types of rolling mills, forgings, extrusions, wire drawing processes, sheet metal operations, concepts on plastic manufacturing processes and rapid manufacturing process and its applications.*

**UNIT 1**

Stress, strain, Two dimensional stress analysis and three dimensional stress analysis, relation between engineering stress and true stress, relation between engineering strain and true strain, yield criteria, yield locus, theory of plasticity, Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth, Comparison of properties of Cold and Hot worked parts

**Learning Outcome & Suggested Student Activities:**

*Students can understand the basic concept on one, two and three dimensional stress analysis, theory of plasticity, strain hardening, hot and cold working process. The students are advised to visit the URLs <http://www.nptel.iitm.ac.in/iitkgp.ac.in>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm>.*

**UNIT II**

ROLLING: Bulk deformation processes – Economics of bulk forming, principles and theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements, applications and limitations, defects in rolled products – machinery and Equipment.

FORGING PROCESSES: Principles of forging -Types Forging – Smith forging, Drop Forging – Roll forging – Forging hammers: Rotary forging – forging defects, Forces in forging of strip, disc and power requirements, applications, Equipment and their selection.

**Learning Outcome & Suggested Student Activities:**

*Students can understand the principles of rolling and forging processes, their applications and defects. The students are advised to visit URLs <http://www.nptel.iitm.ac.in/iitkgp.ac.in>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm>*

**UNIT III**

EXTRUSION PROCESSES: Basic extrusion process and its characteristics. Mechanics of hot and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion Hydrostatic extrusion, forces in extrusion of cylindrical and non cylindrical components – characteristics and defects in extruded parts. Wire Drawing: Process Mechanics and its characteristics, determination of degree of drawing, drawing force, power, and number of stages-defects in products.

**Learning Outcome & Suggested Student Activities:**

*Students can understand the fundamentals of extrusion process and wire drawing processes and their industrial applications. The students are advised to visit the URLs <http://www.nptel.iitm.ac.in/iitkgp.ac.in>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm>.*

**UNIT IV**

Sheet Metal Working – Economical Considerations - Stamping, forming and other cold working processes: Blanking and piercing – Bending and forming – Drawing and its types – Cup drawing and Tube drawing – coining – Hot and cold spinning. Force and power requirement in sheet metal operations, defects in sheet metal products – Equipment, tooling and their characteristics.

***Learning Outcome & Suggested Student Activities:***

Students can understand the various press working processes, their advantages and disadvantages. The students are advised to refer the text book Workshop Technology by *Hajra Choudhary*. ***Students are advised to visit nearby sheet metal works industries.***

**UNIT V**

Processing of plastics, injection and blow moulding, calendaring, thermo forming, compression moulding, transfer moulding, High energy rate forming methods Rapid manufacturing: - Introduction – concepts of rapid manufacturing, information flow for rapid prototyping, classification of rapid prototyping process, stereolithography fused deposition modeling, selective laser sintering, Applications of rapid prototyping process

***Learning Outcome & Suggested Student Activities:***

Students can understand the concept of plastic manufacturing process, rapid manufacturing process and its applications. Students are advised to visit the following URLs <http://www.nptel.iitm.ac.in/iitkgp.ac.in>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm>.

***Text Books:***

1. *Manufacturing Technology, Schmid and Kalpakjian, Pearson Education.*
2. *Manufacturing Technology, Foundry forming and welding, Vol I, P.N. Rao, TMH*

***Reference Books:***

1. *Production Technology, R.K. Jain, Khanna Publishers, 17<sup>th</sup> edition, 2012*
2. *Process and materials of manufacturing – Lindberg, PE*
3. *Principles of Metal Castings, Rosenthal,*
4. *Welding Process, Parmar*
5. *Manufacturing Technology, R.K. Rajput, Laxmi Pub*
6. *Rapid Prototyping Principles and Applications, Rafiq Noorani, Wiley Pub.*

***Web Resources:***

[www.casde.iitb.ac.in/store/events/2003/IAT-Pune.../DFMA.ppt](http://www.casde.iitb.ac.in/store/events/2003/IAT-Pune.../DFMA.ppt)  
[www.rose-hulman.edu/~stienstr/ME470/DFA.ppt](http://www.rose-hulman.edu/~stienstr/ME470/DFA.ppt)  
[www.design4manufacturability.com/DFM\\_article.htm](http://www.design4manufacturability.com/DFM_article.htm)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. III-I Sem.

Th 3  
Tu 1  
C 3

(13A03505) DESIGN OF MACHINE MEMBERS – I

**Course Objective:**

The primary objective of this course is to demonstrate how engineering design is used for many principles learned in previous engineering science courses and to show how these principles are practically applied. This subject will help to the students to learn to analyze and design basic machine elements in mechanical systems. By this subject students will become familiar on design principles, materials selection, stresses developed in machine elements under different loads. The students will also get knowledge on design of the permanent and temporary joints, shafts and keys.

**UNIT I**

INTRODUCTION: General considerations of design, design process. Selection of Engineering Materials - properties –Manufacturing considerations in the design. BIS codes of materials, preferred numbers and interchangeability.

STRESSES IN MACHINE MEMBERS: Simple stresses – Combined stresses – Torsional and bending Stresses – impact stresses – stress -strain relation – Various theories of failure – factor of safety.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are capable to apply design procedures using theories of failure for different elements. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of machine design. <http://machinedesign.com/>  
<http://www.youtube.com/watch?v=qVj4VvMmQjc&list=PL3D4EECEFAA99D9BE&index=6>

**UNIT II**

DESIGN FOR FLUCTUATING LOADS: Stress concentration –notch sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Goodman’s line – Soderberg’s line. Design of components for finite and infinite life.

**Learning Outcome & Suggested Student Activities:**

After completion of this chapter students are able to design simple components under cyclic loading using Goodman’s and Soderberg’s criterions. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of cyclic loading design. <http://machinedesign.com/>  
<http://www.youtube.com/watch?v=SLqkITQfNII&list=PL3D4EECEFAA99D9BE&index=8>

**UNIT III**

DESIGN OF RIVETED JOINTS: Types of riveted joints, design of riveted joints. Boiler shell riveting design and eccentric loading design of riveted joints.

DESIGN OF BOLTED JOINTS: Forms of Screw threads. Stresses in Screw fasteners. Design of bolts with pre-stresses, Design of bolted joints under eccentric loading, Bolts of uniform strength.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to design riveted joints with different configuration, boiler shell joint design and eccentric loading design of riveted joints. Further students are able to design bolted joints with direct loading and eccentric loading. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of joints. <http://machinedesign.com/>  
<http://www.youtube.com/watch?v=Z38Aq9ykUCM&list=PL3D4EECEFAA99D9BE&index=16>

**UNIT IV**

DESIGN OF COTTERS AND KNUCKLE JOINTS: Design of Cotter joints: spigot and socket, sleeve and cotter, jib and cotter joints- Knuckle joints

DESIGN OF SHAFTS: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Standard shaft sizes.



**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to design cotter joint, knuckle joint and shafts. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of shafts, <http://machinedesign.com/>  
<http://www.youtube.com/watch?v=4nlQwVqruRo&list=PL3D4EECEFAA99D9BE&index=20>

**UNIT V**

DESIGN OF KEYS AND COUPLINGS: Design of Rigid couplings: Muff, Split muff and Flange couplings- Design of flexible couplings.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to design various rigid and flexible shaft couplings. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of couplings. <http://machinedesign.com/>  
<http://www.youtube.com/watch?v=4nlQwVqruRo&list=PL3D4EECEFAA99D9BE&index=21>

**Text Books:**

1. *Design of Machine Elements*, V.B.Bhandari, TMH Publishers, NewDelhi, 2<sup>nd</sup> edition, 2013
2. *MachineDesign, Schaum's series*, TMHPublishers, NewDelhi, 1<sup>st</sup> edition, 2011
3. *MachineDesign*, R.K.Jain, KhannaPublishers, NewDelhi.

**Reference Books:**

1. *MachineDesign*, SadhuSingh, KhannaPublishers, NewDelhi
2. *MachineDesign*, R.S. Kurmi and J.K. Gupta, S.ChandPublishers, NewDelhi
3. *MechanicalEngineeringDesign*, JosephE. Shigely, TMH Publishers, NewDelhi, 9<sup>th</sup> edition, 2011 R
4. *DesignofMachineElements*, M.F.Spotts, PHIPublishers, NewDelhi.
5. *MachineDesign*, PandyaandShah, CharotarPublishers, Anand, 17<sup>th</sup> edition, 2009
6. *Machine Design*, R.L. Norton, Tata McGrawHillPublishers, 2<sup>nd</sup> edition, 2002
7. *Machine Design by Groover* – CBS Publications, 5<sup>th</sup> edition, 2012.

**NOTE:** Design data books are not permitted in the examinations.

**Web Resources:** <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv077-page1.htm>

<http://www.fastenal.com/content/feds/pdf/Article%20-%20Bolted%20Joint%20Design.pdf>

[http://people.rit.edu/megite/Lec%203%20Fatigue%20Failure%20031004\\_for\\_students.ppt](http://people.rit.edu/megite/Lec%203%20Fatigue%20Failure%20031004_for_students.ppt) <http://engineershandbook.com/Tables/materials.htm>  
[www.nptel.iitm.ac.in/video](http://www.nptel.iitm.ac.in/video)

**Suggestions:**

1. Students may visit nearby automobile workshops and machine tool shops to know about different machine elements like shafts, keys, couplings and riveted and bolted joints.
2. In addition to the text books students may also go through the reference books authored by V.B. Bhandari, by Pandya and Shah for more number of numerical problems.



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. III-I Sem.

Th 3  
Tu 1  
C 3

(13A03506) HEAT TRANSFER

**Course Objective:**

*The students will gain the ability to get an in-depth understanding of the principles governing the transfer of heat, the techniques, tools and skills required to solve typical thermal related problems, the analysis of energy flows in complicated systems and the design of efficient heat transfer equipments. Enables the student to utilize analogies to solve heat transfer problems. Further students gain hands-on experience in heat transfer experimentation through a number of laboratory tests.*

**UNIT I**

Introduction: Modes and Mechanisms of Heat Transfer – Basic Laws of Heat Transfer – General Applications of Heat Transfer.

Conduction Heat Transfer: Fourier Rate Equation – General Heat Conduction Equation In Cartesian, Cylindrical and Spherical Coordinates.

Simplification and Forms of the Field Equation – Steady, Unsteady and Periodic Heat Transfer – Boundary and Initial Conditions.

One Dimensional Steady State Heat Conduction: In Homogeneous Slabs, Hollow Cylinders and Spheres – Overall Heat Transfer Coefficient – Electrical Analogy – Critical Radius/Thickness of Insulation – With Variable Thermal Conductivity – With Internal Heat Sources or Heat Generation

**Learning Outcome & Suggested Student Activities:**

*After the completion of the unit, student can able to grasp the concept of steady state conduction. Student can learn representing conduction equation in various forms. Student can imply concept successfully to problems encounter in day to day life. The following URL "s will be highly useful to students.*

*<http://k12videos.mit.edu/content/heat-transfer>; <http://www.youtube.com/watch?v=9WwSaIP5pbs>*

*<http://www.youtube.com/watch?v=HIYCR7gXXFo>; <http://www.youtube.com/watch?v=S57nIs503fA>*

*<http://energy.concord.org/ir/experiments-page3.html>*

**UNIT II**

Heat Transfer in Extended Surface (Fins) – efficiency, effectiveness and temperature distribution on Long Fin, Fin with Insulated Tip and Short Fin, Application to Errors in Temperature Measurement.

One Dimensional Transient Heat Conduction: In Systems with Negligible Internal Resistance – Significance of Biot and Fourier Numbers – Chart Solutions of Transient Conduction Systems – Problems on Semi-infinite Body.

**Learning Outcome & Suggested Student Activities:**

*After the completion of the chapter, student is expected understand the concept of extended surfaces and its applications. Also, student can aware transient heat conduction and how it vary w.r.t time. Student is expected to develop the ability to formulate practical conduction heat transfer problems by transforming the physical system into a Mathematical model and selecting an appropriate solution technique and evaluating the significance of results.*

*The following URLs will be highly useful to the students*

*<http://www.youtube.com/watch?v=cMmREKOhIV8>*

*<http://www.youtube.com/watch?v=HiX7DKUIAOM>*

**UNIT III**

Convective Heat Transfer: Dimensional Analysis – Buckingham II Theorem and Its Application for Developing Semi – Empirical Non-Dimensional Correlations for Convective Heat Transfer – Significance of Non-Dimensional Numbers – Concepts of Continuity, Momentum And Energy Equations.

Forced Convection: External Flows: Concepts of Hydrodynamic and Thermal Boundary Layer and Use of Empirical Correlations for Convective Heat Transfer for Flow Over – Flat Plates, Cylinders and Spheres.

Internal Flows: Division of Internal Flow through Concepts of Hydrodynamic and Thermal Entry Lengths – Use of Empirical Relations for Convective Heat Transfer in Horizontal Pipe Flow, Annular Flow.

Free Convection: Development of Hydrodynamic and Thermal Boundary Layer along a Vertical Plate – Use of Empirical Relations for Convective Heat Transfer on Plates and Cylinders in Horizontal and Vertical Orientation.

**Learning outcome & Suggested Student Activities:**

*At the end of the chapter, Student will have the ability to formulate practical forced and natural convection heat transfer problems by transforming the physical system into a mathematical model, selecting an appropriate solution technique and evaluating the significance of results. Students will also demonstrate an ability to analyze the performance.*

*The following URLs will be highly useful to the students*  
<http://www.youtube.com/watch?v=HIYCR7gXXFo>  
<http://www.youtube.com/watch?v=S57nIs503fA>; <http://energy.concord.org/ir/experiments-page3.html>

#### UNIT IV

Heat Transfer with Phase Change:

Boiling: Pool Boiling – Regimes, Determination of Heat Transfer Coefficient in Nucleate Boiling, Critical Heat Flux and Film Boiling.

Condensation: Filmwise and Dropwise Condensation – Nusselt's Theory of Condensation on a Vertical Plate – Film Condensation on Vertical and Horizontal Cylinders Using Empirical Correlations.

Heat Exchangers: Classification of Heat Exchangers – Overall Heat Transfer Coefficient and Fouling Factor – Concepts of LMTD and NTU Methods – Problems using LMTD And NTU Methods.

**Learning outcome & Suggested Student Activities:**

*After the completion of the chapter, student will be able to calculate heat transfer in condensation and boiling systems, turbulent and laminar film condensation. Student can understand the concepts of critical heat flux and different models of critical heat flux. Student can able to grasp the fundamentals of heat exchangers and its analysis.*

*The following URLs will be highly useful to the students to understand simple heat exchangers.*

*MIT: Professor Z. S. Spakovszky's Lecture Notes on Thermodynamics & Propulsion: "Section 18.5: Heat Exchangers" (HTML)*

*Lecture: YouTube: Stanford University: Professor Channing Robertson's Introduction to Chemical Engineering: "Lecture 12: Heat Exchangers"*

<http://www.youtube.com/watch?v=GuIApKpcxQc>

#### UNIT V

Radiative Heat Transfer: Emission Characteristics and Laws of Black-Body Radiation – Irradiation – Total and Monochromatic Quantities – Laws of Planck, Wien, Kirchoff, Lambert, Stefan And Boltzmann – Heat Exchange Between Two Black Bodies – Concepts of Shape Factor – Emissivity – Heat Exchange Between Gray Bodies – Radiation Shields – Electrical Analogy for Radiation Networks.

**Learning outcome & Suggested Student Activities:**

*At the end of the unit, student can have knowledge on fundamental laws of radiative heat transfer. Also, student can understand the concept of radiative heat transfer between black bodies and grey bodies. Student can know radiation shields and their applications. Student can determine shape factor for different geometries and can know its importance in determining radiative heat transfer.*

*The following URLs will be highly useful to the students -<http://energy.concord.org/ir/experiments-page5.html>*

**Text Books:**

1. *Fundamentals of Engg. Heat and Mass Transfer, R.C. Sachdeva, 4/e, New Age International, 2010.*

**Reference Books:**

1. *Heat Transfer, P.K.Nag, 3/e, TMH, 2011*
2. *Heat Transfer, Ghoshdastidar, Oxford Univ. Press, 1<sup>st</sup> edition, 2004*

3. *Heat Transfer, Holman.J.P, 10/e, TMH, 2012*
4. *Heat and Mass Transfer, R.K.Rajput, S.Chand& Company Ltd, 2001*
5. *Fundamentals of Heat and Mass Transfer, Kondandaraman, C.P., 3/e, New Age Publ.*
6. *Fundamentals of Heat and Mass Transfer, Incropera, 5/e, Wiley India.*
7. *Thermal Engineering Data Book, B.S.Reddy and K.H.Reddy Rev/e, I.K. International, 2007*

**NOTE:** Heat transfer Data books are permitted for Exam.

**Suggestion:**

1. Student is advised to visit heat transfer laboratory to understand the concept of three modes of heat transfer.

**Web References:**

*IIT video lecturers (NPTEL)*

*<http://www.wisc-online.com/Objects/ViewObject.aspx?ID=SCE304>*

*<http://web.cecs.pdx.edu/~gerry/heatAnimations/sphereTransient/#TOC>*

*<http://rpaulsingh.com/animated%20figures/animationlisttopic.htm>*

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. III-I Sem.**

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**(13A03507) HEAT TRANSFER LAB**

*NOTE: Thermal Engineering data books are permitted in the examinations*

1. Thermal conductivity of insulating powder material through Concentric Sphere apparatus.
2. Thermal conductivity of insulating material through lagged pipe apparatus
3. Overall heat transfer co-efficient through Composite Slab Apparatus
4. Thermal Conductivity of metal (conductor).
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer coefficient in forced convection.
8. Heat transfer coefficient in natural convection
9. Experiment on Parallel and counter flow heat exchanger.
10. Emissivity of a gray body through Emissivity apparatus.
11. Experiment on Stefan Boltzman Apparatus.
12. Heat transfer in drop and film wise condensation.
13. Experiment on Critical Heat flux apparatus.
14. Study of heat pipe and its demonstration.
15. Study of Two – Phase flow.

*Note: Any 10 of the above 15 experiments are to be conducted.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. III-I Sem.**

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**(13A01509) FLUID MECHANICS AND HYDRAULIC MACHINERY LAB**

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Discharge measurement through Venturimeter.
9. Discharge measurement through Orifice meter.
10. Estimation of friction factor for a given pipe line.
11. Estimation of loss of head due to sudden contraction in a pipeline.
12. Turbine flow meter.

*Note: Any 10 of the above 12 experiments are to be conducted.*

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**B.Tech. III-II Sem.**

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**(13A52501) MANAGERIAL ECONOMICS & FINANCIAL ANALYSIS (MEFA)**

**Course Objective:**

*The objectives of this course are to equip the student with the basic inputs of Managerial Economics and Economic Environment of business and to enrich analytical skills in helping them take sound financial decisions for achieving higher productivity.*

**Learning Outcome:**

*The thorough understanding of Managerial Economics and Analysis of Financial Statements facilitates the Technocrats – cum – Entrepreneurs to take-up decisions effectively and efficiently in the challenging Business Environment.*

**UNIT I**

**INTRODUCTION TO MANAGERIAL ECONOMICS**

Managerial Economics - Definition, nature and scope – contemporary importance of Managerial Economics - Demand Analysis: Determinants- Law of Demand - Elasticity of Demand. Significance – types – measurement of elasticity of demand - Demand forecasting- factors governing demand forecasting- methods of demand forecasting – Relationship of Managerial Economics with Financial Accounting and Management.

**UNIT II**

**THEORY OF PRODUCTION AND COST ANALYSIS**

Production Function – Short-run and long- run production - Isoquants and Isocosts, MRTS, least cost combination of inputs - Cobb-Douglas production function - laws of returns - Internal and External economies of scale - **Cost Analysis:** Cost concepts - Break-Even Analysis (BEA) - Managerial significance and limitations of BEA - Determination of Break Even Point (Simple Problems)

**UNIT III**

**INTRODUCTION TO MARKETS AND NEW ECONOMIC ENVIRONMENT**

Market structures: Types of Markets - Perfect and Imperfect Competition - Features, Oligopoly - Monopolistic competition. Price-Output determination - Pricing Methods and Strategies. Forms of Business Organization – Sole Proprietorship- Partnership – Joint Stock Companies – Public Sector Enterprises – New Economic Environment- Economic systems – Economic Liberalization – Privatization and Globalization

**UNIT IV**

**CAPITAL AND CAPITAL BUDGETING**

Concept of Capital - Over and Under capitalization – Remedial measures - Sources of Short term and Long term capital - Estimating Working Capital requirement – Capital budgeting – Features of Capital budgeting proposals – Methods and Evaluation of Capital budgeting – Pay Back Method – Accounting Rate of Return (ARR) – Net Present Value (NPV) – Internal Rate Return (IRR) Method (simple problems)

**UNIT V**

**INTRODUCTION TO FINANCIAL ACCOUNTING AND ANALYSIS**

Financial Accounting – Concept - emerging need and importance - Double-Entry Book Keeping-Journal - Ledger – Trial Balance - Financial Statements - - Trading Account – Profit & Loss Account – Balance Sheet (with simple adjustments). Financial Analysis – Ratios – Techniques – Liquidity, Leverage, Profitability, and Activity Ratios (simple problems).

**Text Books:**

1. Aryasri: *Managerial Economics and Financial Analysis*, 4/e, TMH, 2009.
2. Varshney & Maheswari: *Managerial Economics*, Sultan Chand, 2009.

**Reference Books:**

1. Premchand Babu, Madan Mohan: *Financial Accounting and Analysis*, Himalaya, 2009
2. S.A. Siddiqui and A.S. Siddiqui: *Managerial Economics and Financial Analysis*, New Age International, 2009.
3. Joseph G. Nellis and David Parker: *Principles of Business Economics*, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: *Managerial Economics in a Global Economy*, Cengage, 2009.
5. H.L.Ahuja: *Managerial Economics*, S.Chand, 3/e, 2009

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. III-II sem.

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(13A03601) CAD/CAM

**Course objective:**

*The objective of this subject is to enable the students to understand and handle design problems in symmetric manner, gain practical experience in handling 2-D drafting and 3-D modeling software systems, apply CAD in real life applications, understand the concepts G and M codes and manual part programming and know the applications of CNC machines. Further the students will become familiar on principles of computer graphics, geometric modeling, NC and CNC machines, group technology and FMS.*

**UNIT I**

Overview of CAD/CAM: Product cycle, CAD, CAM and CIM. CAD Tools, CAM Tools, Utilization in an Industrial Environment, Evaluation criteria. CAD standards, CAD data structure, Data base management systems.

Computer Graphics: Co-ordinate systems, Graphics package functions, 2D and 3D transformations, homogeneous transformations, clipping, hidden line / surface removal colour, shading.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the basic concepts Automation, components of CAD/CAM, input and output components of CAD, Steps involved in computer aided design.*

**UNIT II**

Geometric Modeling: Representation techniques, Parametric and non parametric representation, various construction methods, wire frame modeling, synthetic curves and their representations, surface modeling, synthetics surfaces and their representations.

Solid modeling, solid representation, fundamentals, introduction to boundary representations, constructive solid geometry, analytical solid modeling.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the geometric model of the component in CAD technology of computer graphics. The techniques of raster technology, scan conversion, clipping, removal of hidden lines and hidden surfaces, color, shading and texture.*

**UNIT III**

Numerical Control: NC, NC Modes, NC Elements, NC Machine tools and their structure, Machining centre, types and features. Controls in NC, CNC systems, DNC systems. Adaptive control machining systems, types of adaptive control.

CNC Part Programming: Fundamentals, NC word, NC Nodes, canned cycles, cutter radius compensation, length compensation, computed assisted part programming using APT: Geometry statements, motion statements, post process statements, auxiliary statements, macro statement program for simple components.

**Learning outcomes & Suggested Student Activities:**

*Geometric Modelling constitutes the most important and complex part in most of CDA software packages. Hence the students should focus on various requirements of information that are generated during geometric modeling stage, various types and its applications. Mathematical representations of curves used in geometric construction.*

**UNIT IV**

Group Technology & FMS: Part Family, Classification and Coding, advantages & limitations, Group technology machine cells, benefits. FMS: Introduction, components of FMS, material handling systems, Computer control systems, advantages.

Computer Aided Quality Control: Terminology in Quality control, Inspection and testing, Contact inspection methods - optical and non optical, integration of CAQC with CAD and CIM



**Learning outcome & Suggested Student Activities:**

CNC has revolutionized the manufacturing automation. The flexibility of manufacturing achieved with the use of CNC and associated Technology. The students should aim to understand the principle of NC, CNC, Machining Centre and various methods of part programming. The student is advised to visit manufacturing industry where the CNC machines are used and also interact with CNC programmer in industry.

**UNIT V**

Computer Aided Processes Planning: Retrieval type and Generative type, benefits Machinability data systems, Computer generated time standards.

Computer integrated production planning: Capacity planning, shop floor control, MRP-I, MRP-II, CIMS benefits. Trends in Manufacturing systems: Concepts of Reconfigurable manufacturing, Sustainable manufacturing and lean manufacturing.

**Learning outcomes & Suggested Student Activities:**

Understanding the need of GT as a means of bringing the benefits of mass production to relatively smaller production. Understanding the need of computers in process planning and QC. Understanding the definition and concept of FMS, and its elements etc.

**Text Books:**

1. CAD/CAM, A Zimmers&P.Groover, PE, PHI
2. CAD/CAM-Principles and applications, P.N. Rao, TMH, 3<sup>rd</sup> edition, 2010

**Reference Books:**

1. Automation, Production systems & Computer integrated Manufacturing, Groover, P.E
2. CAD/CAM/CIM, Radhakrishnan and Subramaniah, New Age, 3<sup>rd</sup> edition, 2008
3. Principles of Computer Aided Design and Manufacturing, FaridAmirouche, Pearson
4. CAD/CAM Theory and Practice, R. Sivasubramaniam, TMH
5. Computer Aided Design and Manufacturing, K.Lalit Narayan, PHI, 2008.
6. Computer Aided Manufacturing, T.C. Chang, Pearson, 3<sup>rd</sup> edition, 2008
7. A text book of CAD/CAM, CSP Rao, Hitech Publ.

**Web References:**

[http://www.cadcamfunda.com/cam\\_computer\\_aided\\_manufacturing](http://www.cadcamfunda.com/cam_computer_aided_manufacturing)  
<http://wings.buffalo.edu/eng/mae/courses/460-564/Course-Notes/cnc-classnotes.pdf>

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. III-II Sem.

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(13A03602) MACHINE TOOLS

**Course Objective:**

*The objectives of this course are to introduce to demonstrate the fundamentals of machining processes and machine tools.*

*To develop knowledge and importance of metal cutting parameters, tool materials, cutting fluids and tool wear mechanisms.*

*To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes and acquire knowledge on advanced manufacturing processes. The students will have the knowledge and hands-on experience that will enable them to work in a typical machine shop.*

**UNIT I**

Elementary treatment of metal cutting theory – Elements of cutting process – Geometry of single point tool and angles, chip formation and types of chips – built up edge and its effects, chip breakers. Mechanics of orthogonal cutting –Merchant’s Force diagram, cutting forces – cutting speeds, feed, depth of cut, heat generation, tool life, coolants, machinability –economics of machining. cutting Tool materials and cutting fluids –types and characteristics .

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the basic concepts of the philosophy of metal cutting and the mechanism of chip formation. Student will understand the interface in the machining zone between the tool and the work piece and how the physical and mechanical parameters dictate the cutting performance.*

**UNIT II**

Engine lathe – Principle of working- specification of lathe – types of lathes – work holders and tool holders –Taper turning, thread turning and attachments for Lathes.Turret and capstan lathes – collet chucks – other work holders – tool holding devices – box and tool layout. Principal features of automatic lathes – classification – Single spindle and multi-spindle automatic lathes– tool layout and cam design.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the basic concepts of turning. Student shall be made familiar with various tooling accessories used in turning and understand different constructions of lathe depending on the nature of operation.*

**UNIT III**

Drilling and Boring Machines – Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring tools – machining time calculation.

Shaping, Slotting and Planning machines –Principles of working – Principal parts – specification, classification, Operations performed. Machining time calculations

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the basic principle of drilling, shaping and planning operation, parts of the drilling, shaping and planning machines and tool holding devices, operations performed on drilling, shaping and planning and machining calculations.*

**UNIT IV**

Milling machine – Principles of working – specifications – classifications of milling machines – Principal features – machining operations, Types and geometry of milling cutters– methods of indexing – Accessories to milling machines.

Grinding machine –Theory of grinding – classification– cylindrical and surface grinding machine – Tool and cutter grinding machine – special types of grinding machines – Grinding wheel: Different types of abrasives – bonds, specification and selection of a grinding wheel. Static and dynamic balancing of a

wheel Truing and Dressing of wheels. Lapping, Honing and Broaching machines – comparison of grinding, lapping and honing. machining time calculations.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the principle of milling, grinding, Lapping, Honing and Broaching operation, parts of the milling machine and types of milling and grinding machines.*

**UNIT V**

Principles of design of Jigs and fixtures and uses, 3-2-1 Classification of Jigs & Fixtures – Principles of location and clamping – Types of clamping & work holding devices, Typical examples of jigs and fixtures

Unit built machine tools – multispindle heads. power units-principal of working types of UBMTS, characterization, applications

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the design of Jigs and fixtures and uses, Classification of Jigs & Fixtures – Principles of location and clamping. Some examples of jigs and fixtures. The outcome of this unit is to understand the basic principle of unconventional machining methods USM,AJM,EDM,LBM,EBM,CM and ECM and machining of the USM,AJM,EDM,LBM,EBM,CM and ECM.*

**Text Books:**

1. *Workshop Technology – Vol II, B.S.RaghuVamshi, Dhanpat Rai & Co, 10<sup>th</sup> edition, 2013*
2. *Production Technology by R.K. Jain and S.C. Gupta, Khanna Publishers, 17<sup>th</sup> edition, 2012*

**Reference Books:**

1. *Manufacturing Technology-Kalpakzian- Pearson*
2. *Metal cutting Principles by Milton C.Shaw, oxford Second Edn, 2<sup>nd</sup> edition, 2012*
3. *Production Technology by H.M.T. (Hindustan Machine Tools),TMH, 1<sup>st</sup> edition, 2001*
4. *Production Technology by K.L.Narayana, IK International Pub.*
5. *Unconventional Machining process by V.K.Jain, Allied Pub.*
6. *manufacturing technology Vol II by P.N. Rao, Tata McGraw Hill, 4<sup>th</sup> edition, 2013*
7. *Machining and machine tools by AB. Chattopadhyay, WileyEdn,2013*
8. *Machine Technology Machine tools and operations by Halmi A Yousuf&Harson, CRC Press Taylor and Francies .*

**Web Resources:**

[www.hgfarley.com](http://www.hgfarley.com)  
[www.kennametal.com/](http://www.kennametal.com/) - United States  
[www.mini-lathe.com/links.htm](http://www.mini-lathe.com/links.htm); [machinedesign.com/.../designer-s-guide-to-metalcutting-machinery-0608](http://machinedesign.com/.../designer-s-guide-to-metalcutting-machinery-0608) -  
[www.metalwebnews.com/wc.html](http://www.metalwebnews.com/wc.html)  
[www.britannica.com/EBchecked/topic/463000/planer](http://www.britannica.com/EBchecked/topic/463000/planer) [www.americanmachinist.com](http://www.americanmachinist.com)  
[www.machinetools.net.tw/parts/taiwan\\_voltage\\_regulator.htm](http://www.machinetools.net.tw/parts/taiwan_voltage_regulator.htm)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. III-II Sem.

Th	Tu	C
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(13A03603) REFRIGERATION AND AIR CONDITIONING

**Course Objective:**

*This subject provides insights in how thermodynamic principles are applied within the refrigeration and air conditioning industry. It gives details on how different components work and influence each other. Students will learn how real systems used in commercial, industrial refrigeration and air conditioning industries are built-up.*

*The objective this subject is to make the student to have complete knowledge on various refrigeration methods like VCR, VAR and latest developments, knowledge on various air conditioning methods like summer, winter and year round air conditioning and to make the student to understand the practical applications of refrigeration and air conditioning systems.*

**UNIT I**

Introduction to Refrigeration: Necessity and Applications, Carnot Refrigerator, First and Second Law Applied to Refrigerating Machines, Unit of Refrigeration, COP, EER, Different Refrigeration Methods Air Refrigeration: Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems - Numerical Problems – Refrigeration Needs of Air Crafts.

**Learning Outcome & Suggested Student Activities:**

*At the end of the chapter, student can able to understand the terminologies associated with refrigeration and also understand the basic principles of Refrigeration and applications. Student can also know the aspects of various natural refrigeration methods; understand the components of Air refrigeration system and the necessity of air craft refrigeration.*

*The following URLs are very useful to the students*

*<http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20%20Lecture%201.pdf>*

*<http://www.ignou.ac.in/upload/Unit%201-32.pdf>*

*<http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20Lecture%209.pdf>*

**UNIT II**

Vapour Compression Refrigeration ( VCR ) System – Basic Cycle - Working Principle and Essential Components of The Plant – COP – Representation of Cycle On T-S and P-h Charts – Expander Vs. Throttling, Effect of Sub Cooling and Super Heating – Cycle Analysis – Actual Cycle- Influence of Various Parameters on System Performance – Construction and Use of P-h Charts – Numerical Problems.

Refrigerants – Desirable Properties – Classification of Refrigerants Used – Nomenclature- Secondary Refrigerants- Lubricants – Ozone Depletion – Global Warming- Newer Refrigerants.

**Learning Outcome & Suggested Student Activities:**

*After the completion of the chapter, student can know the purpose and function of each of the components in the domestic refrigerator, analyzing the concepts of sub-cooling and super heating to improve the COP and also necessity of replacements for CFCs and HCFCs with new refrigerants. Following URLs are highly useful to the students*

*[http://www.nptel.iitm.ac.in/courses/IITMADRAS/Applied\\_Thermodynamics/Module\\_6/6\\_Simple\\_Vapor\\_Compression\\_RS.pdf](http://www.nptel.iitm.ac.in/courses/IITMADRAS/Applied_Thermodynamics/Module_6/6_Simple_Vapor_Compression_RS.pdf)*

*[http://www.mcquay.com/mcquaybiz/literature/lit\\_ch\\_wc/AppGuide/AG31-007.pdf](http://www.mcquay.com/mcquaybiz/literature/lit_ch_wc/AppGuide/AG31-007.pdf)*

**UNIT III**

Vapor Absorption Refrigeration ( VAR ) System – Description and Working of NH<sub>3</sub> – Water System and Li Br –Water ( Two Shell & Four Shell) System -Calculation of Max COP, Principle of Operation of Three Fluid Absorption System.

Steam Jet Refrigeration System: Working Principle and Basic Components-Estimation of Motive Steam Required, Principle and Operation of: (I) Thermo-Electric Refrigerator (Ii) Vortex Tube OrHilsch Tube.

**Learning Outcome & Suggested Student Activities:**

After the completion of the chapter, student can know the purpose and function of each of the basic components of the absorption refrigeration system. Student can have knowledge on latest developments of Electrolux, thermo electric vortex tube methods. Following URLs are highly useful to the students  
<http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20Lecture%2014.pdf>  
[http://en.wikipedia.org/wiki/Thermoelectric\\_cooling](http://en.wikipedia.org/wiki/Thermoelectric_cooling)

**UNIT IV**

Introduction to Air Conditioning: Psychrometric Properties & Processes – Characterization of Sensible and Latent Heat Loads — Need For Ventilation, Consideration of Infiltrated Air – Heat Load Concepts. Air Conditioning Systems: Air Cooler (Evaporative Cooling) ,Window, Split, Summer , Winter, Year Round, Central Air Conditioning Systems.

**Learning Outcome & Suggested Student Activities:**

After the end of the chapter, student can have knowledge on the use of psychrometric terms in Air conditioning. Student can learn the use of psychrometric chart to know psychrometric properties of air. Student can able to understand the terms sensible heat load and latent heat load. This technical information is fundamental to all types of domestic, commercial and industrial systems for the calculations of heat loads.

Student is advised to conduct experiment on A.C tutor in the laboratory. Following URLs are highly useful to the students <http://server.fst.uga.edu/kerr/FDST%204060/pdf%20files/7%20Psychrometrics.pdf>  
<http://people.eng.unimelb.edu.au/mjbrear/436-432/chapter%208%20-%20psychrometry.pdf>  
<http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/R&AC%20Lecture%2031.pdf>

**UNIT V**

Air Conditioning Equipment - Humidifiers – Dehumidifiers – Air Filters, Fans and Blowers. Human Comfort: Requirements of Temperature, Humidity And Concept of Effective Temperature, Comfort Chart, Heat Pump – Heat Sources – Different Heat Pump Circuits.

**Learning Outcome & Suggested Student Activities:**

After the completion of the chapter, student can understand the components of A/C system and describe the cooling equipment combinations. Student can describe the concept of human comfort chart and the processes by which the body produces and rejects heat. Student can be familiar with the Heat pump circuit analysis. Following URLs are highly useful to the students

Effective temp- <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/R&AC%20Lecture%2029.pdf>  
[http://courses.washington.edu/me333afe/Comfort\\_Health.pdf](http://courses.washington.edu/me333afe/Comfort_Health.pdf)  
<http://web.me.unr.edu/me372/Spring2001/Heat%20Pumps.pdf>

**Text Books:**

1. Refrigeration and Air Conditioning ,CP Arora, TMH, 15<sup>th</sup> edition, 2013.
2. A Course in Refrigeration and Air conditioning, S. CArora & Domkundwar, Dhanpatrai

**Reference Books:**

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age, 2<sup>nd</sup> edition, 2013
2. Principles of Refrigeration - Dossat / Pearson Education, 4<sup>th</sup> edition, 2007.
3. Refrigeration and Air Conditioning-P.L.Ballaney, 2<sup>nd</sup> edition, 2012.
4. Basic Refrigeration and Air-Conditioning – P.N.Ananthanarayanan / TMH, 4<sup>th</sup> edition, 2013.

**NOTE:** Tables/Codes: Thermal Engineering Data Book containing Réfrigérant and Psychrometric property Tables and charts are permitted in Exam

**Suggestions:**

The entire syllabus is covered in the text book – “ A Course in Refrigeration and Air conditioning “ by Domkundwar, Arora, Dhanpatrai Publications ( Highly useful book for GATE exam and other Government /Private sector competitive examinations)

Students can visit the nearby small scale Industries like Ice Plants to understand the principles of production of Ice and to observe the other simple components for practical understanding. Student is also advised to visit domestic refrigerator manufacturing industries/ Centralized and Split A/C system units.

Students are advised to watch the video lectures in the website - <http://nptel.iitm.ac.in>

The fundamental concepts of Thermodynamics, Psychrometrics etc., are required for better understanding of this subject.

**Web Resources:**

<http://www.refrigerationbasics.com/index.htm>

<http://www.howstuffworks.com/ac.htm> <http://www.ashrae.org>

<http://www.taftan.com/thermodynamics/AIRCOND.HTM>

<http://www.wisegeek.com/how-does-air-conditioning-work.htm>

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. III-II Sem.

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(13A03604) DESIGN OF MACHINE MEMBERS– II

**Course Objective:**

To aware the student about basic concepts of curved beams with different cross sections, design of power transmission elements, understand the design concepts of various types of springs, various types of bearings and gears.

To know the students how to apply design concepts in designing of IC engine parts like Piston, cylinder, connecting rod and crank shaft.

**UNIT I**

DESIGN OF CURVED BEAMS: Stresses in curved beams, Expression for radius of neutral axis for rectangular, circular, trapezoidal and T-Section. Design of crane hooks, C-clamps.

DESIGN OF POWER TRANSMISSIONS SYSTEMS: Design of Flat belt drives, V-belt drives & rope drives. Selection of wire ropes, design procedure for chain drives.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to design crane hooks, C-clamps and various belt, rope and chain drives. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of power transmission elements.

<http://machinedesign.com/>

<http://www.youtube.com/watch?v=PEKfs2Q1WqM&list=PL3D4EECEFAA99D9BE&index=19>

<http://www.youtube.com/watch?v=nMsB6Soz4Hc&list=PL3D4EECEFAA99D9BE&index=30>

**UNIT II**

DESIGN OF MECHANICAL SPRINGS: Stress and deflections of helical Springs-Springs for fatigue loading – Natural frequency of helical springs-Energy storage capacity- Helical Torsion springs- Design of leaf springs.

DESIGN OF POWER SCREWS: Design of screw- Square, ACME and Buttress screws- Efficiency of the screw. Design of compound screw, differential screw, ball screw- possible failures

**Learning Outcome & Suggested Student Activities:**

After completion of this unit, students are able to design helical springs for two wheel vehicle and laminated springs for trucks. Also students can apply design concepts in designing power screws. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of springs and power screws.

<http://machinedesign.com/>

<http://www.youtube.com/watch?v=PEKfs2Q1WqM&list=PL3D4EECEFAA99D9BE&index=19>

<http://www.youtube.com/watch?v=46quOD7V-cQ&list=PL3D4EECEFAA99D9BE&index=28>

**UNIT III**

DESIGN OF BEARINGS: Types of Journal bearings – Lubrication – Bearing Modulus-bearing materials – journal bearing design – Ball and roller bearings – Static loading of ball & roller bearings, bearing life –Failure of bearings.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to design journal bearings, ball bearings and roller bearings and to know the advantages of rolling contact bearings against sliding contact bearings. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of bearings.

<http://machinedesign.com/>

<http://www.mae.ncsu.edu/klang/courses/mae442/Tranmission/Journal%20Bearing.ppt>

[http://nhbb.com/files/catalog\\_pages/HiTech\\_Catalog.pdf](http://nhbb.com/files/catalog_pages/HiTech_Catalog.pdf)



## UNIT IV

DESIGN OF SPUR & HELICAL GEARS: Spur gears- Helical gears – Load concentration factor – Dynamic load factor. Surface compressive strength – Bending strength – Design analysis of spur and Helical gears – Estimation of centre distance, module and face width. Check for dynamic and wear considerations.

### **Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to design spur and helical gears for different input conditions. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of gears.

<http://machinedesign.com/> [http://nptel.iitm.ac.in/courses/IIT-MADRAS/Machine\\_Design\\_II/pdf/2\\_9.pdf](http://nptel.iitm.ac.in/courses/IIT-MADRAS/Machine_Design_II/pdf/2_9.pdf)  
<http://www.youtube.com/watch?v=8bml2pK6Ra0>

## UNIT V

DESIGN OF IC ENGINE PARTS: Pistons– Construction, Design of piston. Cylinder, Cylinder block, Connecting Rod. Cranks and Crank shafts- Center and over hung cranks.

### **Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to know various forces acting on IC engine parts and failure criteria to be adopted for various parts. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of IC Engine parts.

<http://machinedesign.com/>  
[http://umpir.ump.edu.my/1778/1/Design\\_Of\\_Connecting\\_Rod\\_Of\\_Internal\\_Combustion\\_Engine\\_A\\_Topology\\_Optimization\\_Approach.pdf](http://umpir.ump.edu.my/1778/1/Design_Of_Connecting_Rod_Of_Internal_Combustion_Engine_A_Topology_Optimization_Approach.pdf)  
<http://www.d-p.com.gr/pistons/piston-designs.html>

### **Text Books:**

1. *Mechanical Engineering Design*, Joseph E. Shigely, TMH Publishers, New Delhi, 9<sup>th</sup> edition, 2010.
2. *Machine Design*, R.L. Norton, Tata McGraw Hill Publishers, 2<sup>nd</sup> edition, 2012.

### **Reference Books:**

1. *Machine Design, Schaum's series*, TMH Publishers, New Delhi, 1<sup>st</sup> edition, 2011
2. *Design of Machine Elements*, V.B. Bhandari, TMH Publishers, New Delhi, 2<sup>nd</sup> edition, 2013.
3. *Machine Design*, Sadhu Singh, Khanna Publishers, New Delhi
4. *Design of Machine Elements*, M.F. Spotts, PHI Publishers, New Delhi.
5. *Machine Design*, Pandya and Shah, Charotar Publishers, Anand, 17<sup>th</sup> edition, 2012.

**NOTE:** Design data books are permitted in the examinations.

**Web References:** <http://www.uni.edu/~rao/Md-17%20Shaft%20Design.pdf> <http://www.uni.edu/~rao/Md-15%20Keys%20and%20Couplings.pdf>

<http://etidweb.tamu.edu/ftp/ENTC463/Notes/ENTC463Key%20and%20Coupling.pdf>

<http://www.science.howstuffworks.com/transport/engines.../bearing1.html>

<http://www.fi.edu/time/Journey/Time/Escapements/gearint.html>

### **Suggestions:**

1. students may visit nearby automobile workshops and machine tool shops to know about different machine elements like gears, bearings, springs, power screws, flexible drives and IC engine parts.
2. In addition to the text books students may also go through the reference books authored by V.B. Bhandari, by Pandya and Shah for more number of numerical problems.



## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. III-II Sem.

Th 3  
Tu 1  
C 3

### (13A03605) AUTOMOBILE ENGINEERING

#### **Course Objective:**

The students acquire sufficient knowledge to classify Engines, Chassis, Fuel Supply Systems, Cooling Methods, Lubrication Methods, Ignition Systems, Generating Systems, Suspension Systems, transmission system, steering mechanism and braking methods. The students get the working knowledge of assembly of various components of layout and of various electrical equipment of an automobile.

#### **UNIT I**

Introduction: Components of a Four Wheeler Automobile – Chassis and Body – Power Unit –Power Transmission – Rear Wheel Drive, Front Wheel Drive, Four Wheel Drive – Types of Automobile Engines, Engine Construction, Turbo Charging and Super Charging – Oil Filters, Oil Pumps – Crank Case Ventilation.

#### **Learning outcome & Suggested Student Activities:**

Student can understand the function of each and every component of an automobile. Student can understand the use of turbo charging and super charging. Students may refer the following website [auto.howstuffworks.com](http://auto.howstuffworks.com), [www.em.gov.au](http://www.em.gov.au) for better understanding of this topic.

#### **UNIT II**

Emissions from Automobiles – Pollution Standards National and International – Pollution Control–Techniques – Multipoint Fuel Injection for SI Engines- Common Rail Diesel Injection, Emissions from Alternative Energy Sources– Hydrogen, Biomass, Alcohols, LPG, CNG - Their Merits And Demerits.

Electrical System: Charging Circuit, Generator, Current – Voltage Regulator – Starting System, Bendix Drive, Mechanism of Solenoid Switch, Lighting Systems, Horn, Wiper, Fuel Gauge – Oil Pressure Gauge, Engine Temperature Indicator.

#### **Learning outcome & Suggested Activities:**

Student can be able to grasp the knowledge on emission standards, emission control techniques and electrical systems. Student can identify thrust areas for carrying their dissertation in future. Students may refer the following website [www.dec.ny.gov](http://www.dec.ny.gov), [www.studymode.com](http://www.studymode.com), [www.ehow.com](http://www.ehow.com), [www.automotiveservices.blogspot.com](http://www.automotiveservices.blogspot.com) for better understanding of this topic.

#### **UNIT III**

Transmission System: Clutches- Principle- Types: Cone Clutch, Single Plate Clutch, Multi Plate Clutch, Magnetic and Centrifugal Clutches, Fluid Fly Wheel – Gear Box- Types: Sliding Mesh, Constant Mesh, Synchromesh, Epi-Cyclic, Over Drive, Torque Converter.

Propeller Shaft – Hotch – Kiss Drive, Torque Tube Drive, Universal Joint, Differential, Rear Axles.

#### **Learning outcome & Suggested Student Activities:**

At the end of the unit, student can have broad knowledge on each and every component of transmission system of a automobile. Students may refer the following websites [en-wikipedia.org/wiki/transmission](http://en-wikipedia.org/wiki/transmission), [www.youtube.com](http://www.youtube.com), [www.youtube.com](http://www.youtube.com), [jalopink.com](http://jalopink.com), [www.geansandstuff.com](http://www.geansandstuff.com) for better understanding of this topic.

#### **UNIT IV**

Steering System: Steering Geometry – Camber, Castor, King Pin Rake, Combined Angle Toe-In, Center Point Steering. Types Of Steering Mechanism – Ackerman Steering Mechanism, Davis Steering Mechanism, Steering Gears – Types, Steering Linkages.

#### **Learning outcome & Suggested Student Activities:**

After the completion of the chapter, student can able to understand purpose and methods of steering systems and their applications. Students may refer the following website [www.scribd.com](http://www.scribd.com), [www.youtube.com](http://www.youtube.com), [leemyles.com](http://leemyles.com), [www.howcanworks.com](http://www.howcanworks.com), [www.forza.se/sider/of/listton/bi/stein1.pdf](http://www.forza.se/sider/of/listton/bi/stein1.pdf) for better understanding of this topic.

## UNIT V

Suspension System: Objects of Suspension Systems – Rigid Axle Suspension System, Torsion Bar, Shock Absorber, Independent Suspension System.

Braking System: Mechanical Brake System, Hydraulic Brake System, Pneumatic and Vacuum Brake Systems.

### **Learning outcome & Suggested Student Activities:**

*At the end of the unit. Student can have ample knowledge on suspension system and braking system of an automobile.*

*Students may refer the following website [www.youtube.com](http://www.youtube.com), [www.howcanworks.com](http://www.howcanworks.com), [www.forza.se/sider/of/listton/bi/stein1.pdf](http://www.forza.se/sider/of/listton/bi/stein1.pdf) for better understanding of this topic.*

### **Text Books:**

1. *Automotive Mechanics – Vol. 1 & Vol. 2, Kirpal Singh, Standard Publishers Distributors, 13<sup>th</sup> edition, 2013.*
2. *Automobile Engineering , William Crouse, TMH, 10<sup>th</sup> edition, 2006.*

### **Reference Books:**

1. *Automobile Engineering ,R.K.Rajput,Laxmi Pub, 1<sup>st</sup> edition, 2013.*
2. *Automobile Engineering ,K.K.Ramalingam/Scitech Pub, 2<sup>nd</sup> edition.*
3. *Automotive engines , Newton, Steeds & Garret.*

### **Books in Digital Libraray:**

[www.nptel.iitm.ac.in](http://www.nptel.iitm.ac.in)

### **Suggestions:**

*Student is requested to visit the research and development cell of Automobile manufacturing companies and A.R.A.I emission testing centers.*

*For better understanding of these systems students may visit the Automobile service centre and APSRTC workshop.*

B.Tech. III-II Sem.

<b>L</b>	<b>C</b>
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(13A03606) CAD LAB

**COMPUTER AIDED DRAFTING (CAD(P)**

**LIST OF EXPERIMENTS:**

- I Introduction to CAD software
- II. 2D drafting using Auto CAD (Two exercises)
- III. 3D modeling using Auto CAD (Any four exercises)

Introduction to 3D Modeling Using Autocad Software

- 1. Modeling of Component in 3D – V block
- 2. Modeling of Component in 3D – Open Bearing
- 3. Modeling of Component in 3D – Angular block
- 4. Modeling of Component in 3D – Dovetail Guide
- 5. Modeling of Component in 3D – Dovetail Bracket
- 6. Modeling of Component in 3D – Dovetail stop
- 7. Geometric Modeling Using Pro-E or CATIA or solid works or iron CAD ( Any four exercises)

Assembly Modeling: Student must do at least two exercises

- 1. Assembly of a screw jack parts
- 2. Assembly of a knuckle joint
- 3. Assembly of a Oldham's coupling
- 4. Assembly of a footstep bearing
- 5. Assembly of a stuffing box
- 6. Assembly of a square tool post

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. III-II Sem.**

<b>L</b>	<b>C</b>
<b>3</b>	<b>2</b>

**(13A03607) MACHINE TOOLS LAB**

1. Demonstration of construction & operations of general purpose machines: Lathe, Drilling machine, Milling machine, Shaper, Planing machine, Slotting machine, Cylindrical Grinder, Surface grinder and Tool & cutter grinder.
2. Job on Step turning and taper turning on lathe machine
3. Job on Thread cutting and knurling on -lathe machine.
4. Job on Drilling and Tapping
5. Job on Shaping and Planing
6. Job on Slotting
7. Job on Milling (groove cutting/ gear cutting)
8. Job on Cylindrical and Surface Grinding
9. Job on Grinding of Tool angles.

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## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

**B.Tech. III - II Sem.**

### **(13A52502) ADVANCED ENGLISH LANGUAGE COMMUNICATION SKILLS LAB (Audit Course)**

#### **Introduction:**

*The introduction of the Advanced Communication Skills Lab is considered essential at 3<sup>rd</sup> year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.*

*The proposed course should be a laboratory course to enable students to use „good“ English and perform the following:*

- *Gathering ideas and information to organise ideas relevantly and coherently.*
- *Engaging in debates.*
- *Participating in group discussions.*
- *Facing interviews.*
- *Writing project/research reports/technical reports.*
- *Making oral presentations.*
- *Writing formal letters.*
- *Transferring information from non-verbal to verbal texts and vice-versa.*
- *Taking part in social and professional communication.*

#### **Course Objective:**

*This Lab focuses on using multi-media instruction for language development to meet the following targets:*

- *To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.*
- *Further, they would be required to communicate their ideas relevantly and coherently in writing.*
- *To prepare all the students for their placements.*

#### **Learning Outcome:**

- *Accomplishment of sound vocabulary and its proper use contextually*
- *Flair in Writing and felicity in written expression.*
- *Enhanced job prospects.*
- *Effective Speaking Abilities*

The following course content to conduct the activities is prescribed for the Advanced English Language Communication Skills (AELCS) Lab:

#### **UNIT I**

##### **COMMUNICATIVE COMPETENCY:**

1. Reading Comprehension
2. Listening comprehension
3. Vocabulary for competitive purpose
4. Spotting errors

#### **UNIT II**

##### **TECHNICAL WRITING**

1. Report writing
2. Curriculum vitae
3. Covering letter
4. E-mail writing

### UNIT III

#### PRESENTATIONAL SKILLS

1. Oral presentation
2. Power point presentation
3. Poster presentation
4. Stage dynamics

### UNIT IV

#### CORPORATE SKILLS

1. Dress code
2. Telephonic skills
3. Net Etiquettes

### UNIT V

#### GETTING READY FOR JOB

1. Group discussions
2. Interview skills
3. Psychometric tests

#### MINIMUM REQUIREMENT:

The Advanced English Language Communication Skills (AELCS) Laboratory shall have the following infra-structural facilities to accommodate at least 60 students in the lab:

- Spacious room with appropriate acoustics.
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
- T. V, a digital stereo & Camcorder
- Headphones of High quality

#### SUGGESTED SOFTWARE:

The software consisting of the prescribed topics elaborated above should be procured and used.

1. **K-VAN SOLUTIONS-Advanced communication lab**
2. **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**
3. **TOEFL & GRE( KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)**
4. **Train2success.com**

#### References:

1. **Objective English For Competitive Exams**, Hari Mohana Prasad, 4<sup>th</sup> edition, Tata Mc Graw Hill.
2. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, O U Press 2009.
3. **Books on TOEFL/GRE/GMAT/CAT/ IELTS** by Barron"s/DELTA/Cambridge University Press.2012.
4. **Soft Skills for Everyone**, Butterfield Jeff, Cengage Publications, 2011.
5. **Practice Psychometric Tests: How to familiarize yourself with genuine recruitment tests**, 2012.
6. **Management Shapers Series** by Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
7. **Handbook for Technical Writing** by David A McMurrey & Joanne Buckely CENGAGE Learning 2008.
8. **English for Technical Communication for Engineering Students**, Aysha Vishwamohan, Tata Mc Graw-Hill 2009.
9. **Word Power Made Handy**, Shalini Verma, S Chand Publications, 2011.
10. **Effective Technical Communication**, Ashrif Rizvi, TataMcGrahill, 2011.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-I Sem.

Th 3  
Tu 1  
C 3

(13A03701) OPERATIONS RESEARCH

**Course Objective:**

*The subject should enable the students to the nature and scope of various decision making situations within business contexts, understand and apply operation research techniques to industrial applications, To make the student capable of Formulating the various real life decision making problems as Mathematical programming problems. Students to learn the fundamental Techniques of Operations Research and to choose a suitable OR technique to solve problem on hand.*

**UNIT I**

Introduction to OR and Linear Programming-1

OR definition– Classification of Models –Types of Operations Research models;

Linear Programming- Problem Formulation, Graphical Method, Simplex Method, Two–Phase Simplex Method, Big-M Method

Special Cases of LP- Degeneracy, Infeasibility and Multiple Optimal Solutions;

**Learning Outcome & Suggested Student Activities:**

*At the end of the Unit, the student will be able to create mathematical models of the real life situations and capable of obtaining best solution using Graphical Method and Simplex Method.*

*(The student must refer to any of the text books and practice solving several problems as it is very common to make mistakes while solving due to lack of practice). The student should take up a real life problem and formulate it as a mathematical programming problem.*

*Further, the students may visit the following URL for live online tutorial for LPP formulation*

<http://www.mathsdoctor.tv>

**UNIT II**

Linear programming-2: Duality– Principle, Economic Interpretation of Duality, Dual Simplex Method  
Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution-  
North-West Corner Rule, Least Cost Method, Vogel’s Approximation Method;

Optimality Methods-Stepping Stone Method and Modified Distribution (MODI)

Method; Special Cases -Unbalanced Transportation Problem, Degenerate Problem;

Assignment Problem – Formulation; Optimal Solution -Traveling Salesman problem.

**Learning Outcome &Suggested Student Activities:**

*At the end of this Unit, the student must be able to implement the theory of duality for simplifying the solution procedure for certain LPPs, and solve the special cases of LPP such as Transportation and Assignment problems. A large number of problems are to be solved by the student in order to gain much required capability of handling the problems without mistakes.*

*The following URLs will be useful to the students for in-depth knowledge <http://nptel.iitm.ac.in/video.php?subjectId=112106134>,*

*[http://www.Math.harvard.edu/archive/20\\_spring\\_05/handouts](http://www.Math.harvard.edu/archive/20_spring_05/handouts)*

**UNIT III**

Game Theory: Introduction – Minimax (Maximin) Criterion and Optimal Strategy, Saddle Point, Solution of Games with Pure Strategy –Games with Mixed Strategies – 2 X 2 Games – Dominance Principle– Solution by Graphical Method of m X 2 & 2 X n games

Queuing Theory: Introduction –Terminology, Service Channel, Arrival Pattern, Population, Departure Pattern(Service Pattern), Queue Discipline, Birth & Death Process, Balking, Reneging, Jockeying; Single Channel Models with Poisson Arrivals, Exponential Service Times with finite queue length and non-finite queue length; Multichannel Models with Poisson Arrivals, Exponential Service Times with finite queue length and non finite queue length.

**Learning Outcome & Suggested Student Activities:**

*At the end of this Unit, the student will have knowledge of choosing the best strategy out of the available strategies which is an essential skill for any business manager to successfully face the competition. The following web link will direct the students to the video lecture on Game Theory.*

*[http://www.youtube.com/watch?feature=player\\_detailpage&v=h0bdo06qNVw](http://www.youtube.com/watch?feature=player_detailpage&v=h0bdo06qNVw)*

*The student will be capable of identifying the suitable Queuing Model for real world waiting lines and make estimations like Average Waiting Times, Average Queue Length, Probability of Waiting in the queue etc.*

*The students may watch the following web video for better understanding of the subject.*

*[http://www.youtube.com/watch?feature=player\\_detailpage&v=xGkpXk-AnWU#t=104s](http://www.youtube.com/watch?feature=player_detailpage&v=xGkpXk-AnWU#t=104s)*

*The students should refer to any OR text book for more number of practice problems.*

**UNIT IV**

Sequencing -Assumptions-n-jobs-2 Machines model, n-jobs-3-machines models.

PERT & CPM: Introduction to Project Management, Activities, Events, Predecessor Relationships, AOA Diagram, Early Start, Early Finish, Late Start & Late Finish Times, Earliest Occurrence and Latest Occurrence of the Event, Total Float, Free Float, Independent Float

CPM- Deterministic Model- Critical Path, Crashing, Optimal Project Duration, Least Possible Project Duration

PERT- Probabilistic Model- Various types of Activity Time Estimates, Standard Deviation and Variance of the Activities and Projects, and Probability of Completing the Project within scheduled time

**Learning Outcome & Suggested Student Activities:**

*At the end of this Unit, student will be able to represent any project in the form of a network and estimate the parameters like Project Completion Time, Project Costs, and Optimum Duration of the Project, Probabilities of completing Projects as per schedule etc by applying either CPM or PERT technique as per the suitability.*

*The following URL will lead us to a video lecture on this Unit*

*[http://www.youtube.com/watch?feature=player\\_detailpage&v=H58TPQNr2kM](http://www.youtube.com/watch?feature=player_detailpage&v=H58TPQNr2kM)*

**UNIT V**

Dynamic Programming : Introduction – Bellman’s Principle of Optimality – Applications of Dynamic Programming- Capital Budgeting Problem – Shortest Path Problem – Solution of Linear Programming Problem by DP

Replacement and Maintenance Analysis: Introduction – Types of Maintenance, Types of Replacement Problem, Determination of Economic Life of an Asset, and Simple Probabilistic Model for Items which completely fail-Individual Replacement Model, Group Replacement Model.

**Learning Outcome & Suggested Student Activities:**

*At the end of this Unit, the student will be aware of applying Dynamic Programming technique to solve the complex problems by breaking them into a series of sub-problems. The following URL contains a video lecture on Dynamic Programming and the students are advised to go through*

*[http://www.youtube.com/watch?feature=player\\_detailpage&v=ug7O1ISZyg0](http://www.youtube.com/watch?feature=player_detailpage&v=ug7O1ISZyg0)*

*Further, the student will gain knowledge in different types of maintenance, failure patterns and the economic replacement policies which are very much important for the continuous functioning of machinery in an organization. The students may visit the following websites for better understanding of the subject.*

*<http://www2.ensc.sfu.ca/undergrad/courses/ENSC201/Unit09/lecture9.html>*

*<http://pakaccountants.com/what-is-depreciated-replacement-cost/>*

**Text Books:**

1. *Introduction to Operations Research, H.A.Taha, PHI, 9<sup>th</sup> edition, 2013.*
2. *Introduction to Operations Research*  
*Frederick K. Hiller, Bodhibrata Nag, PreetamBasu, Geralld J. Lieberman, TMH, 9<sup>th</sup> edition, 2011.*



**Reference Books:**

1. *Operations Research* by R Panneerselvam, PHI, 2<sup>nd</sup> edition, 2012.
2. *Operations Research*, Wagner, PHI Publications , 2<sup>nd</sup> edition.
3. *Operation Research*, J.K.Sharma,MacMilan, 5<sup>th</sup> edition, 2013.
4. *Linear Programming*, SusyPhillipose, PHI
5. *Operations Research*, A.M.Natarajan,P.Balasubramani,A. Tamilarasi,Pearson Education, 8<sup>th</sup> edition, 2011.
6. *Operations Research: Methods & Problems* , Maurice Saseini, ArhurYaspan& Lawrence Friedman
7. *Operations Research*, Dr. C.Nadhamuni Reddy & Sri Gopal Krishna, Kurnool Publishers

**Web References:**

<http://www2.informs.org/Resources/>

<http://www.mit.edu/~orc/>

<http://www.ieor.columbia.edu/>

<http://www.universalteacherpublishations.com/univ/ebooks/or/Ch1/origin.htm>

<http://www.wolfram.com/solutions/OperationsResearch/>

<http://nptel.iitm.ac.in/video.php?subjectId=112106134>

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-I Sem.

Th 3  
Tu 1  
C 3

(13A03702) AUTOMATION AND ROBOTICS

**Course Objective:**

*The subject should enable the students to understand the principles of automation, importance of automated flow lines and its types.*

*To learn the concepts of Robotics, kinematics of robot, principles of robot drives and controls, sensors used in robots and programming methods.*

**UNIT I**

Introduction to Automation: Need, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation.

Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand to know what is automation, types of automation, components of automation, strategies and levels of automation. Student is advised to visit URLs <http://www.nptel.iitm.ac.in/and iitb.ac.in>, <http://www.learnerstv.com/video/Free-video-Lecture-30103-Engineering.htm> for video lectures.*

**UNIT II**

Automated flow lines: Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage, Quantitative analysis of flow lines.

Assembly line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the types of flow lines, quantitative analysis of flow lines, how the assembly is carried out on automated flow line without interruption and how to balance the line and flexible assembly lines. Student is advised to visit URLs <http://www.nptel.iitm.ac.in/and iitb.ac.in>, <http://www.learnerstv.com/video/Free-video-Lecture-30103-Engineering.htm> for video lectures.*

**UNIT III**

Introduction to Industrial Robotics: Classification of Robot Configurations, functional line diagram, degrees of freedom. Components common types of arms, joints grippers, factors to be considered in the design of grippers.

Robot actuators and Feedback components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

**Learning outcome & Suggested Student Activities:**

*Student should come to know the various components in the anatomy of robot. By knowing this the student may apply in the design of new robotic structure. Student is advised to visit URLs <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm>*

**UNIT IV**

Manipulator Kinematics: Homogenous transformations as applicable to rotation and transition - D-H notation, Forward inverse kinematics.

Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton - Euler formations. Trajectory Planning: Trajectory Planning and avoidance of obstacles path planning, skew motion, joint integrated motion - straight line motion.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to understand the applications of various types of end effectors, and sensor devices. Student should also learn about the homogeneous transformations and its applications in the analysis of a robotic structure and method of developing different types of mechanisms and kinematics of the robot. Student is advised to visit URLs <http://www.nptel.iitm.ac.in> , <http://www.iitb.ac.in> , <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm>

**UNIT V**

Robot Programming: Methods of programming - requirements and features of programming languages, software packages. Problems with programming languages.

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading - Process - spot and continuous arc welding & spray painting - Assembly and Inspection.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to understand robot programming languages which may adopt in different applications of robot. Student also knows the control motion mechanism in all devices of robot and application of robots in manufacturing sector. Student is advised to visit URLs <http://www.nptel.iitm.ac.in> and [iitb.ac.in](http://www.iitb.ac.in), <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm>

**Text Books:**

1. Automation , Production systems and CIM, M.P. Groover/Pearson Edu.
2. Industrial Robotics - M.P. Groover, TMH.

**Reference Books:**

1. Robotics , Fu K S, McGraw Hill, 4<sup>th</sup> edition, 2010.
2. An Introduction to Robot Technology, P. Coiffet and M. Chaironze, Kogam Page Ltd. 1983 London.
3. Robotic Engineering , Richard D. Klafter, Prentice Hall
4. Robotics, Fundamental Concepts and analysis – Ashitave Ghosal, Oxford Press, 1/e, 2006
5. Robotics and Control , Mittal R K & Nagrath I.J , TMH.
6. Introduction to Robotics – John J. Craig, Pearson Edu

**Web References:**

[http://www.cadcamfunda.com/cam\\_computer\\_aided\\_manufacturing](http://www.cadcamfunda.com/cam_computer_aided_manufacturing)  
<http://wings.buffalo.edu/eng/mae/courses/460-564/Course-Notes/cnc-classnotes.pdf>  
<http://nptel.iitm.ac.in/courses.php?branch=Mechanical>  
<http://academicearth.org/courses/introduction-to-roboticsVideo>  
references:-<http://nptel.iitm.ac.in/video.php?courseId=1052>

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-I Sem.

Th 3  
Tu 1  
C 3

(13A03703) FINITE ELEMENT METHODS

**Course objective:**

The subject should enable the students to learn the principles involved in discretization in finite element approach, form stiffness matrices and force vectors for simple elements, find the various approach followed in finite element approach, use the various elements for discretization and learn about shape functions.

To learn the application of FEM to various structural problems incorporating temperature and boundary conditions and heat transfer problems.

**UNIT I**

INTRODUCTION: Equilibrium equations in elasticity subjected to body force, traction forces and point loads, stress strain relations in 3D elasticity, plane stress and plane strain, Boundary conditions, Initial conditions. Governing equation for Steady state heat conduction with convective boundary conditions.

Approximate methods for solving the differential equations: Rayleigh-Ritz method, Weighted residual methods, Galerkin's method.

Integral formulation: Principle of a minimum potential energy, principle of virtual work, Generalized Finite element approach in solving these problems.

Solution methods for solving simultaneous equations.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to know introductory basic principles and approaches for solving FEM problems in different fields. In addition to text books, the following URLs will be highly useful to the students to understand basic approaches to formulate and solving of FEM problems.

<http://www.youtube.com/watch?v=NYiZQszz9cQ&list=PLA4CBD0C55B9C3878&index=1>

<http://www.youtube.com/watch?v=RQBxWF9b-Fs&list=PLA4CBD0C55B9C3878>

**UNIT II**

Problems with One-dimensional geometry:

Bars: Formulation of stiffness matrix, Load vectors, Incorporation of boundary conditions: Elimination approach and penalty approach.

Trusses: Plane truss and space truss elements, Example problems involving plane truss elements. Examples involving multipoint constrains. Stress calculations.

Beams & Frames: Bending of beams, Interpolation functions, formulation of stiffness matrix and load vectors. Plane frames, space frames. Transformations of stiffness and load vectors.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to formulate FEM model for simple problems. In addition to text books, the following URLs will be highly useful to the students to formulate FEM models for simple problems using different elements.

[http://web.iitd.ac.in/~achawla/public\\_html/429/fem/overview.pdf](http://web.iitd.ac.in/~achawla/public_html/429/fem/overview.pdf)

[http://www.cmmacs.ernet.in/cmmacs/Lect\\_notes/sangeeta1.pdf](http://www.cmmacs.ernet.in/cmmacs/Lect_notes/sangeeta1.pdf)

<http://www.mecheng.iisc.ernet.in/~suresh/me237/fea/Chapter4.pdf>

**UNIT III**

INTERPOLATION MODELS: Polynomial form of interpolation functions - linear, quadratic and cubic, simplex, complex, Multiplex elements, Selection of the order of the interpolation polynomial, Convergence requirements, 2D Pascal Triangle, Linear interpolation polynomials in terms of global coordinates for triangular (2D simplex) elements, Linear interpolation polynomials in terms of local coordinates for triangular (2D simplex) elements, quadrilateral element.

HIGHER ORDER AND ISOPARAMETRIC ELEMENTS: Lagrangian interpolation, Higher order one dimensional elements- quadratic, Cubic element and their shape functions, properties of shape functions,

Shape functions of 2D quadratic triangular element in natural coordinates, 2D quadrilateral element shape functions – linear, quadratic, Biquadric rectangular element Tetrahedral and hexahedral elements.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to write interpolation functions to higher order isoparametric elements. In addition to text books, the following URLs will be highly useful to the students to understand basic concepts of isoparametric elements.

<http://www.kochmann.caltech.edu/ae108a/IsoparametricElements.pdf>

<http://www.me.mtu.edu/~bettig/MEEM4405/Lecture08.pdf> <http://site.iugaza.edu.ps/marafa/files/FEM-Chapter-10.pdf>

**UNIT IV**

**FINITE ELEMENT APPLICATION IN SOLID MECHANICS:**

Problem modeling and Finite element analysis in 2D plane elasticity with triangular and quadrilateral elements, Isoparametric, subparametric and superparametric elements. Interpolation, Jacobian, matrices relating strain and nodal displacements, stiffness matrix formulation, Consistent and lumped load vectors, Numerical integration Gaussian quadrature.

Axi-symmetric triangular elements: formulation of stiffness and load vectors.

Introduction to 3D stress analysis.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to derive element matrices for applying the principles to find stresses in beams and trusses and temperature distribution in composite walls and fins. In addition to text books, the following URLs will be highly useful to the students to develop and solve FEM models using beam and truss elements.

<http://www.youtube.com/watch?v=UeatU9OpDNA&list=PLA4CBD0C55B9C3878>

[http://uqu.edu.sa/files2/tiny\\_mce/plugins/filemanager/files/4041296/ComputerApplicationsInStructures/LeturesTutorialsDownloadedFromWeb/Lecture%20%20Truss%20and%20Beam%20FEM.pdf](http://uqu.edu.sa/files2/tiny_mce/plugins/filemanager/files/4041296/ComputerApplicationsInStructures/LeturesTutorialsDownloadedFromWeb/Lecture%20%20Truss%20and%20Beam%20FEM.pdf)

<http://www.engineering.uiowa.edu/~sxiao/class/058-153/lecture-24.pdf>

[www.rpi.edu/~des/CST.ppt](http://www.rpi.edu/~des/CST.ppt)

**UNIT V**

**HEAT TRANSFER AND FLUID MECHANICS PROBLEMS:**

Steady state heat conduction with convective and heat flux boundary conditions, Functional approach, Galerkin approach formulation of element characteristic matrices and vectors in 1D and 2D problems. Temperature distribution in composite walls one dimensional and two dimensional fins and extended surfaces.

Two dimensional potential flow problems: Potential function formulation and stream function formulation.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to solve bars, trusses, beams and heat transfer problems using FEM and also to apply boundary conditions in realistic problems. In addition to text books, the following URLs will be highly useful to the students to develop and solve FEM models using different elements. The students are also advised to use FEM software to solve all application problems.

<http://www.mecheng.iisc.ernet.in/~suresh/me237/fea/Chapter6.pdf>

<http://www.colorado.edu/engineering/cas/courses.d/IFEM.d/IFEM.Ch22.d/IFEM.Ch22.pdf>

**Text Books:**

1. *Introduction to Finite Element in Engineering*, Tirupati Chandrapatla and Bellagundu, Pearson Education, New Delhi.
2. *Finite Element Methods*, S. S. Rao, Pergamon Press, New York

**Reference Books:**

1. *Introduction to FEM*, J. N. Reddy, TMH Publishers, New Delhi.
2. *Finite Element Analysis*, C.S. Krishna Moorthy, TMH Publishers, New Delhi.
3. *Fundamentals of Finite Element Analysis*, David V. Hutton, TMH Publishers, New Delhi.

4. *Introduction to the Finite Element Methods, Desai and Abel , CBS Publishers, New Delhi.*
5. *Finite and Boundary Methods in Engineering, O.P.Gupta, Oxford and IBH Publishers, New Delhi.*
6. *Finite Element Modeling for Stress Analysis, R. D. Cook, John. Wiley & Sons, 1995.*

**WEB REFERENCES**

1. *Finite Element Method IIT Kanpur Course, Prof. C.S. Upadhyay*  
<http://nptel.iitm.ac.in/video.php?subjectId=112104115>
2. *Computational Methods in Design and Manufacturing by Dr. R. Krishnakumar, Department of Mechanical Engineering, IIT Madras* <http://nptel.iitm.ac.in/video.php?subjectId=112106135>

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-I Sem.

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(13A03704) METROLOGY AND MEASUREMENTS

**Course objective:**

Students will be able to understand the Limits and Fits, linear measurements and angular measurements, gauges, comparators, optical measuring methods, measurement of flatness and roughness of surface. And also learn about the screw thread and gear measuring methods, Alignment tests on machine tools.

Students will be able to understand various transducers to measure displacement like Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers and also learn about Calibration procedure, temperature and pressure calibration methods, the measurement of flow stress, strain measurements acceleration and vibration.

**UNIT I**

LIMITS, FITS and TOLERANCES : Introduction, Definitions, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard system – International Standard organization system for plain work.

LIMIT GAUGES and GAUGE DESIGN: Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle. Design of Go and No Go gauges.

COMPARATORS: Principle of Measurement with Mechanical, Optical, Electrical, Electronic, Pneumatic comparators and their uses.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to understand the Limits, Fits and Tolerance. Indian standard system – International Standard organization system. He will know the principles of working of the most commonly used instruments for measuring linear and angular distances.

<http://www.nptel.iitm.ac.in> <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv113-Page1.htm>

**UNIT II**

LINEAR MEASUREMENT: Length standard, line and end & wavelength standards, slip gauges – calibration of the slip gauges, Dial indicator, micrometers, vernier height gauges.

MEASUREMENT OF ANGLES AND TAPERS: Different methods – Bevel protractor – angle gauges – spirit levels – sine bar – Sine plate, rollers and spheres used to determine the tapers.

FLATNESS MEASUREMENT: Measurement of flatness of surfaces – straight edges– surface plates – optical flat and auto collimators, interferometer and their uses.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to study the different types of Comparators, optical measuring instruments, flatness measurement methods and measuring methods of surface roughness.

<http://www.nptel.iitm.ac.in/> and for notes, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv113-Page1.htm>

**UNIT III**

SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surface waviness- Numerical assessment of surface finish – CLA, R.M.S Values –  $R_a$  ,  $R_z$  values, Methods of measurement of surface finish-profilograph, Talysurf, BIS symbols for indication of surface finish.

SCREW THREAD MEASUREMENT: Elements of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch- profile thread gauges.

GEAR MEASUREMENT: Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch, pressure angle and tooth thickness.

MACHINE TOOL ALIGNMENT TESTS: Requirements of Machine Tool Alignment Tests, Alignment tests on lathe, milling and drilling machine tools. Preparation of acceptance charts.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to understand, Screw thread elements and measuring methods, Gear tooth profile measurement, CMM, Alignment tests on lathe, milling and drilling machine tools.

**UNIT IV**

MEASUREMENT OF DISPLACEMENT: Theory and construction of various transducers to measure displacement - Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

MEASUREMENT OF SPEED: Mechanical Tachometers - Electrical tachometers - Stroboscope, Noncontact type of tachometer .

STRESS & STRAIN MEASUREMENTS: Various types - electrical strain gauge - gauge factor - method of usage of resistance strain gauge for bending, compressive and tensile strains - usage for measuring torque, Strain gauge Rosettes.

MEASUREMENT OF ACCELERATION AND VIBRATION: Different simple instruments - Principles of Seismic instruments - Vibrometer and accelerometer.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to understand working of various instruments used for measuring for displacement, temperature and pressure.

**UNIT V**

MEASUREMENT OF TEMPERATURE: Standards and calibration, thermal expansion methods, thermo electric sensors(thermocouples), Electrical Resistance sensors, Junction semiconductor sensors, Digital thermometers, Radiation methods.

MEASUREMENT OF PRESSURE AND SOUND: Standards and calibration, basic methods of pressure measurement, dead weight gauges and manometers, Elastic transducers, vibrating cylinder, resonant transducers, High and low pressure measurement, sound measurement.

MEASUREMENT OF FORCE, TORQUE, POWER: Standards and calibration, Basic methods of Force Measurement, Torque measurement on rotating shafts, shaft power measurement(dynamometers), Vibrating wire force transducers.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to understand working of various instruments used for measuring for flow, speed, stress, strain and Vibration.

**Text Books:**

- (1) *Mechanical Measurements*, Beckwith, Marangoni, Linehard, PHI, PE
- (2) *Measurement systems: Application and design*, Doebelin Earnest. O. Adaptation by Manik and Dhanesh, TMH, 2012.
- (3) *Engineering Metrology*, R.K. Jain, Khanna Publishers, 20<sup>th</sup> edition, 2013.

**Reference Books:**

- (1) *Engineering Metrology*, Mahajan, DhanpatRai, 2<sup>nd</sup> edition, 2013.
- (2) *BIS standards on Limits & Fits*
- (3) *Fundamentals of Dimensional Metrology*, Connie Dotson, 4e, Thomson
- (4) *Metrology & Measurement by Anand K Bewoor, vinay A kulkarni, Mc GrawHill, 2013.*
- (5) *Instrumentation, measurement & analysis*, B.C.Nakra & KK Choudhary, TMH, 6<sup>th</sup> edition, 2011.

**Web References:**

<http://emtool box.nist.gov>  
[CambridgeViscosity.com/Viscometer](http://CambridgeViscosity.com/Viscometer)  
[www.e.FlukeCal.com/Calibration](http://www.e.FlukeCal.com/Calibration)  
[www.inscotemperature.com/](http://www.inscotemperature.com/)  
[www.solartronmetrology.com/](http://www.solartronmetrology.com/)



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-I Sem.

Th 3  
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(13A03705) COMPUTATIONAL FLUID DYNAMICS  
(Elective-II)

**Course Objective:**

*This course covers topics related to Computational Fluid Dynamics (CFD). CFD is an important tool in engineering analysis and design of fluid systems. In this course Students will develop the equations describing fluid flow and numerical solutions to these equations. Emphasis will be placed on understanding different approaches employed for both time and spatial discretization and how to evaluate these approaches. Students will look at time accurate and steady-state methods, explicit and implicit techniques, laminar and turbulent flow, compressible and incompressible approaches, stability considerations, etc. These techniques will be applied to applications of mixing and heat transfer.*

**UNIT I**

INTRODUCTION: Methods to solve a physical problem , numerical methods , brief comparison between FDM, FEM & FVM, applied numerical methods. Solution of a system of simultaneous linear algebraic equations, Iterative schemes of matrix inversion, direct methods for matrix inversion, direct methods for banded matrices. Finite difference applications in heat conduction and convection, heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer.

**Learning outcome & Suggested Student Activities:**

*This chapter gives the overall view of the various kinds of numerical methods adopted. It also discusses about various solutions for the numerical methods adopted in CFD. The applications of finite difference methods with examples in conduction and convective heat transfer are introduced.*

**UNIT II**

FINITE DIFFERENCES: Discretization, consistency, stability, and fundamentals of fluid flow modeling. Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

**Learning outcome & Suggested Student Activities:**

*This chapter gives how to discretize partial differential equations, including the governing flow equations which is the foundation for the finite difference method. Explicit and implicit approaches represent the fundamental distinction between various numerical techniques.*

**UNIT III**

ERRORS AND STABILITY ANALYSIS: introduction, first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme. REVIEW OF EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER: Introduction, Conservation of mass Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier stokes equations.

**Learning outcome & Suggested Student Activities:**

*This chapter focuses on numerical errors that are generated and how the numerical calculations become unstable and also entails the conservations of mass, momentum and energy equations to the fluid flow along with Navier stokes equation.*

**UNIT IV**

STEADY FLOW: Dimensions form of momentum and energy equations, navier stokes equation, and conservative body force fields, stream function, vorticity formulation, boundary, layer theory, buoyancy, driven convection and stability.

***Learning outcome & Suggested Student Activities:***

*This unit gives the fundamental principles of fluid mechanics, its governing differential equations and boundary conditions.*

**UNIT V**

**SIMPLE CFD TECHNIQUES:** Viscous flows conservation form space marching, relaxation techniques, viscous flows, conservation form space marching relaxation techniques, artificial viscosity, the alternating direction implicit techniques, pressure correction technique, computer graphic techniques used in CFD. Quasi one dimensional flow through a nozzle, turbulence models, standard and high Reynolds number models and their applications.

***Learning outcome & Suggested Student Activities:***

*This unit gives the information about some techniques for numerical solutions for flow problems. These equations are applicable to time and space marching solutions especially parabolic hyperbolic and elliptic equations.*

***Text Books:***

1. *Computational Fluid Dynamics, J Chung (2010), 2nd edition, Cambridge University Press, India.*
2. *Computational Fluid Dynamics, John .D. Anderson (2010), 3rd edition, McGraw- Hill International Edition, India.*

***Reference Books:***

1. *Computational Fluid Dynamics for Engineers, Ronnie Anderson (2012), 2nd edition, Cambridge University Press, India.*
2. *Computational aerodynamics and fluid dynamics an introduction, Jean-Jacques Chattot (2010), 3rd edition, Springer, Germany.*
3. *Essential computational fluid Dynamics – olegzikanov, wiley India.*
4. *Introduction to computational fluid dynamics – pradip, Niyogi S.K. Chakrabary, M.K. Laha – pearson.*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-I Sem.

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(13A03706) MECHATRONICS  
(Elective-II)

**Course Objective:**

*To make the students to learn about the*

*Basic electronics, electrical and mechanical components used to control the machines and industries.*

*Various types of sensors, signal conditioning systems and various pneumatic and hydraulic components used in control systems.*

*Micro controllers, PLCS and PLC program and programmable motion control systems.*

**UNIT I**

INTRODUCTION: Definition – Trends - Control Methods: Stand alone, PC Based (Real Time Operating Systems, Graphical User Interface, Simulation) - Applications: SPM, Robot, CNC, FMS, CIM.

***Learning outcome & Suggested Student Activities:***

*This unit helps the students to understand the importance of mechatronics subject and controlling the various machines, robots etc. Students may observe CNC machines in CAD/CAM lab to understand the mechatronics concepts.*

*Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter- 1, by the authors - W .Bolton, publishers - Pearson Education Press, 3rd edition, 2005.*

*Students may refer the following website [www.nptel.iitm.ac.in/ECE/mechatronics](http://www.nptel.iitm.ac.in/ECE/mechatronics) [www.ustudy.in/mech/mechs](http://www.ustudy.in/mech/mechs) [en.wikipedia.org/wiki/mechatronics](http://en.wikipedia.org/wiki/mechatronics) for better understanding of this topic.*

**UNIT II**

SIGNAL CONDITIONING: Introduction – Hardware - Digital I/O , Analog input – ADC , resolution , speed channels Filtering Noise using passive components – Resistors, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering.

***Learning outcomes & Suggested Student Activities:***

*This unit helps the students to understand how to convert the analog signals into useful required form. These signal condition systems may be observed in electronics and communication engineering department labs.*

*Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter – 3, by the authors - W Bolton, publishers- Pearson Education Press, 3rd edition, 2005.*

*Students may refer the following website [www.nptel.iitm.ac.in/ECE/mechatronics](http://www.nptel.iitm.ac.in/ECE/mechatronics) [www.saylor.org/courses/me302](http://www.saylor.org/courses/me302) for better understanding of this topic.*

**UNIT III**

PRECISION MECHANICAL SYSTEMS: Pneumatic Actuation Systems - Electro-pneumatic Actuation Systems - Hydraulic Actuation Systems - Electro-hydraulic Actuation Systems - Timing Belts – Ball Screw and Nut - Linear Motion Guides - Linear Bearings - Bearings- Motor / Drive Selection.

***Learning outcome & Suggested Student Activities:***

*In this unit the students learn about the pneumatic and hydraulic systems and about some precisions mechanical component which are useful in the field of automation. This automation system can be observed in many processing industries and manufacturing industries to handle the materials and control the machines (or) process. Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter-5, 6 & 7 by the authors - W .Bolton, publishers - Pearson Education Press, 3rd edition, 2005. Students may refer the following website [www.pic-design.com](http://www.pic-design.com), [www.sdp-si.com](http://www.sdp-si.com), [www.csio.res.in](http://www.csio.res.in),*

## UNIT IV

**ELECTRONIC INTERFACE SUBSYSTEMS:** Motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers, over current sensing, resettable fuses, Power Supply - Bipolar transistors/ mosfets.

**ELECTROMECHANICAL DRIVES:** Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - PWM's - Pulse Width Modulation – Variable Frequency Drives.

### ***Learning outcome & Suggested Student Activities:***

*The objective of this unit is to make the student aware of electronic systems, electromechanical drives used in automation. Some of the systems may be observed electrical and electronics labs for better understanding. Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter- 7 by the authors – W. Bolton, publishers- Pearson Education Press, 3rd edition, 2005. Students may refer the following website [www.pic-design.com](http://www.pic-design.com), [www.sdp-si.com](http://www.sdp-si.com), [www.csio.res.info](http://www.csio.res.info) better understanding of this topic.*

## UNIT V

**MICROCONTROLLERS OVERVIEW:** 8051 Microcontroller , micro processor structure - Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors – Applications, Programming –Assembly.

**PROGRAMMABLE LOGIC CONTROLLERS:** Basic Structure - Programming: Ladder diagram - Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection, interface – R232 etc.,-Applications.

### ***Learning outcome & Suggested Student Activities:***

*This unit helps the student to know about microcontrollers and to programming of programmable logic controls. Students may visit pharmaceutical industries, thermal power plants etc. To observe the PLC based control systems. to know about the interface between processing equipment and central system.*

*Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter- 15, 14 & 19 by the authors - W .Bolton, publishers- Pearson Education Press, 3rd edition, 2005. Students may refer the following website [www.authorstream.com](http://www.authorstream.com), [www.atmel.in](http://www.atmel.in), [www.lifehacker.com](http://www.lifehacker.com)*

### ***Text Books:***

- 1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering , W Bolton, Pearson Education Press, 3rd edition, 2005.*
- 2. Mechatronics, M.D.Singh, J.G.Joshi, PHI.*

### ***Reference Books:***

- 1. Mechatronics Source Book, Newton C Braga, Thomson Publications, Chennai.*
- 2. Mechatronics, N. Shanmugam, Anuradha Agencies Publisers.*
- 3. Mechatronics System Design, Devdas shetty,Richard,Thomson.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. IV-I Sem.**

<b>Th</b>	<b>Tu</b>	<b>C</b>
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**(13A03707) CONCURRENT ENGINEERING  
(Elective-II)**

**Course Objective:**

*Student has to understand the concept and need for sequential engineering or Concurrent engineering and it's benefit for the modern industry.*

*Student has to understand the co-operation/ coordination required between the different departments like marketing, design and the latest softwares available sofar*

*The student has to know the different procedures to be followed during the design, modifications, and optimization techniques for the Design for Manufacture (DFM).*

*The student has to understand the importance of quality of the product and know the methods of evaluating the quality.*

*The student must be able to assess the reliability & economics of the Design for Manufacture (DFM) being done/ learned.*

**UNIT I**

**INTRODUCTION:** Sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs.

**SUPPORT FOR CE:** Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process.

**Learning Outcome & Suggested Student Activities:**

*Students can understand the meaning, objectives and benefits of the concurrent engineering, life-cycle design of the products, structure and organisation and implementation process of the CE.*

*Students are advised to refer text book mikell P. Groover for CE definition & advantages and for solid modeling, Besterfield on quality control for it supports and also visit URLs [www.perfectlogic.com/articles/AI/ExpertSystems/ExpertSystems.html](http://www.perfectlogic.com/articles/AI/ExpertSystems/ExpertSystems.html).*

**UNIT II**

**DESIGN PRODUCT FOR CUSTOMER:** Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD). Modeling of Concurrent engineering design- Compatibility approach, Compatibility index, implementation of the Compatibility model, integrating the compatibility Concerns

**Learning Outcome & Suggested Student Activities:**

*Student can understand the design of the product as per the customer requirements and also understand the co-operation/ coordination required between the different departments like marketing, design and the latest softwares available so far.*

*Students are advised to visit industries like IFB, ITW for better understanding of the concept.*

**UNIT III**

**DESIGN FOR MANUFACTURE (DFM):** Introduction, role of DFM in CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms, Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assemblability.

**Learning Outcome & Suggested Student Activities:**

*Students can understand the role of design for manufacturing in concurrent engineering, different DFM methods, creative design methods and computer based approach to DFM.*

*Student can be explained the procedures being followed by companies such as KPIT Cummins-Pune and made to visit the same which is nearby.*

#### **UNIT IV**

**QUALITY BY DESIGN:** Quality engineering & methodology for robust product design, parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach.

***Learning Outcome & Suggested Student Activities:***

*Students can understand the importance of quality during the product design and methods used to evaluate the quality.*

*Student can be given a small component for Design for Manufacture (DFM) in consultation with industries*

#### **UNIT V**

**DESIGN FOR X-ABILITY:** Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.

***Learning Outcome & Suggested Student Activities:***

*Students can understand the design of the product for reliability, maintainability and economics. Students are advised to visit the following URLs [www.lumbs.lu.se/database/alumini/03-04/theses/jeganova-julija.pdf](http://www.lumbs.lu.se/database/alumini/03-04/theses/jeganova-julija.pdf) for lifecycle design of products and also visit [www.rug.nl/staff/e.w.berghout/nijlandberghout\\_flcmgt.pdf](http://www.rug.nl/staff/e.w.berghout/nijlandberghout_flcmgt.pdf) for life cycle semi realization.*

***Text Books:***

- 1. Concurrent Engineering- Kusiak - John Wiley & Sons*
- 2. Concurrent Engineering- Menon - Chapman & Hall*

***Reference Books:***

- 1. Integrated Product Development/Anderson MM and Hein, L. Berlin, Springer Verlag, 1987.*
- 2. Design for Concurrent Engineering/ Cleetus, J. Concurrent Engg. Research Centre, Morgantown, WV, 1992.*

*Student can be directed to industries who uses the Concurrent Engineering concepts.*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-I Sem.

Th 3 Tu 1 C 3

(13A03708) PRODUCTION AND OPERATIONS MANAGEMENT  
(Elective-II)

*Course Objective:*

To make the students understand the functions of production planning & controls, generating of new products, issues in product design and strategies of aggregate planning.

To provide the knowledge on principles of forecasting, forecasting methods, types and its accuracy.

To provide the knowledge on facilities location, various types layouts and assembly line balancing.

To provide the knowledge on lean management, concepts of JIT, six sigma, quality control, MRP, ERP and LOB.

To make the students understand the inventory management and scheduling techniques.

**UNIT I**

Functions of Production Planning & Controls operations & productivity, productivity measurement, Design of goods and services: selection, generating new products, product development, issues in product design.

Strategies for aggregates planning, aggregate planning using O.R. Models, Chase planning, Expediting, controlling aspects.

**Learning Outcome & Suggested Student Activities:**

At the end of this unit students can get the concepts on Production planning & controls operations and its functions, productivity and productivity measurements, design of goods and services and aggregate planning. Students are advised to visit following URLs [http://www.nptel.iitm.ac.in/courses/IIT-MADRAS/Management\\_Science\\_II/Pdf/3\\_5.pdf](http://www.nptel.iitm.ac.in/courses/IIT-MADRAS/Management_Science_II/Pdf/3_5.pdf). And also well documented note is available in pdf form at the following links.

[www.processprotocol.com/extranet/doucuments/pdf/.../production1.pdf](http://www.processprotocol.com/extranet/doucuments/pdf/.../production1.pdf)

[elearning.dbhosting.net/.../Production%20Planning%20And%20Control](http://elearning.dbhosting.net/.../Production%20Planning%20And%20Control)

<http://www.academicearth.org/lectures/product-development-process-observation>

**UNIT II**

Forecasting – Importance of forecasting – Types of forecasting, their uses – General Principles of forecasting – Forecasting techniques – qualitative methods and quantitative methods – accuracy of forecasting methods.

**Learning Outcome & Suggested Student Activities:**

Students can understand the importance of forecasting, uses of long term and short term forecasting and application of qualitative and quantitative methods for finding the future demands. Students are advised to refer the text book Forecasting: Methods and Applications Spyros G. Makridakis, Steven C. Wheelwright ,

Rob J Hyndman. For video lectures advised to visit following URLs

<http://www.learnerstv.com/video/Free-video-Lecture-2496-Management.htm>;

[http://www.slideshare.net/jrdn\\_27/qualitative-and-quantitative-methods-of-research](http://www.slideshare.net/jrdn_27/qualitative-and-quantitative-methods-of-research)

**UNIT III**

Factors affecting facilities location, mathematical models for facilities, location, Types of facilities-layout: product layout, process layout, group technology layout, Assembly line balancing, computerized layout: ALDEP, CRAFT, CORELAP.

**Learning Outcome & Suggested Student Activities:**

At the end of the unit the student will be able to understand where the plant is to be located based on facilities available and what are the important factors affecting the facilities location of a plant, and plant layout. And also able to understand plant layout design to facilitate material flow and processing of a product in the most efficient manner through the shortest possible time. Can compare the rural & urban sites, methods of selection. The following URLs are useful to the students

<http://www.slideshare.net/satya4/plant-layout-16143741>

<http://freevideolectures.com/Course/2371/Project-and-Production-Management/32>

<http://www.tcyonline.com/video-tutorials-computerised-layout-planning/101568>

#### **UNIT IV**

Lean Management, philosophy and creation of lean enterprise, JIT concepts-Kanban System-Elements of total quality management, Six Sigma Quality Control.

MRP, –lot sizing techniques in MRP, introduction to ERP, LOB (Line of Balance).

#### **Learning Outcome & Suggested Student Activities:**

*Students can understand the how philosophy of lean management applied to develop lean enterprise and basic concepts JIT, Six sigma control etc., Students are advised to visit the following URLs*

*.<http://www.learnerstv.com/video/Free-video-Lecture-6944-Management.htm>;*

*<http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-852j-integrating-the-lean-enterprise-fall-2005/lecture-notes/>*

*<http://freevideolectures.com/Course/2688/Human-Resource-Management/13>*

#### **UNIT V**

Scheduling Policies – Techniques, flow shop and job shop Scheduling techniques.

Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P-Systems and Q-Systems-(S, s) Policy.

#### **Learning Outcome & Suggested Student Activities:**

*At the end of the unit the student will be able to understand the scheduling policies, flow shop and job shop scheduling techniques and concepts of Inventory, Classification, Functions, it's associated costs etc., and also able to recognize the importance of Inventory control to ensure their availability with minimum capital lock up. The following URLs are useful to the students.*

*<http://www.technologyevaluation.com/search/for/inventory-management-pdf.html>*

*<http://freevideolectures.com/Course/3096/Operations-and-Supply-Chain-Management/10>*

#### **Text Books:**

1. Modern Production , Operations Management , Baffa&RakeshSarin.
2. Operation Management by B. Mahadevan,PearsonEdu.
3. Operation and O.M by Adam & Ebert- PHI Pub.,

#### **Reference Books:**

1. Operations Management – S.N. Chary.
2. Inventory Control Theory and Practice , Martin K. Starr and David W. Miller.
3. Production Control A Quantitative Approach , John E. Biegel.
4. Production Control , Moore.
5. Operations Management , Joseph Monks.
6. Operation Management by Jay Heizar & Read new Pearson
7. Elements of Production Planning and Control, Samuel Eilon.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. IV-I Sem.**

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**(13A03709) METROLOGY & MEASUREMENTS LAB**

Any 6 experiments from each section

**Section A:**

1. Measurement of bores by internal micrometers and dial bore indicators.
2. Use of gear teeth vernier calipers and checking the chordal addendum and chordal height of spur gear.
3. Alignment test on the lathe and milling machine
4. Study of Tool makers microscope and its application
5. Angle and taper measurements by Bevel protractor, Sine bars, spirit level etc.
6. Thread measurement by Two wire/ Three wire method.
7. Surface roughness measurement by Talysurf instrument.
8. Use of straight edge and spirit level in finding the flatness of surface plate.

**Section B:**

1. Calibration of Pressure Gauges
2. Calibration of transducer or thermocouple for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Study and calibration of capacitive transducer for angular measurement.
5. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
6. Study and calibration of a rotometer for flow measurement.
7. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
8. Study and calibration of Mcleod gauge for low pressure.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. IV-I Sem.**

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**(13A03710) COMPUTER AIDED ENGINEERING LAB(CAE LAB)**

I. Introduction to Analysis Software Package

II. Structural analysis:(Any Four exercises)

Analysis of a rectangular plate with a hole

1. Analysis of a truss member under loading
2. Analysis of a bracket plate with axial loading
3. Analysis of a bracket plate with eccentric loading
4. Static Analysis of Prismatic bar
5. Static Analysis of a Corner Bracket
6. Static Analysis of beam
7. Analysis of Thermally Loaded support Structure
8. Analysis of Hinged support member
9. Analysis of Tapered plate under transverse

load III. Thermal analysis:(Any two exercises)

1. Analysis of a square plate considering conduction
2. Analysis of a square plate considering conduction and convection
3. Analysis of a compound bodies considering conduction and convection

IV. CAM (Any Six exercises)

1. Introduction to CNC & NC Machines
2. Introduction to CNC & NC part programming – for Different operations like Turning, Threading, Milling, Drilling etc., (G-Codes & M-Codes)
3. Experiments on CNC lathe -Turning, Threading operations
4. Experiments on Milling Machine - Plane Milling, Drilling Operations
5. Experiment on Robot – pick up an object with & without using teach window
6. Developing a CNC code for a given job using
  - i) Solid works- CAM
  - ii) PRO-E- CAM
  - iii) MASTER CAM
  - iv) Edge CAM

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. IV-II Sem.**

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**(13A03801) INDUSTRIAL ENGINEERING AND MANAGEMENT**

**Course Objective:**

*To introduce the engineer to the ways in which management principles are applied in the kinds of work in which they are most likely to be involved.*

*To provide students with knowledge of approaches in designing and improving processes.*

*To make the student aware of various functional operations and their inter relationships of business such as procurement, financing, marketing and information systems.*

*To ensure that the students can apply/analyze relevant quantitative models to solve real world problems*

*To make the students capable of appraising real life business situations and suggest solution alternatives as related to operations management techniques*

**UNIT I**

Concepts of Management-Administration and Organization – Functions of Management – Schools of Management Thought: Taylor’s Scientific Management, Fayol’s Principles of Management, Douglas Mc-Gregor’s Theory X and Y, Mayo’s Hawthorne Experiments, Herzberg’s Two factor Theory of Motivation, Maslow’s Hierarchy of Human needs – Systems Approach to Management.

Organizational Structures- Functional- Divisional- Matrix etc., Basic Concepts Related to Organization – Departmentation and Decentralization and their Merits, Demerits and Suitability

**Learning Outcome & Suggested Student Activities:**

*At the end of this Unit, the student will be aware of the basic functional areas of organizations, Management Principles, Concepts and various Schools of Thought on Management, and also the various types of Organizational Structure need to be followed based on size, type of organization.*

*Video sessions are available on this chapter in the web [http://www.youtube.com/watch?V-gDRrnR\\_44EY](http://www.youtube.com/watch?V-gDRrnR_44EY). For extensions, alternative web links which provide video lectures are <http://freevideolectures.com/Course/3011/Organisation-Management> <http://freevideolectures.com/Course/2892/HRM-301-Organizational-Behavior/21>*

**UNIT II**

Plant Location: Definition, Factors affecting the Plant Location, Comparison of Rural and Urban sites, Methods for Selection of Plant – Matrix Approach

Plant Layout: Definition, Objectives, Organization, Types of Production, Types of Plant Layout – Various Data Analyzing Forms – Travel Chart, Optimization of Layout-Load Distance Model & CRAFT-Materials Handling Function-Objectives - Types-Selection Criteria of Material Handling Equipment.

**Learning Outcome & Suggested Student Activities:**

*At the end of this Unit, the student will be able to evaluate the qualitative and quantitative parameters for locating a plant and decide on plant layouts and optimization.*

*Video sessions are available on this chapter in the web link [www.youtube.com/watch?v=xk7hS8zCHgA](http://www.youtube.com/watch?v=xk7hS8zCHgA)*

*Video sessions on plant layout are found in the web link <http://www.youtube.com/watch?v=9rfqwRM6NGw>.*

*A study visit to any Automobile Industry, Mechanical Engineering Workshops is to be organized to create an opportunity for the students to appreciate the different kinds of Plant Layouts. The students can talk to three entrepreneurs one each in Manufacturing, Trade and Service to find out the factors they have considered for locating their plants/firms and also find out how the availability of infrastructure and labour has affected their decision.*

**UNIT III**

Work Study – Definition, Objectives, Method Study – Definition, Objectives, Steps Involved – Various Types of Associated Charts – Differences between Micromotion and Memomotion Studies.

Work Measurement - Definition, Time Study, Steps involved - Equipment, Different Methods of Performance Rating - Allowances, Standard Time Calculation. Work Sampling - Definition, Steps Involved, Standard Time Calculations, Differences with Time Study – Applications.

**Learning Outcome & Suggested Student Activities:**

*At the end of this Unit, the students will have thorough knowledge on work study, work simplification, standardization and improving the method of doing work and also setting time standards for doing work and procedures to arrive at the standard time.*

*Students are advised to visit the following web sites*

*[http://www.2shared.com/document/bnM\\_CTZw/Introduction\\_to\\_Work\\_Study\\_PDF.html](http://www.2shared.com/document/bnM_CTZw/Introduction_to_Work_Study_PDF.html)*

*The students should take up an activity of Work study in any Industrial Workshop where Batch Production or Mass Production is in practice*

#### UNIT IV

Material Management – Objectives, Inventory – functions, types, associated cost, inventory classification techniques- ABC Analysis; Inventory Models- Deterministic models- EOQ Model – Models with one Price Break and Multiple Price Breaks- shortages are not allowed – Stochastic Models – Demand may be Discrete Variable or Continuous Variable – Instantaneous Production, Instantaneous Demand and Continuous Demand and No Set-up Cost

Stores Management and Stores Records- Purchase Management, Duties of Purchase Manager, Associated forms

**Learning Outcome & Suggested Student Activities:**

*At the end of this Unit, the student will have knowledge on various activities associated with Material Management like Material Procurement, Inventory Maintenance, Keeping track on Material consumption etc.*

*The following URLs will lead us to certain good video lectures on this topic*

*[http://www.youtube.com/watch?feature=player\\_detailpage&v=tO5MmOBdkxk](http://www.youtube.com/watch?feature=player_detailpage&v=tO5MmOBdkxk)*

*<http://freevideolectures.com/Course/2365/Fundamentals-of-Operations-Research/21>*

#### UNIT V

Human Resource Management-Functions of HRM, Job Evaluation, Merit Rating- Difference with Job Evaluation, Different Methods of Merit Ratings, Wage Incentives, Different Types of Incentive Schemes  
Inspection & Quality Control: Differences between Inspection & Quality Control. Statistical Quality Control- Techniques-Variables and Attributes- Control Charts: X and R Charts; P Charts and C Charts. Acceptance Sampling Plan – Single Sampling and Double Sampling Plans- OC Curves. Introduction to TQM- Quality circles-BIS & ISO Standards-Importance and Evaluation Procedure  
Marketing Management- Introduction, Marketing vs Selling, Market Segmentation

**Learning outcome & Suggested Student Activities:**

*At the end of this Unit, the students will understand the functions of HRM, methods of Performance Evaluation, Wage and Incentive Calculation. They will also know the Difference between Inspection & Quality Control, Statistical Quality Control Techniques, TQM, BIS & ISO and also functions of HRM. They will also understand the basics of Marketing.*

*Video lectures can be found in the following web links*

*<http://www.learnerstv.com/video/Free-video-Lecture-10024-Management.htm>*

*<http://www.youtube.com/watch?v=lb86qgWmMgY>*

**Text Books:**

1. *Manufacturing Organization and Management, T.Amrine/ Pearson, 2<sup>nd</sup> Edition, 2004*
2. *Industrial Engineering and Management, Dr. C.Nadamuni Reddy, New Age International Publishers, 1<sup>st</sup> edition, 2011.*

**Reference Books:**

1. *Industrial Engineering and production management, MartindTelsang S.Chand.*
2. *Industrial Engineering and Management, O.P.Khanna, DhanpatiRai, 18<sup>th</sup> edition, 2013.*
3. *Work Study by ILO(International Labour Organization)*
4. *Management by James AF Stoner, Freeman 6<sup>th</sup> Ed, Pearson Education, New Delhi,2005*

5. *Production and Operations management, PanneerSelvam, PHI,2004.*
6. *Statistical Quality Control by EL Grantt, McGrawhil*
7. *Motion and time studies by Ralph M Barnes, John Wiley and Sons,2004*

**Web References:**

<http://nptel.iitm.ac.in/>

[www.learnerstv.com/Free-Engineering-video-lecture-courses.htm](http://www.learnerstv.com/Free-Engineering-video-lecture-courses.htm)

<http://www.bized.co.uk/fme/5.htm>

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-II Sem.

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(13A03802) POWER PLANT ENGINEERING

**Course Objective:**

To understand the student present day energy demand.

To make the student to aware of components of power plants that run using conventional and non-conventional methods, factors affecting the site selection for a power plant and concept of base load plant and peak load plant.

To make the student aware of Pros and Cos of various power plants.

To enable the student to recognize the importance of secondary energy source.

**UNIT I**

Introduction To The Sources Of Energy – Resources and Development of Power in India.

Layouts of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power Cycles - Comparison and Selection,

Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor – Tariff - Related Exercises, Effluents from Power Plants and Impact on Environment – Pollutants and Pollution Standards – Methods of Pollution Control. Inspection And Safety Regulations.

**Learning outcome & Suggested Student Activities:**

Student can recognize the importance of power production suited to the demand. Student can have an idea of various power plants. Student can understand economics of power distribution, Power Tariff, Load Factor and other related terms. Student can know the impact of power plants on the environment. Students are advised to visit various power plants. The student can download the course material from the web site <http://www.nprcet.org/e%20content/Misc/e-Learning/EEE/II%20YEAR/EE2252%20-%20Power%20Plant%20Engineering.pdf>

**UNIT II**

Steam Power Plant : Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement – Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Steam Power Plant : Combustion Process : Properties of Coal – Overfeed and Under Feed Fuel Beds, Traveling Grate Stokers, Spreader Stokers, Retort Stokers, Pulverized Fuel Burning System And Its Components, Combustion Needs and Draught System, Cyclone Furnace, Design and Construction, Dust Collectors, Cooling Towers And Heat Rejection. Analysis of Pollution from Thermal Power Plants - Pollution Controls.CO<sub>2</sub> Recorders

**Learning outcome & Suggested Student Activities:**

Student is able to understand the latest high pressure boilers, concept of fluidized bed combustion and importance of handling and storage. Student can able to learn the waste heat recovery methods. In addition, student can know various cooling towers and its application.

Student is advised to visit the cogeneration plants to under the waste heat recovery concept. Student can download the notes from the web site <http://www.nprcet.org/e%20content/Misc/e-Learning/EEE/II%20YEAR/EE2252%20-%20Power%20Plant%20Engineering.pdf> and [wikipedia.org/wiki/Power\\_station](http://wikipedia.org/wiki/Power_station), The student can refer the text book A Course in Power Plant Engineering, Arora and S. Domkundwar.

**UNIT III**

Diesel Power Plant: Diesel Power Plant: Introduction – IC Engines, Types, Construction– Plant Layout with Auxiliaries – Fuel Storage

Gas Turbine Plant : Introduction – Classification - Construction – Layout With Auxiliaries – Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

**Learning outcome & Suggested Student Activities:**

*Student can grasp concepts of diesel power plant and gas turbine plants. Student can distinguish open cycle and closed cycle gas turbine cycles.*

*Normally, every college will be equipped with diesel power plant. Students are suggested to visit near by diesel power plant and gas turbine plant. The students have already studied these units in Thermal Engineering-I & II. The student can make uses of these notes of thermal engineering.*

**UNIT IV**

Hydro Electric Power Plant: Water Power – Hydrological Cycle / Flow Measurement – Drainage Area Characteristics – Hydrographs – Storage and Pondage – Classification of Dams and Spill Ways.

Hydro Projects and Plant: Classification – Typical Layouts – Plant Auxiliaries – Plant Operation Pumped Storage Plants.

**Learning outcomes & Suggested Students Activities:**

*Student can have knowledge on water power. Student can able to understand the methods of storing water and can have an idea over constructions of dams and spill ways. Student can enable to draw the layout of hydel power plant. Student s are advised to visit nearby hydel power plants. Student can download the course material from the web site <http://www.nprcet.org/e%20content/Misc/e-Learning/EEE/II%20YEAR/EE2252%20-%20Power%20Plant%20Engineering.pdf>*

**UNIT V**

Power from Non-Conventional Sources: Utilization of Solar Collectors- Principle Of its Working, Wind Energy – Types of Turbines – HAWT & VAWT-Tidal Energy. MHD power Generation.

Nuclear Power Station: Nuclear Fuel – Nuclear Fission, Chain Reaction, Breeding and Fertile Materials – Nuclear Reactor –Reactor Operation.

Types of Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding – Radioactive Waste Disposal.

**Learning outcome & Suggested Student Activities:**

*After the completion of the chapter, student can be familiar with the power generation through secondary energy sources. Student can able to understand the power generation through solar energy, wind energy, MHD and Nuclear energy. Student can enable to distinguish various nuclear reactors. Also, student can know the methods of dumping radiation waste and can discern the impact of radiation effect on human living. Student is suggested to visit any nuclear power station. The student can download the course material from the web site <http://www.nprcet.org/e%20content/Misc/e-Learning/EEE/II%20YEAR/EE2252%20-%20Power%20Plant%20Engineering.pdf>, and [wikipedia.org/wiki/Power\\_station](http://wikipedia.org/wiki/Power_station).*

**Text Books:**

1. Power plant Engineering, P.K. Nag, TMH, 3<sup>rd</sup> edition, 2013.
2. A course in power plant Engineering, Arora and S. Domkundwar.

**Reference Books:**

1. A Text Book of Power Plant Engineering , Rajput , Laxmi Publications, 4<sup>th</sup> edition, 2012.
2. Power plant Engineering, Ramalingam, Scietech Publishers
3. power plant engineering P.C. Sharma, S.K. Kataria Publications,2012.

**Suggestion to the Students:**

*It is very essential to visit one Thermal power station and one Hydro electric Power station in order to understand the various components.*



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-II Sem.

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(13A03803) GAS TURBINES AND JET PROPULSION  
(Elective-III)

**Course Objective:**

To make the student to understand the concept of power generation through gas turbines and the analysis of Brayton cycle/ Joule cycle.

To make the student to know the methods of improving the specific work and efficiency of a simple gas turbine cycle.

To make the student aware of various propulsion devices and use of thrust equations.

To make the student to know the working of Ramjet engine in detail.

To make the student to understand the working of rocket engine and detail study on fuels used in rocket engine.

**UNIT I**

Gas Turbines: Gas Turbine Operating Cycles, Cycle Work Ratio, Optimum Pressure Ratio, Gas Turbine Applications, Gas Turbine Advantages & Disadvantages, Energy Flow & Back Work, Deviation From Ideal Cycle, Means of Improving the Efficiency and the Specific Output of Simple Cycle, Gas Turbine with Regeneration, Thermal Efficiency of Gas Turbine with & without Regenerator, Inter cooling & Reheating, Related Problems.

**Learning outcome & Suggested Student Activities:**

At the end of the chapter, student can analyze the simple gas turbine cycle in determining the specific work and thermal efficiency. Also, student can able to know the methods in improving them is using combinations of reheating as well as regeneration.

Student is advised to work hard in solving problems based on various combinations of gas turbine with heat exchanger, reheater and inter cooler. Student is advised to visit a near by gas turbine power plant. Student is advised to get concepts from the NPTEL or [nprcet.org](http://nprcet.org) Elearning. The student can refer the text book Gas turbines, Cohen, Rogers & Sarvana Muttoo, Addison Wiley & longman

**UNIT II**

Jet Propulsion: Historical Sketch- Reaction Principle- Essential Features of Propulsion Devices- Thermal Jet Engines, Classification of – Energy Flow, Thrust, Thrust Power and Propulsion Efficiency- Need for Thermal Jet Engines and Applications.

Turboprop and Turbojet – Thermodynamic Cycles and Principles of Operation – Performance Evaluation – Thrust Augmentation and Thrust Reversal – Contrasting with Piston Engine Propeller Plant.

**Learning outcomes & Suggested Student Activities:**

After the study of the unit, student can able to understand the basic principle of jet propulsion. Also, student can able to know the working of various Pilotless and piloted propulsion devices.

Student can understand thrust equations, calculating propulsive power, and propulsion efficiency. Also, student can have knowledge on thrust augmentation methods. At the end, student can analyze the propulsive devices thermodynamically.

Student can get study material from NPTEL or [nprcet.org](http://nprcet.org) Learning. Students are advised to go through the websites of defense services for better understanding a propulsive device. Student can refer the text book Gas turbines, Cohen, Rogers & Sarvana Muttoo, Addison Wiley & longman



### UNIT III

Ram Jet Engine- Thermo Dynamic Cycle, Plant Lay Out, Essential Components – Principle of Operation – Performance Evaluation – Comparison Among Atmospheric Thermal Jet Engines- Serqujet and Pulse Jet, Elementary Treatment.

#### **Learning outcome & Suggested Student Activities:**

*At the end of the chapter, student can analyze the working of ramjet engine thermodynamically. Student can aware the calculations related to efficiency. Student can distinguish the working of Ramjet from Pulsejet and Serquijet engines.*

*The student can down load PPT <http://www.authorstream.com/Presentation/aSGuest41068-353530-jet-engine-entertainment-ppt-powerpoint> in order to aware of different types of propulsive devices. The student can get notes from the NPTEL or [nprcet.org](http://nprcet.org) Elearning. The student can refer the text book Gas turbines , cohen , Rogers & Sarvana Muttoo , Addison Wiley & longman*

### UNIT IV

Rocket Engines: Need of Rocket Engine, Applications- Basic Principle of Operation and Parameters of Performance – Classification, Solid and Liquid Propellant Rocket Engines, Advantages, Domains of Application – Propellants – Comparison of Propulsion Systems.

#### **Learning outcome & Suggested Student Activities:**

*At the end of the chapter, student can able to understand the working of rocket engine. Student can have knowledge on propellants of rocket engines. Student can aware of parameters affecting the parameters of performance. Student can get difference between various domains of application.*

*Student is advised to visit nearby space research centres for better understanding the working of a rocket engine. The student can visit [wikipedia.org/wiki/Rocket\\_engine](http://wikipedia.org/wiki/Rocket_engine) in order to get awareness of different types of Rocket engines. The student can get course material from NPTEL or [nprcet.org](http://nprcet.org) Elearning. The student can refer the text book Gas turbines , cohen , Rogers & Sarvana Muttoo , Addison Wiley & longman*

### UNIT V

Rocket Technology: Flight Mechanics, Application of Thrust Profiles, Acceleration- Staging of Rockets, Need For – Feed Systems, Injectors And Expansion Nozzles – Rocket Transfer and Ablative Cooling. Testing & Instrumentation - Need for Cryogenics – Advanced Propulsion Systems, Elementary Treatment of Electrical Nuclear And Plasma Arc Propulsion.

#### **Learning outcomes & Suggested Student Activities:**

*After the completion of the chapter, student can aware of thrust profile, its application and staging. Student can know advanced topics of rocket transfer, ablative cooling. Student can understand the importance of cryogenic engine and can aware advanced topics like nuclear and arc propulsion.*

*The student can visit to [wikipedia.org/wiki/Rocket\\_engine](http://wikipedia.org/wiki/Rocket_engine) in order to get awareness of different types of Rocket engines. The student can get course material from the NPTEL or [nprcet.org](http://nprcet.org) Elearning. The student can refer the text book Gas turbines , cohen , Rogers & Sarvana Muttoo , Addison Wiley & longman*

#### **Text Books:**

1. Gas Turbines , V. Ganesan TMGH
2. Gas Dynamics & Jet Propulsion, Dr. S.L. Somasundaram.

#### **Reference Books:**

1. Gas turbines , cohen , Rogers & Sarvana Muttoo , Addison Wiley & longman
2. Thermodynamics of propulsion, Hill & Paterson.
3. Rocket Propulsion , Sutton.
4. Element of Gas Turbines propulsion , Jack D Matingly, MGH

#### **Web Resources:**

<http://inventors.about.com/library/inventors/blinternalcombustion.htm> <http://www.animatedengines.com/>

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-II Sem.

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(13A03804) TOOL DESIGN  
(Elective-III)

**Course Objective:**

To make the students to understand the design of single point cutting tool.

To learn about the design of drilling tool, tool wear Machinability index and tool life.

To make the students to understand jigs and fixtures, design principle of jigs and fixtures, locating and clamping principles.

To learn about the sheet metal operations, Design forming ,drawings ,Bending and drawing dies, forming dies.

To make the students to understand plastics commonly used as tooling material.

**UNIT I**

Tool materials: Ferrous, non ferrous, materials, heat treatment, plastics Classification of moulds used in processing of plastics, Design of injection, blow, and compression moulds.

**Learning outcome & Suggested Student Activities:**

After completion of this unit, students are able to understand the fundamentals of plastics as tooling materials, processing of plastics for tooling materials, heat treatment of materials, ferrous, nonferrous, non metallic, tooling materials.

**UNIT II**

Design of single point cutting tools: Single point, cutting tools-various systems of specifications, geometry and their interrelation, theories of formation of chip and their effect.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to understand single point cutting tool geometry and its design theory of chip formation.

**UNIT III**

Design of multipoint cutting tools: Drill geometry, Design of Drills, Rake & Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, milling cutters, cutting speeds and feed-machining times-design-form cutters, combination tools, reamers etc.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to understand the drilling tool geometry and its design. Tool life, machinability and tool wear.

**UNIT IV**

Design of jigs and fixtures: Basic principles of location and clamping, locating, methods and devices, jigs, definitions, types, general consideration in the design of jigs, drills bushing, methods of construction, fixtures-vice fixtures milling, boring, and lathe grinding fixtures.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to understand the design of Jigs and fixtures and advantages and disadvantages of Jigs and fixtures, types of Jigs & Fixtures – Principles of location and clamping. Some examples of jigs and fixtures.

**UNIT V**

Design of sheet metal blanking and piercing: Fundamentals of die cutting operating, power press- types, General press information, Material handling equipment, cutting action in punch and die operation. Die clearance, and types of Die construction. Die design fundamentals-blanking and piercing die construction, pilots, stripper and pressure pads presswork material, strip layout.

Design of sheet metal bending, forming and drawings die: Bending dies, drawing dies, forming dies, drawing operations, variables that effect metal flow during drawing. Determination of blank size, drawing force, single and double action draw dies.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to understand the press working operations like punching, blanking, bending, drawing and forming, types of power presses, design of die, strip layout

**Text Books:**

1. *Tool Design*, Donaldson, Lecain and Goold, Tata McGraw Hill, 4<sup>th</sup> edition, 2012.
2. *Principles of Metal cutting*, A Bhattacharya, New Central Book Agency, Calcutta
3. *ASTME Hand book on Tool Design*.

**Reference Books:**

1. *Production Engineering Design (Tool Design)*, SurendraKenav and Umesh 'Chandra, Satyaprakashan, New Delhi 1994..
2. *Design of cutting Tools. Use of Metal Cutting Theory*. ASTME publication Michigan USA, 1969. Amitabha Battacharya

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B.Tech. IV-II Sem.

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**(13A03805) TRIBOLOGY**  
(Elective – III)

**Course Objective:**

*Students should be able to understand the effect and importance of friction between different surfaces and should know to calculate the friction.*

*Students must be able to know the phenomenon of wear between surfaces in contact and its implications. Students should be able to understand the principles, methods, purpose and selection of lubricants for the reduction of friction.*

*Students should be able to understand the lubrication theory and the flow of lubricants with different applications.*

*Students should know the surface treatment methods to improve the wear resistance and friction properties. Material selection for different types of bearings could be understand*

**UNIT I**

**SURFACES AND FRICTION:** Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction - Adhesion Ploughing- Energy dissipation mechanisms Friction Characteristics of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction - Stick slip motion - Measurement of Friction.

**Learning Outcome & Suggested Student Activities:**

*Students can understand the characteristics of engineering surfaces, sources of friction, friction characteristics of metals and non metals and friction measurements. The following URLs are highly useful for better understanding. For the topic rolling friction go through the website <http://www.phy.davidson.edu/fachome/dmb/PY430/Friction/rolling.html>. For friction related topics go through the link <http://nptel.iitm.ac.in/courses/112102015/5> and <http://nptel.iitm.ac.in/courses/112102014/3>*

**UNIT II**

**WEAR:** Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear - Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture wear - Wear of Ceramics and Polymers - Wear Measurements.

**Learning Outcome & Suggested Student Activities:**

*Students can understand the wear and wear mechanisms, situations causing wear and methods to reduce and also know the materials for a particular wear situation. Students are advised to visit materials lab in the college for understand the properties and also visit following URLs [http://www.substech.com/dokuwiki/doku.php?id=mechanisms\\_of\\_wear](http://www.substech.com/dokuwiki/doku.php?id=mechanisms_of_wear) [http://www.substech.com/dokuwiki/doku.php?id=tribology\\_of\\_ceramics&s=film%20lubrication%20theory](http://www.substech.com/dokuwiki/doku.php?id=tribology_of_ceramics&s=film%20lubrication%20theory) <http://nptel.iitm.ac.in/courses/112102015/11> and <http://nptel.iitm.ac.in/courses/112102014/6>*

**UNIT III**

**LUBRICANTS AND LUBRICATION TYPES:** Types, properties, Requirements of Lubricants - Testing methods - Hydrodynamic Lubrication - Elasto hydrodynamic lubrication- Boundary Lubrication, Mist lubrication, Requirements of lubrication, Solid Lubrication, Hydrostatic Lubrication.

**Learning Outcome & Suggested Student Activities:**

*Students can understand the properties of different lubricants used for various applications, testing methods of lubrications and types of lubrications. Students are able to identify the lubrication modes such as hydrodynamic lubrication, elasto-hydrodynamic lubrication, formulate elasto-hydrodynamic lubrication models for line and point contacts. Students are advised to visit automobile workshop/various labs in the college and to know how the lubricants are using for different applications. The following URLs are useful for better understanding [http://www.substech.com/dokuwiki/doku.php?id=classification\\_of\\_lubricants&s=types%20properties%20](http://www.substech.com/dokuwiki/doku.php?id=classification_of_lubricants&s=types%20properties%20)*

*lubricants*

<http://nptel.iitm.ac.in/courses/112102015/17> and <http://nptel.iitm.ac.in/courses/112102014/11>

#### **UNIT IV**

**FILM LUBRICATION THEORY:** Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings - Reaction torque on the bearings - Virtual Co-efficient of friction - The Somerfield diagram.

#### **Learning Outcome & Suggested Student Activities:**

*Students can able to understand the theory of film lubrication, principles of bearing selection, reaction torque on the bearings, virtual co-efficient of friction, somerfield diagram and bearing arrangement in machines. The students are advised to observe the working of journal bearing in any workshops/ machine labs an also visit following URLs <http://nptel.iitm.ac.in/courses/112102015/24> and <http://nptel.iitm.ac.in/courses/112102014/19> [http://rotorlab.tamu.edu/me626/Notes\\_pdf/Modern%20Lub%20Notes%2001-15.pdf](http://rotorlab.tamu.edu/me626/Notes_pdf/Modern%20Lub%20Notes%2001-15.pdf).*

#### **UNIT V**

**SURFACE ENGINEERING AND MATERIALS FOR BEARINGS:** Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes - Surface coatings - Plating and anodizing - Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

#### **Learning Outcome & Suggested Student Activities:**

*Students can understand how the surface treatment methods are useful to improve the wear resistance and friction properties for the mating surfaces and also know the selection of bearing materials for different types of bearings. Students are advised to visit bearings manufacturing industry to understand design concepts, materials and also visit following URLs [http://www.substech.com/dokuwiki/doku.php?id=engine\\_bearing\\_materials&s=materials%20bearings](http://www.substech.com/dokuwiki/doku.php?id=engine_bearing_materials&s=materials%20bearings) <http://nptel.iitm.ac.in/courses/112102015/28> and <http://nptel.iitm.ac.in/courses/112102014/27>.*

#### **Text Books:**

1. I.M. Hutchings, Tribology, " Friction and Wear of Engineering Material ", Edward Arnold, London, 1992.

#### **Reference Books:**

1. T.A. Stolarski, " Tribology in Machine Design ", Industrial Press Inc., 1990.
2. Kenneth C Ludema, Friction, Wear, Lubrication: A textbook in Tribology, CRC Press, 1996.
3. A.Cameron, " Basic Lubrication theory ", Longman, U.K., 1981.
4. M.J.Neale (Editor), " Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K., 1975.
5. B.C. Majumdar "Introduction to Tribology bearings", S. Chand

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-II Sem.

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(13A03806) COMPOSITE MATERIALS  
(Elective – III)

**Course Objective:**

To understand the variety of composite materials (anisotropic material) vis a vis metals and alloys from the view point of industrial applications.

To understand manufacturing methods of composites for economic production. To understand methods of analysis to help effective product design.

**UNIT – I**

**INTRODUCTION TO COMPOSITES**

Fundamentals of composites - need for composites – Enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC, Fiber reinforced composites. Applications of various types of composites.

**Learning Outcome & Suggested Student Activities**

Is to understand the need of composite materials and know the properties, types and Applications of various types of composites. Student my refer the text book Chawla K.K., Composite materials, Springer – Verlag, 1987 To down load video lectures nptel.iitm.ac.in/courses/101104010, www.learnerstv.com/.../Free-video-Lecture-29989-Engineering.htm,

**UNIT II**

**POLYMER MATRIX COMPOSITES**

Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres – Woven fabrics – Non woven random mats – various types of fibres. PMC processes - Hand layup processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding - Resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP).

**Learning Outcome & Suggested Student Activities:**

Is to understand the Types of polymers Thermosetting and thermoplastic resins etc, types of fibers and manufacturing methods of polymers. Student my refer the text book Chawla K.K., Composite materials, Springer – Verlag, 1987 To down load video lectures nptel.iitm.ac.in/courses/101104010, www.learnerstv.com/.../Free-video-Lecture-29989-Engineering.htm

**UNIT III**

**METAL MATRIX COMPOSITES**

Characteristics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Limitations of MMC, Metal Matrix.. Effect of reinforcement - Volume fraction – Rule of mixtures. Processing of MMC – Powder metallurgy process - diffusion bonding – stir casting – squeeze casting.

**Learning Outcome & Suggested Student Activities:**

Is to understand the various types of metal composites and difference between alloy and metal composites, and manufacturing methods of metal composites. Student my refer the text book Mathews F.L. and Rawlings R.D., Composite materials: Engineering and Science, Chapman and Hall, London, England, 1st edition, 1994. To down load video lectures nptel.iitm.ac.in/courses/101104010, www.learnerstv.com/.../Free-video-Lecture-29989-Engineering.htm

## UNIT IV CERAMIC MATRIX COMPOSITES

Engineering ceramic materials – properties – advantages – limitations – Monolithic ceramics - Need for CMC – Ceramic matrix - Various types of Ceramic Matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing).

### **Learning Outcome & Suggested Student Activities:**

*Is to understand the properties advantages, limitations of ceramics, types of ceramics and manufacturing methods of ceramic composites. Student may refer the text book Mathews F.L. and Rawlings R.D., Composite materials: Engineering and Science, Chapman and Hall, London, England, 1st edition, 1994. To download video lectures [nptel.iitm.ac.in/courses/101104010](http://nptel.iitm.ac.in/courses/101104010), [www.learnerstv.com/.../Free-video-Lecture-29989-Engineering.htm](http://www.learnerstv.com/.../Free-video-Lecture-29989-Engineering.htm)*

## UNIT V ADVANCES IN COMPOSITES

Carbon / carbon composites – Advantages of carbon matrix – limitations of carbon matrix Carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol gel technique. Composites for aerospace applications.

### **Learning Outcome & Suggested Student Activities:**

*Student can able to understand the properties advantages, limitations of carbon composites and manufacturing methods of carbon composites. Student may refer the text book Mathews F.L. and Rawlings R.D., Composite materials: Engineering and Science, Chapman and Hall, London, England, 1st edition, 1994. To download video lectures [nptel.iitm.ac.in/courses/101104010](http://nptel.iitm.ac.in/courses/101104010), [www.learnerstv.com/.../Free-video-Lecture-29989-Engineering.htm](http://www.learnerstv.com/.../Free-video-Lecture-29989-Engineering.htm)*

### **Text Books:**

1. Mathews F.L. and Rawlings R.D., *Composite materials: Engineering and Science*, Chapman and Hall, London, England, 1st edition, 1994.
2. Chawla K.K., *Composite materials*, Springer – Verlag, 1987

### **Reference Books:**

1. Clyne T.W. and Withers P.J., *Introduction to Metal Matrix Composites*, Cambridge University Press, 1993.
2. Strong A.B., *Fundamentals of Composite Manufacturing*, SME, 1989.
3. Sharma S.C., *Composite materials*, Narosa Publications, 2000.
4. *Short Term Course on Advances in Composite Materials*, Composite Technology Centre, Department of Metallurgy, IIT- Madras, December 2001.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. IV-II Sem.**

<b>Th</b>	<b>Tu</b>	<b>C</b>
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**(13A03807) MODERN MANUFACTURING METHODS  
(Elective-IV)**

**Course Objective:**

*To make the students to understand the advanced manufacturing techniques evolved in manufacturing scenario.*

*To learn about the advanced manufacturing techniques USM,AJM,ECM,CM,EDM,PM,EBM,LSB,*

**UNIT I**

Need for Modern Manufacturing Methods: Non-traditional machining methods and rapid prototyping methods - their relevance for precision and lean manufacturing.

Classification of non-traditional processes - their selection for processing of different materials and the range of applications.

Introduction to rapid prototyping - Classification of rapid prototyping methods - sterolithography, fused deposition methods - materials, principle of prototyping and various applications.

*Learning outcome & Suggested Student Activities:*

*After completion of this unit students are able to understand importance of non-traditional machining processes, features, classifications and applications of non-traditional methods.*

*<http://www.nptel.iitm.ac.in>*

*<http://www.iitkgp.ac.in> <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm>.*

**UNIT II**

Ultrasonic machining – Elements of the process, mechanics of material removal, process parameters, applications and limitations.

Abrasive jet, Water jet and abrasive water jet machining: Basic mechanics of material removal, descriptive of equipment, process variables, applications and limitations.

*Learning outcome & Suggested Student Activities:*

*After completion of this unit students are able to understand the processes of USM and AJM, process parameters, application and limitations.*

*<http://www.nptel.iitm.ac.in>*

*<http://www.iitkgp.ac.in> <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv530-Page1.htm>*

**UNIT III**

Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, metal removal rate in ECM, Tooling, process variables, applications, economic aspects of ECM.

Chemical Machining: Fundamentals of chemical machining- Principle of material removal- maskants – etchants- process variables, advantages and applications.

*Learning outcome & Suggested Student Activities:*

*After completion of this unit students are able to understand the Electro-chemical process and applicable in manufacturing environment in terms of accuracy, surface finish and MRR and their relative advantages and disadvantages. He has to understand the chemical machining advantages and applications.*

*<http://www.nptel.iitm.ac.in>*

*<http://www.iitkgp.ac.in> <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm> <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv530-Page1.htm>*



## UNIT IV

Thermal Metal Removal Processes: Basic principle of spark erosion (EDM), Wire cut EDM, and Electric Discharge Grinding processes - Mechanics of machining, process parameters, selection of tool electrode and dielectric fluids, choice of parameters for improved surface finish and machining accuracy - Applications of different processes and their limitations.

Plasma Machining: Principle of material removal, description of process and equipment, process variables, scope of applications and the process limitations.

### **Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the types of thermal based metal removal processes, principle of working, accuracy in machining, surface finish, tool selection and other machining parameters.*

*<http://www.nptel.iitm.ac.in>, <http://www.iitkgp.ac.in>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv530-Page1.htm>*

## UNIT V

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes - process mechanics, parameters, applications and limitations.

Laser Beam Machining: Process description, Mechanism of material removal, process parameters, capabilities and limitations, features of machining, applications and limitations.

### **Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand and its the applications of electron beam and laser beam in manufacturing environment, accuracy, machining speed and etc, with respect to all non-traditional machining processes.*

*<http://www.nptel.iitm.ac.in>, <http://www.iitkgp.ac.in>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv530-Page1.htm>*

### **Text Books:**

1. *Advanced machining processes*, VK Jain, Allied publishers.
2. *Manufacturing processes for engineering materials* by Serope Kalpakjian and Steven R Schmid, 5edn, Pearson Pub.

### **Reference Books:**

1. *New Technology*, Bhattacharya A, The Institution of Engineers, India 1984
2. *Manufacturing Technology*, Kalpakzian, Pearson
3. *Modern Machining Process*, Pandey P.C. and Shah H.S., TMH.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-II Sem.

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(13A03808) DESIGN OF HEAT TRANSFER EQUIPMENT  
(Elective-IV)

**Course Objective:**

To make the students to understand the design concepts of various heat transfer equipment such as Condensers, evaporators, cooling towers, spray ponds, fans and piping system  
To make student aware of using Kay chart, London chart and Moody's chart.  
To make student aware over the design concepts of design concepts of compressors, fan and piping system

**UNIT I**

Shell and Tube Heat Exchangers: Tube layouts for exchangers baffle Heat exchangers, calculation of shell and tube heat exchangers – shell side film coefficients, shell side equivalent diameter, the true temperature difference in a 1-2 heat exchanger, influence of approach temperature on correction factor, shell side pressure drop, tube side pressure drop, Analysis of performance of 1-2 heat exchanger, and design calculation of shell and tube heat exchanger. Flow arrangements for increased heat recovery, the calculations of 2-4 exchangers. - Mean Temperature distribution for Parallel and Counter Flow - Effectiveness Method (N.T.U.) – Keys and London Charts.

**Learning Outcome & Suggested Student Activities:**

After the completion of the unit, student can know the use of Kay and London chart in the analysis of heat exchanger. Student can differentiate ideal and actual heat exchanger.  
Students are advised visit to heat transfer lab consisting mixed and no-mix heat exchanger. Students are advised to visit the following URL for better understanding the concepts.  
[www.alfalaval.com/plateheatexchange](http://www.alfalaval.com/plateheatexchange)  
[www-che.engr.cuny.cuny.edu/rinard/design/materials/3.pdf](http://www-che.engr.cuny.cuny.edu/rinard/design/materials/3.pdf)

**UNIT II**

Design of Condensers: Types - Overall Heat Transfer Coefficients – Temperature Distribution and Heat Flow in Condenser – Pressure Drop in Condenser – Extended Fin Surfaces – Fouling Factor – Correction Factor.

**Learning Outcomes & Suggested Student Activities:**

Student can know the application of extended surface in the design of a condenser. Also students are advised to visit the condenser plant of steam power plant. [www.conftool.com/.../Hermes-2012-Thermodynamic\\_Design\\_of\\_Condensers\\_and\\_evaporators-2100-pdf](http://www.conftool.com/.../Hermes-2012-Thermodynamic_Design_of_Condensers_and_evaporators-2100-pdf) [www.cycle-tempo.nl/Apparatus/Condenser.pdf](http://www.cycle-tempo.nl/Apparatus/Condenser.pdf)

**UNIT III**

Design Of Evaporators: Types - Temperature Distribution and Heat Flow in an Evaporator – Pressure Drop – Factors Affecting the Design of Evaporators – Fouling Factor – Correction Factor.

**Learning Outcome & Suggested Student Activities:**

At the end of the unit, student can know the selection of suitable length and diameter of evaporator pipe needed considering pressure drop into account during fluid flow. Student can know the application of design in the area of steam generators. Student can know the impact of dust accumulation on rate of heat transfer in the form of fouling factor.  
Students are advised to visit the following URL for better understanding the concepts.  
[epdfiles.engr.wisc.edu/pdf\\_web\\_files/epd/L401.pdf](http://epdfiles.engr.wisc.edu/pdf_web_files/epd/L401.pdf)  
[Thermodynamic\\_Design\\_of\\_Condensers\\_and\\_evaporators-2100-2-pdf](http://www.cycle-tempo.nl/Apparatus/Condenser.pdf)  
[http://refrigtech.com/Knowledge\\_Center/Knowledge\\_Characteristics\\_Evaporators.pdf](http://refrigtech.com/Knowledge_Center/Knowledge_Characteristics_Evaporators.pdf)

## UNIT IV

Design Of Cooling Towers And Spray Ponds: Classification – Performance of Cooling Towers – Analysis of Counter Flow Cooling Towers – Cross Flow Cooling Towers - Enthalpy – Temperature Diagram of Air and Water – Cooling Ponds – Types of Cooling Ponds – Procedure for Calculation of Outlet Conditions.

### **Learning Outcome & Suggested Student Activities:**

At the end of the chapter, student can able to design cooling tower considering the heat rejection capacity of a condenser under forced and natural draught. Student can know different types of cooling towers and cooling ponds.

Students are advised to visit thermal power plants and Ice making plants to get practical expose. Students are advised to visit the following URL for better understanding the concepts.

<http://www.che.com/nl/YToyOntpOjA7czo0Oil4OTQ5IjtpOjE7czo4NjoicHJyY2Vzc2luZl9hbmRfaGFuZGxpbmcvdGhlcm1hbF9hbmRfZW5lcmd5X21nbXQvaGVhdF9leGNoYW5nZXJzX2NybmRlbnNlcnNfYW5kX2Nvb2xlcuMiO30=/>

<http://kolmetz.com/pdf/EDG/ENGINEERING%20DESIGN%20GUIDELINES%20-%20Cooling%20Towers%20-%20Rev01.pdf>, <http://cedb.asce.org/cgi/WWWdisplay.cgi?10570>

## UNIT V

Vapourisers, Evaporators and Reboilers: Calculation of a horizontal condenser, vertical condenser, de-superheater condenser, vertical condenser – sub-cooler, horizontal condenser.

### **Learning Outcome & Suggested Student Activities:**

At the end of the chapter, student can able to design vapouriser evaporators and Reboilers, student can know how evaporators will work, functioning of reboilers.

### **Text Books:**

1. Numerical heat transfer and fluid flow, Suhas V. Patankar, Butter-worth Publishers
2. Computational fluid dynamics, Basics with applications, John. D. Anderson! Mc Graw Hill.

### **Reference Books:**

1. Computational Fluid Flow and Heat Transfer, Niyogi, Pearson Publications

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-II Sem.

Th 3  
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(13A03809) MECHANICAL VIBRATIONS  
(Elective-IV)

**Course Objective:**

To make the students to learn about basic concepts and definitions of mechanical vibrations and to write equation of motion for discrete spring-mass systems with different configuration using classical and energy methods.

To make the students to learn about basic concepts of forced vibrations, vibration transmissibility and isolation and seismic instruments. Further to understand about various vibration control methods.

To familiarize the students about theory of vibrations of two degree freedom system and various types of vibration absorbers.

To analyze the two degree and multi degree of Freedom Systems.

To familiarize the students about theory of vibrations of multi degree freedom system and various methods to solve vibration problems of multi degree freedom systems.

To familiarize the students about theory of vibrations of continuous systems and to find whirling speed of shaft with and without damping.

**UNIT I**

Introduction: Importance and scope, definitions and terminology, simple harmonic motion, combination of simple harmonic motions, Fourier analysis.

Single Degree Freedom Systems: Un-damped free vibration: Classical method, Energy method, equivalent systems, torsional systems. Damped free vibration- Viscous damping, under damping, critical damping, over damping, Coulomb damping, equivalent damping coefficient. Simple problems.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to find natural frequency of un-damped single degree freedom systems and the behavior of single degree freedom systems with damping. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of mechanical vibrations.

<http://www.youtube.com/watch?v=DMLEZMXOmc>

<http://www.newagepublishers.com/samplechapter/001216.pdf>

<http://www.youtube.com/watch?v=fwpat51ffSs&list=PL46AAEDA6ABAFCA78&index=27>

**UNIT II**

Forced vibrations of Single Degree Freedom Systems : Steady state forced vibration, sources of excitation, impressed harmonic force, resonance impressed force due to unbalance, motion excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping, General theory of seismic instruments, accelerometer and vibrometer, methods of vibration control- excitation reduction at source, system modification.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit, students are able to solve vibration problems with forcing function. to know about various instruments. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of forced vibrations.

<http://www.iitr.ac.in/outreach/web/CIRCIS/PG/AVN/RC/Revision%20of%20concepts4SDOF-Forced.pdf>

<http://www.freestudy.co.uk/dynamics/forced%20vibrations.pdf>

<http://www.youtube.com/watch?v=irudCaBrij0&list=PL46AAEDA6ABAFCA78&index=30>

<http://www.youtube.com/watch?v=tCiHYyPX6NM&list=PL46AAEDA6ABAFCA78&index=28>

**UNIT III**

Two Degree Freedom Systems: Formulation of Equation of motion, Natural frequencies and modes of vibration by classical method, coupled pendulum Beat Phenomena, forced vibration, dynamic vibration absorber.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit the students are able to analyze the two degree freedom systems with and without damping and to solve problems on vibration absorber. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of vibrations of two degree freedom systems.

<http://web.itu.edu.tr/~gundes/2dof.pdf>

[http://www.iitg.ernet.in/scifac/qip/public\\_html/cd\\_cell/chapters/r\\_tiwari\\_dyn\\_of\\_mach/Chapter\\_12\\_Vibration%20of%20two-degree-of-freedom%20system.pdf](http://www.iitg.ernet.in/scifac/qip/public_html/cd_cell/chapters/r_tiwari_dyn_of_mach/Chapter_12_Vibration%20of%20two-degree-of-freedom%20system.pdf) <http://www.youtube.com/watch?v=6gX4ox-r5t0&list=PL46AAEDA6ABAFCA78>

**UNIT IV**

Multi Degree Freedom Systems: Lagrangian method for formulation of equation of motion Influence coefficient method, Lumped mass and distributed mass systems, Stodola method, Holzer's method, Matrix iteration method, orthogonality of mode shapes, model analysis of free and forced vibrations.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit the students are able to analyze the multi degree freedom systems using Stodola method, Holzer's method and Matrix iteration method. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of vibrations of many degree freedom systems. <http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-20-structural-mechanics-fall-2002/lecture-notes/unit22.pdf>

<http://www.youtube.com/watch?v=h7dUHXxfP9w&list=PL46AAEDA6ABAFCA78>

**UNIT V**

Vibration of Continuous Systems: Longitudinal vibration of bars, torsional vibrations of circular rods or shafts, lateral vibrations of beams and shafts.

Whirling of Shafts: Critical speed of shafts, Rayleigh's upper bound approximation, Dunkerley's lower bound approximation, critical speed of shafts with damping.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit the students are able to find lowest natural frequency of the shaft using Rayleigh's upper bound approximation and Dunkerley's lower bound approximation. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of vibrations of continuous systems.

<http://www.freestudy.co.uk/dynamics/forced%20vibrations.pdf>

<http://aerade.cranfield.ac.uk/ara/arc/rm/2854.pdf>

<http://www.youtube.com/watch?v=klqMuDDb0Tc&list=PL46AAEDA6ABAFCA78>

**Text Books:**

1. Elements of Vibrations Analysis L. Meirovich Tata McGraw Hill.
2. Vibration of Mechanical Systems, C. Nataraj, Cenage Learning, 1<sup>st</sup> edition, 2012.

**Reference Books:**

1. Mechanical Vibrations, S. Graham Kelly, Tata McGraw Hill.
2. Vibration Theory and Applications, William Thomson, Pearson Education, New Delhi
3. Vibration problems in Engineering, Timeoshenko and Young, John Wiley and sons Publishers, Singapore.
4. Singrasu S. Rao, Mechanical Vibrations, Pearson Education, New Delhi.

**Web References:**

- Machine Dynamics by Prof. Amitabha Ghosh, IITK, Kanpur <http://nptel.iitm.ac.in/video.php?subjectId=112104114>
- Machine Dynamics by Prof. C. Amarnath, Prof. K. Kurien Issac, Prof. P. Seshu of IITB, Mumbai <http://www.cdeep.iitb.ac.in/nptel/Mechanical/Dynamics%20of%20Machines/TOC.html>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. IV-II Sem.**

<b>Th</b>	<b>Tu</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>3</b>

**(13A03810) PRODUCT DESIGN  
(Elective-IV)**

**UNIT I**

**PRODUCT DEVELOPMENT PROCESS**

General problem solving process - Flow of Work during the process of designing - Activity Planning  
Timing and scheduling, Planning Project and Product Costs - Effective Organization Structures -  
Interdisciplinary Cooperation, Leadership and Team behavior.

**UNIT II**

**TASK CLARIFICATION**

Importance of Task Clarification - Setting up a requirements list - Contents, Format, Identifying the  
requirements, refining and Extending the requirements, Compiling the requirements list, Examples.  
Using requirements lists - Updating, Partial requirements lists, Further uses - Practical applications of  
requirements lists.

**UNIT III**

**CONCEPTUAL DESIGN**

Steps in Conceptual Design.

Abstracting to identify the essential problems - Aim of Abstraction, Broadening the problem.  
Formulation, Identifying the essential problems from the requirements list, Establishing functions  
structures, Overall function, Breaking a function down into sub-functions.

Developing working structures - Searching for working principles, Combining Working Principles,  
Selecting Working Structures, Practical Application of working structures.

Developing Concepts - Firming up into principle solution variants, Evaluating principle solution variants,  
Practical Applications of working structures.

Examples of Conceptual Design - One Handed Household Water Mixing Tap, Impulse - Loading Test  
Rig.

**UNIT IV**

**EMBODIMENT DESIGN** - Steps of Embodiment Design, Checklist for Embodiment

Design Basic rules of Embodiment Design

Principles of Embodiment Design - Principles of Force Transformations, Principles of Division of Tasks,  
Principles of Self-Help, Principles of Stability and Bi-Stability, Principles of Fault-Free Design

Guide for Embodiment Design - General Considerations, Design to allow for expansion, Design to allow  
for creep and relaxation, Design against Corrosion, Design to minimize wear, Design to Ergonomics,  
Design for Aesthetics, Design for Production, Design for Assembly, Design for Maintenance, Design for  
Recycling, Design for Minimum risk, Design to standards.

Evaluation of Embodiment Designs.

**UNIT V**

**MECHANICAL CONNECTIONS, MECHATRONICS AND ADAPTRONICS**

Mechanical Connections - General functions and General Behavior, Material connections, From  
Connections, Force connections, Applications.

Mechatronics - General Architecture and Terminology, Goals and Limitations, Development of  
Mechatronic Solution, Examples.

Adaptronics - Fundamentals and Terminology, Goals and Limitations, Development of Adaptronics  
Solutions, Examples.

**Text Books:**

1. *Engineering Design: G.Paul; W. Beitzetal, Springer International Education 2010.*
2. *Product Design And Development: Kevin Otto: K. Wood Pearson Education 2013.*

**Reference Books:**

1. *Product Planning Essentials: Kenith B. Kahu, Yes dee Publishing 2011.*
2. *Product Design and Development: K.T. Ulrich TMH Publishers 2011.*

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
*(Established by Govt. of A.P., Act. No. 30 of 2008)*  
**ANANTHAPURAMU – 515 002 (A.P.) INDIA.**

**Course Structure for B.Tech-R15 Regulations**

**Mechanical Engineering**

**B.Tech I – I Semester (ME)**

S.No	Course code	Subject	L	T	P	C
1.	15A52101	Functional English	3	1	-	3
2.	15A54101	Mathematics – I	3	1	-	3
3.	15A05101	Computer Programming	3	1	-	3
4.	15A51101	Engineering Chemistry	3	1	-	3
5.	15A01101	Environmental Studies	3	1	-	3
6.	15A52102	English Language Communication Skills Lab	-	-	4	2
7.	15A51102	Engineering Chemistry Lab	-	-	4	2
8.	15A05102	Computer Programming Lab	-	-	4	2
Total			15	5	12	21

**I-II Semester**

S.No	Course code	Subject	L	T	P	Drg	C
1.	15A52201	English for Professional Communication	3	1	-	-	3
2.	15A54201	Mathematics – II	3	1	-	-	3
3.	15A03201	Material Science and Engineering	3	1	-	-	3
4.	15A56101	Engineering Physics	3	1	-	-	3
5.	15A03101	Engineering Drawing	-	-	-	6	3
6.	15A03202	Material Science and Engineering Lab	-	-	4	-	2
7.	15A56102	Engineering Physics Lab	-	-	4	-	2
8.	15A99201	Engineering & IT Workshop	-	-	4	-	2
Total			12	4	12	6	21

- \* L - Lecture hours
- \* T - Tutorial hours
- \* P - Practical hours
- \* Drg - Drawing
- \* C - Credits

**II B. Tech – I Sem**

S.No.	Course Code	Subject	L	T	P	C
1	15A54301	Mathematics - III	3	1	-	3
2	15A52301	Managerial Economics & Financial Analysis	3	1	-	3
3	15A01308	Mechanics of Solids	3	1	-	3
4	15A03301	Engineering Drawing for Mechanical Engineers	3	1	-	3
5	15A03302	Engineering Mechanics	3	1	-	3
6	15A03303	Thermodynamics	3	1	-	3
7	15A01309	Mechanics of Solids Lab	-	-	4	2
8	15A03304	Computer Aided Drafting Lab	-	-	4	2
Total			18	06	08	22

**II B. Tech – II Sem**

S.No.	Course Code	Subject	L	T	P	C
1	15A54401	Probability and Statistics	3	1	-	3
2	15A99301	Basic Electrical and Electronics Engineering	3	1	-	3
3	15A03401	Machine Drawing	3	1	-	3
4	15A03402	Kinematics of Machines	3	1	-	3
5	15A03403	Thermal Engineering – 1	3	1	-	3
6	15A03404	Manufacturing Technology	3	1	-	3
7	15A03405	Thermal Engineering Laboratory	-	-	4	2
8	15A03406	Manufacturing Technology Laboratory	-	-	4	2
9	15A03407	Comprehensive Online Examination-I	-	-	-	1
Total			18	06	08	23



**B.Tech III-I Semester (ME)**

S. No.	Course Code	Subject	L	T	P	C	
1.	15A01510	Fluid Mechanics and Hydraulic Machines	3	1	-	3	
2.	15A03501	Thermal Engineering - II	3	1	-	3	
3.	15A03502	Dynamics of Machinery	3	1	-	3	
4.	15A03503	Machine Tools	3	1	-	3	
5.	15A03504	Design of Machine Members - I	3	1	-	3	
6.		<b>MOOCS -I</b>		1	-		
	15A03505	a. Entrepreneurship	3			3	
	15A03506	b. Nano Technology					
	15A03507	c. Micro Electro Mechanical Systems					
7.	15A01511	Fluid Mechanics and Hydraulic Machines Laboratory	-	-	4	2	
8.	15A03508	Machine Tools Laboratory	-	-	4	2	
9.	15A99501	Audit course – Social Values & Ethics	2	0	2	0	
<b>Total</b>			<b>20</b>	<b>6</b>	<b>10</b>	<b>22</b>	

**B.Tech III-II Semester (ME)**

S. No.	Course Code	Subject	L	T	P	C	
1.	15A03601	Operations Research	3	1	-	3	
2.	15A03602	Design of Machine Members – II	3	1	-	3	
3.	15A03603	Heat Transfer	3	1	-	3	
4.	15A03604	Finite Element Method	3	1	-	3	
5.	15A03605	Metal forming Process	3	1	-	3	
6.		<b>CBCC-I</b>		1	-		
	15A03606	a. Non Conventional Source of Energy	3			3	
	15A03607	b. Total Quality Management					
	15A03608	c. Mechatronics					
	15A01608	d. Intellectual Property Rights					
7.	15A03609	Heat Transfer Laboratory	-	-	4	2	
8.	15A03610	Computer Aided Engineering Laboratory	-	-	4	2	
9.	15A52602	Advanced English Language Communication Skills (AELCS) Laboratory (Audit Course)			2	-	
10.	15A03611	Comprehensive Online Examination - II	-	-	-	1	
<b>Total</b>			<b>18</b>	<b>6</b>	<b>11</b>	<b>23</b>	

**B.Tech IV-I Semester (ME)**

S. No.	Course Code	Subject	L	T	P	C
1.	15A52601	Management Science	3	1	-	3
2.	15A03701	Automobile Engineering	3	1	-	3
3.	15A03702	CAD/CAM	3	1	-	3
4.	15A03703	Metrology and Measurements	3	1	-	3
5.	15A03704 15A03705 15A03706	<b>CBCC-II</b> a. Refrigeration and Air – Conditioning b. Tool Design c. Modern Manufacturing Methods	3	1	-	3
6.	15A03707 15A03708 15A03709	<b>CBCC-III</b> a. Computational Fluid Dynamics b. Automation and Robotics c. Production & Operations Management	3	1	-	3
7.	15A03710	CAD/ CAM Laboratory	-	-	4	2
8.	15A03711	Metrology and Measurements Laboratory	-	-	4	2
<b>Total</b>			<b>18</b>	<b>6</b>	<b>8</b>	<b>22</b>

**B.Tech IV-II Semester (ME)**

S. No.	Course Code	Subject	L	T	P	C
1.	15A03801 15A03802 15A03803	<b>MOOCS-II</b> a. Industrial Engineering b. Product Design c. Composite Materials	3	1	0	3
2.	15A03804 15A03805 15A03806	<b>MOOCS -III</b> a. Power Plant Engineering b. Gas Turbines and Jet Propulsion c. Energy Management	3	1	0	3
3.	15A03807	Comprehensive Viva Voce	0	0	4	2
4.	15A03808	Technical Seminar	0	0	4	2
5.	15A03809	Project work	0	0	24	12
<b>Total</b>			<b>6</b>	<b>2</b>	<b>32</b>	<b>22</b>

**Minor Discipline in ME**

<b>S. No.</b>	<b>Course Code</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	15A03303	Thermodynamics	3	1	-	3
2	15A03403	Thermal Engineering-I	3	1	-	3
3	15A03501	Thermal Engineering-II	3	1	-	3
4	15A03603	Heat Transfer	3	1	-	3
5	15A03101	Minor Discipline Project	-	-	-	8
		<b>Total</b>	<b>12</b>	<b>4</b>	<b>-</b>	<b>20</b>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B. Tech I-I Sem. (ME)**

L	T	P	C
3	1	0	3

**(15A52101) FUNCTIONAL ENGLISH****(Common to All Branches)****Preamble:**

English is an international language as well as a living and vibrant one. People have found that knowledge of English is a passport for better career, better pay, and advanced knowledge and for communication with the entire world. As it is a language of opportunities in this global age, English is bound to expand its domain of use everywhere. The syllabus has been designed to enhance communication skills of the students of engineering and pharmacy. The prescribed book serves the purpose of preparing them for everyday communication and to face the global competitions in future.

The text prescribed for detailed study focuses on LSRW skills and vocabulary development. The teachers should encourage the students to use the target language. The classes should be interactive and learner-centered. They should be encouraged to participate in the classroom activities keenly.

In addition to the exercises from the text done in the class, the teacher can bring variety by using authentic materials such as newspaper articles, advertisements, promotional material etc.

**Objectives:**

- To enable the students to communicate in English for academic and social purpose.
- To enable the students to acquire structure and written expressions required for their profession.
- To develop the listening skills of the students.
- To inculcate the habit of reading and critical thinking skills.
- To enhance the study skills of the students with emphasis on LSRW skills.

**UNIT –I**

**Topics:** Paragraph writing, writing letters, role play, reading graphs, prepositions, designing posters, tenses, making recommendations.

**Text:** ENVIRONMENTAL CONSCIOUSNESS' from *MINDSCAPES*  
Climate Change - Green Cover – Pollution

**UNIT –II**

**Topics:** Compound nouns, imperatives, writing instructions, interpreting charts and pictures, note making, role play, prefixes, subject-verb agreement.

**Text:** EMERGING TECHNOLOGIES from *MINDSCAPES*  
Solar Thermal Power - Cloud Computing - Nanotechnology

**UNIT –III**

**Topics:** Making conversations, homonyms and homophones, SMS and use of emotions, past participle for irregular verbs, group discussion, E - mail communication, antonyms, Preparing projects

**Text:** GLOBAL ISSUES from *MINDSCAPES*  
Child Labour - Food Crisis - Genetic Modification - E-Waste - Assistive Technology

**UNIT –IV**

**Topics:** Group discussion, affixes, double consonants, debates, writing a book / film review, predicting and problem-solving-future tense, adverbs

**Text:** SPACE TREK from *MINDSCAPES*  
Hubble Telescope - Chandrayan-2 - Anusat - Living Quarters - Space Tourism

**UNIT –V**

**Topics:** Compare and contrast, effective writing, group discussion, writing reports, writing advertisements, tweeting and blogging, types of interviews, framing questions.

**Text:** MEDIA MATTERS from *MINDSCAPES*  
History of Media - Language and Media - Milestone in Media - Manipulation by Media - Entertainment Media - Interviews

**Text Books:**

1. MINDSCAPES: English for Technologists and Engineers, Orient Blackswan, 2014.

**References:**

1. A Practical Course in Effective English Speaking Skills by J.K.Gangal, PHI Publishers, New Delhi.2012
2. Technical Communication, Meenakshi Raman, Oxford University Press,2011.
3. Spoken English, R.K. Bansal & JB Harrison, Orient Longman,2013, 4<sup>th</sup> edition.
4. Murphy's English Grammar with CD, Murphy, Cambridge University Press,3<sup>rd</sup> edition.
5. An Interactive Grammar of Modern English, Shivendra K. Verma and Hemlatha Nagarajan , Frank Bros & CO,2008.

**Outcomes:**

- Have improved communication in listening, speaking, reading and writing skills in general.
- Have developed their oral communication and fluency in group discussions and interviews.
- Have improved awareness of English in science and technology context.
- Have achieved familiarity with a variety of technical reports.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech I-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**(15A54101) MATHEMATICS – I**
**(Common to All Branches)**
**Objectives:**

- To train the students thoroughly in Mathematical concepts of ordinary differential equations and their applications.
- To prepare students for lifelong learning and successful careers using mathematical concepts of differential and Integral calculus, ordinary differential equations and vector calculus.
- To develop the skill pertinent to the practice of the mathematical concepts including the students abilities to formulate and modeling the problems, to think creatively and to synthesize information.

**UNIT – I**

Exact, linear and Bernoulli equations, Applications to first order equations; Orthogonal trajectories, Simple electric circuits.

Non-homogeneous linear differential equations of second and higher order with constant coefficients with RHS term of the type  $e^{ax}$ ,  $\sin ax$ ,  $\cos ax$ , polynomials in  $x$ ,  $e^{ax}V(x)$ ,  $xV(x)$ .

**UNIT – II**

Method of variation of parameters, linear equations with variable coefficients: Euler-Cauchy Equations, Legendre's linear equation. Applications of linear differential equations- Mechanical and Electrical oscillatory circuits and Deflection of Beams.

**UNIT – III**

Taylor's and Maclaurin's Series - Functions of several variables – Jacobian – Maxima and Minima of functions of two variables, Lagrange's method of undetermined Multipliers with three variables only. Radius of curvature.

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**UNIT – IV**

Multiple integral – Double and triple integrals – Change of Variables – Change of order of integration. Applications to areas and volumes in Cartesian and polar coordinates using double and triple integral.

**UNIT – V**

Vector Calculus: Gradient – Divergence – Curl and their properties; Vector integration – Line integral - Potential function – Area – Surface and volume integrals. Vector integral theorems: Green's theorem – Stoke's and Gauss's Divergence Theorem (Without proof). Application of Green's, Stoke's and Gauss's Theorems.

**Text Books:**

1. Engineering Mathematics-I, E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher
2. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.

**References:**

1. Engineering Mathematics Volume-I, by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S.Chand publication.
2. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.
3. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
4. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.

**Outcomes:**

- The students become familiar with the application of differential and integral calculus, ordinary differential equations and vector calculus to engineering problems.
- The students attain the abilities to use mathematical knowledge to analyze, formulate and solve problems in engineering applications.



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech I-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**(15A05101) COMPUTER PROGRAMMING**
**(Common to All Branches)**
**Objectives:**

- Understand problem solving techniques
- Understand representation of a solution to a problem
- Understand the syntax and semantics of C programming language
- Understand the significance of Control structures
- Learn the features of C language

**UNIT - I**

Overview of Computers and Programming - Electronic Computers Then and Now - Computer Hardware - Computer Software - Algorithm - Flowcharts - Software Development Method - Applying the Software Development Method.

Types, Operators and Expressions: Variable Names - Data Types and Sizes - Constants - Declarations - Arithmetic Operators - Relational and Logical Operators - Type Conversions - Increment and Decrement Operators - Bitwise Operators - Assignment Operators and Expressions - Conditional Expressions - Precedence and Order of Evaluation.

**UNIT - II**

Selections Statements – Iteration Statements – Jump Statements- Expression Statements - Block Statements.

Single Dimensional Arrays – Generating a Pointer to an Array – Passing Single Dimension Arrays to Functions – Strings – Two Dimensional Arrays – Indexing Pointers – Array Initialization – Variable Length Arrays

**UNIT - III**

Pointer Variables – Pointer Operators - Pointer Expressions – Pointers And Arrays – Multiple Indirection – Initializing Pointers – Pointers to Functions – C’s Dynamic Allocation Functions – Problems with Pointers.

Understanding the scope of Functions – Scope Rules – Type Qualifiers – Storage Class Specifiers- Functions Arguments –The Return Statement.

#### **UNIT - IV**

Command line arguments – Recursion – Function Prototypes – Declaring Variable Length Parameter Lists

Structures – Arrays of Structures – Passing Structures to Functions – Structure Pointers – Arrays and Structures within Structures – Unions – Bit Fields – Enumerations – typedef

#### **UNIT - V**

Reading and Writing Characters – Reading and Writing Strings – Formatted Console I/O – Printf - Scanf – Standard C Vs Unix File I/O – Streams and Files – File System Basics – Fread and Fwrite – Fseek and Random Access I/O – Fprintf ( ) and Fscanf( ) – The Standard Streams – The Preprocessor Directives #define and #include.

#### **Text Books:**

1. “The Complete Reference C”- Fourth Edition- Herbert Schildt- McGrawHill Education.
2. “The C Programming Language” Second Edition- Brian W. Kernighan- Dennis M. Ritchie- Prentice Hall-India. (UNIT- I)

#### **References:**

1. Programming in C, Second Edition – Pradip Dey, Manas Ghosh, Oxford University Press.
2. “C From Theory to Practice”- George S. Tselikis- Nikolaos D. Tselikas- CRC Press.
3. “Programming with C”- R S Bichkar- University Press.
4. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A.Ananda Rao, Pearson Education. (UNIT-I)
5. Computer Fundamentals and C Programming- Second Edition- P.Chenna Reddy- Available at Pothi.com (<http://pothi.com/pothi/book/dr-p-chenna-reddy-computer-fundamentals-and-c-programming>).

#### **Outcomes:**

- 
- Apply problem solving techniques in designing the solutions for a wide-range of problems
  - Choose appropriate control structure depending on the problem to be solved
  - Modularize the problem and also solution

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech I-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**(15A51101) ENGINEERING CHEMISTRY**
**(Common to ECE/EIE/ME/IT)**
**Objectives:**

- The Engineering Chemistry course for undergraduate students is framed to strengthen the fundamentals of chemistry and then build an interface of theoretical concepts with their industrial/engineering applications.
- The course main aim is to impart in-depth knowledge of the subject and highlight the role of chemistry in the field of engineering.
- The lucid explanation of the topics will help students understand the fundamental concepts and apply them to design engineering materials and solve problems related to them. An attempt has been made to logically correlate the topic with its application.
- The extension of fundamentals of electrochemistry to energy storage devices such as commercial batteries and fuel cells is one such example.
- After the completion of the course, the student would understand the concepts of chemistry and apply to various materials for engineering applications.

**UNIT – I WATER QUALITY AND TREATMENT**

Impurities in water, Hardness of water and its Units, Disadvantages of hard water, Estimation of hardness by EDTA method, Numerical problems on hardness, Estimation of dissolved oxygen, Alkalinity, acidity and chlorides in water, Water treatment for domestic purpose (Chlorination, Bleaching powder, ozonisation)

Industrial Use of water:

For steam generation, troubles of Boilers: Scale & Sludge, Priming and Foaming, Caustic Embrittlement and Boiler Corrosion.

Treatment of Boiler Feed water:

Internal Treatment: Colloidal, Phosphate, Carbonate, Calgon and sodium aluminate treatment.

External Treatment: Ion-Exchange and Permutit processes.

**UNIT – II            POLYMERS**

i) Introduction: Basic concepts of polymerisation, Types of polymerisation (Chain Growth (Addition), Step growth (Condensation)), Mechanism: cationic, anionic, free radical and coordination covalent.

Plastomers: Thermosetting and Thermoplastics, Preparation, properties and Engineering applications of PVC, Teflon, Bakelite and nylons.

Elastomers

Natural Rubber; Processing of natural rubbers, Compounding of Rubber

Synthetic Rubber: Preparation, properties and engineering applications of Buna-S, Buna-N, Polyurethane, Polysulfide (Thiokol) rubbers

ii) Conducting polymers: Mechanism, synthesis and applications of polyacetylene, polyaniline.

iii) Inorganic Polymers: Basic Introduction, Silicones, Polyphosphazins  $(-R)_2P=N-$  applications

**UNIT – III            ELECTROCHEMISTRY**

i) Galvanic cells, Nernst Equation, Numerical calculations, Batteries: Rechargeable batteries (Lead acid, Ni-Cd, Lithium Ion Batteries), Fuels cells: (Hydrogen-Oxygen and Methanol-Oxygen, Solid oxide)

ii) Corrosion: Introduction, type of corrosion (Concentration cell corrosion, Galvanic corrosion), Chemical (Dry) and Electrochemical (Wet) Theory of corrosion. Galvanic series, factors affecting the corrosion (Metal and environment). Prevention: Cathodic protection (Sacrificial anode and impressed current), Inhibitors (Anodic and cathodic), electroplating (Copper, nickel and chromium) and electroless plating (Copper and nickel)

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**UNIT – IV                    FUELS AND COMBUSTION**

Classifications of Fuels – Characteristics of Fuels- Calorific Value – Units, Numerical Problems.

Solid Fuels: Coal-Classification and Analysis (proximate and ultimate), Coke :Characteristics of metallurgical coke, Manufacture of Metallurgical Coke by Otto Hoffmann's by product oven processes.

Liquid Fuels:

Petroleum: Refining of Petroleum, Gasoline- Octane Number, Diesel -Cetane Number, Synthetic Petrol: Bergius Processes, Fischer Troph's synthesis

Power Alcohol: Manufacture, Advantages and Disadvantages of Power Alcohol

Gaseous Fuels: Natural gas, Producer gas, Water gas, Coal gas and Biogas. Determination calorific value of Gases fuels by Junker's calorimeter.

Combustion: Basic principles and numerical problems, Flue Gas analysis by Orsat's apparatus.

**UNIT – V                    CHEMISTRY OF ENGINEERING MATERIALS**

i) Cement: Composition, Classification, preparation (Dry and Wet processes), Setting and Hardening (Hydration and Hydrolysis)

ii) Refractories: Introduction, Classification , properties and applications

iii) Lubricants: Introduction, classification (Solid, liquid, semi solid, emulsion and synthetic),Theory of lubrication (Thin film, Thick film & Extreme pressure) , properties of lubricants and applications.

iv) Carbon clusters: Fullerenes and Carbon Nano Tubes (CNT)

**Text Books:**

1. Engineering Chemistry, First Edition, Jayaveera KN, Subba Reddy GVand Ramachandraiah C, McGraw Hill Higher Education, New Delhi, 2013.

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2. A Text Book of Engineering Chemistry, 15<sup>th</sup> Edition, Jain and Jain, Dhanapathi Rai Publications, New Delhi, 2013.

**References:**

1. A Text book of Engineering Chemistry, 12<sup>th</sup> Edition, SS Dhara,Uma, S. Chand Publications, New Delhi, 2010.
2. Engineering Chemistry, First edition, K.B. Chandra Sekhar, UN.Das and Sujatha Mishra, SCITECH Publications India Pvt Limited, 2010.
3. Engineering Chemistry, First edition, Seshamaheswaramma K and Mridula Chugh, Pearson Education, 2013.

**Outcomes:** The student is expected to:

- Differentiate between hard and soft water. Understand the disadvantages of using hard water domestically and industrially. Select and apply suitable treatments domestically and industrially.
- Understand the electrochemical sources of energy
- Understand industrially based polymers, various engineering materials.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech I-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**(15A01101) ENVIRONMENTAL STUDIES**

**(Common to ECE/EIE/ME/IT)**

**Objectives:**

To make the students to get awareness on environment, to understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life to save earth from the inventions by the engineers.

**UNIT – I**

**MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES:** – Definition, Scope and Importance – Need for Public Awareness.

**NATURAL RESOURCES :** Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

**UNIT – II**

**ECOSYSTEMS:** Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

- a. Forest ecosystem.
- b. Grassland ecosystem
- c. Desert ecosystem
- d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)



**BIODIVERSITY AND ITS CONSERVATION :** Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

### UNIT – III

**ENVIRONMENTAL POLLUTION:** Definition, Cause, effects and control measures of :

- a. Air Pollution.
- b. Water pollution
- c. Soil pollution
- d. Marine pollution
- e. Noise pollution
- f. Thermal pollution
- g. Nuclear hazards

**SOLID WASTE MANAGEMENT:** Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

### UNIT – IV

**SOCIAL ISSUES AND THE ENVIRONMENT:** From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

### UNIT – V

**HUMAN POPULATION AND THE ENVIRONMENT:** Population growth, variation among nations. Population explosion – Family Welfare Programmed. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

**FIELD WORK:** Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc..

**Text Books:**

1. Text Book of Environmental Studies for Undergraduate Courses, Erach Bharucha, Universities Press Pvt Ltd, Hyderabad. 2<sup>nd</sup> Edition 2013.
2. Environmental Studies by Kaushik, New Age Publishers.

**References:**

1. Environmental Studies by Rajagopalan, Oxford Publishers.
2. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.
3. Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P. Ela - Printice hall of India Private limited.

**Outcomes:**

- Students will get the sufficient information that will clarify modern environmental concepts like equitable use of natural resources, more sustainable life styles etc.
- Students will realize the need to change their approach so as to perceive our own environmental issues correctly, using practical approach based on observation and self learning.
- Students become conversant with the fact that there is a need to create a concern for our environment that will trigger pro-environmental action; including simple activities we can do in our daily life to protect it.
- By studying environmental sciences, students are exposed to the environment that enables one to find out solution of various environmental problems encountered on and often.
- At the end of the course, it is expected that students will be able to identify and analyze environmental problems as well as the risks associated with these problems and efforts to be taken to protect the environment from getting polluted. This will enable every human being to live in a more sustainable manner.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech I-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>(15A52102) ENGLISH LANGUAGE COMMUNICATION SKILLS (ELCS) LAB</b>				

**(Common to All Branches)**

The Language Lab focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations and contexts.

**Objectives:**

- To enable students to learn better pronunciation through stress on word accent, intonation, and rhythm.
- To help the second language learners to acquire fluency in spoken English and neutralize mother tongue influence
- To train students to use language appropriately for interviews, group discussion and public speaking

**UNIT - 1**

1. Phonetics -importance
2. Introduction to Sounds of Speech
3. Vowels and consonants sounds
4. Phonetic Transcription

**UNIT - II**

5. Word Stress
6. Syllabification
7. Rules of word stress
8. Intonation

**UNIT - III**

9. Situational Dialogues
10. Role Plays
11. JAM
12. Describing people/objects/places

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**UNIT - IV**

13. Debates
14. Group Discussions
15. Interview skills

**UNIT - V**

16. Video speech writing
17. Book reviews -oral and written

**Minimum Requirements for ELCS Lab:**

The English Language Lab shall have two parts:

1. Computer Assisted Language Learning (CALL) Lab: The Computer aided Language Lab for 60 students with 60 systems, one master console, LAN facility and English language software for self- study by learners.
2. The Communication Skills Lab with movable chairs and audio-visual aids with a P.A. system, Projector, a digital stereo-audio & video system and camcorder etc.  
System Requirement (Hardware component):

Computer network with LAN with minimum 60 multimedia systems with the following specifications:

- i) P – IV Processor
  - a) Speed – 2.8 GHZ
  - b) RAM – 512 MB Minimum
  - c) Hard Disk – 80 GB
- ii) Headphones of High quality

**Suggested Software:**

1. Clarity Pronunciation Power – Part I (Sky Pronunciation)
2. Clarity Pronunciation Power – part II
3. K-Van Advanced Communication Skills
4. Walden InfoTech Software.

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**References:**

1. A Textbook of English Phonetics for Indian Students 2<sup>nd</sup> Ed T. Balasubramanian. (Macmillian),2012.
2. A Course in Phonetics and Spoken English, Dhamija Sethi, Prentice-Hall of India Pvt.Ltd
3. Speaking English Effectively, 2<sup>nd</sup> Edition Krishna Mohan & NP Singh, 2011. (Mcmillan).
4. A Hand book for English Laboratories, E.Suresh Kumar, P.Sreehari, Foundation Books,2011
5. Spring Board Succes, Sharada Kouhik, Bindu Bajwa, Orient Blackswan, Hyderabad, 2010.

**Outcomes:**

- Become active participants in the learning process and acquire proficiency in spoken English.
- Speak with clarity and confidence thereby enhance employability skills.

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<b>B. Tech I-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**(15A51102) ENGINEERING CHEMISTRY LAB****(Common to ECE/EIE/ME/IT)****Objectives:**

- Will learn practical understanding of the redox reaction
- Will learn the preparation and properties of synthetic polymers and other material that would provide sufficient impetus to engineer these to suit diverse applications
- Will also learn the hygiene aspects of water would be in a position to design methods to produce potable water using modern technology.

**List of Experiments:**

1. Determination of total hardness of water by EDTA method.
2. Determination of Copper by EDTA method.
3. Estimation of Dissolved Oxygen by Winkler's method
4. Estimation of iron (II) using diphenylamine indicator (Dichrometry – Internal indicator method).
5. Determination of Alkalinity of Water
6. Determination of acidity of Water
7. Preparation of Phenol-Formaldehyde (Bakelite)
8. Determination of Viscosity of oils using Redwood Viscometer I
9. Determination of Viscosity of oils using Redwood Viscometer II
10. Determination of calorific value of gaseous fuels by Junker's Calorimeter
11. Conductometric estimation of strong acid using standard sodium hydroxide solution

- 
12. Determination of Corrosion rate and inhibition efficiency of an inhibitor for mild steel in hydrochloric acid medium.
  13. Potentiometric determination of iron using standard potassium dichromate
  14. Colorimetric estimation of manganese.
  15. pH meter calibration and measurement of pH of water and various other samples.

(Any 10 experiments from the above list)

**References:**

1. Vogel's Text book of Quantitative Chemical Analysis, Sixth Edition – Mendham J et al, Pearson Education, 2012.
2. Chemistry Practical– Lab Manual, First edition, Chandra Sekhar KB, Subba Reddy GV and Jayaveera KN, SM Enterprises, Hyderabad, 2014.

**Outcomes:**

- Would be confident in handling energy storage systems and would be able combat chemical corrosion
- Would have acquired the practical skill to handle the analytical methods with confidence.
- Would feel comfortable to think of design materials with the requisite properties
- Would be in a position to technically address the water related problems.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech I-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**(15A05102) COMPUTER PROGRAMMING LAB**
**(Common to All branches)**
**Objectives:**

- Learn C Programming language
- To make the student solve problems, implement algorithms using C language.

**List of Experiments/Tasks**

1. Practice DOS and LINUX Commands necessary for design of C Programs.
2. Study of the Editors, Integrated development environments, and Compilers in chosen platform.
3. Write, Edit, Debug, Compile and Execute Sample C programs to understand the programming environment.
4. Practice programs: Finding the sum of three numbers, exchange of two numbers, maximum of two numbers, To read and print variable values of all data types of C language, to find the size of all data types, to understand the priority and associativity of operators using expressions, to use different library functions of C language.
5. Write a program to find the roots of a Quadratic equation.
6. Write a program to compute the factorial of a given number.
7. Write a program to check whether the number is prime or not.
8. Write a program to find the series of prime numbers in the given range.
9. Write a program to generate Fibonacci numbers in the given range.
10. Write a program to find the maximum of a set of numbers.
11. Write a program to reverse the digits of a number.
12. Write a program to find the sum of the digits of a number.
13. Write a program to find the sum of positive and negative numbers in a given set of numbers.
14. Write a program to check for number palindrome.
15. Write a program to evaluate the sum of the following series up to 'n' terms  

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \dots$$
16. Write a program to generate Pascal Triangle.
17. Write a program to read two matrices and print their sum and product in the matrix form.
18. Write a program to read matrix and perform the following operations.
  - i. Find the sum of Diagonal Elements of a matrix.
  - ii. Print Transpose of a matrix.



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- iii. Print sum of even and odd numbers in a given matrix.
19. Write a program to accept a line of characters and print the number of Vowels, Consonants, blank spaces, digits and special characters.
  20. Write a program to insert a substring in to a given string and delete few characters from the string. Don't use library functions related to strings.
  21. Write a program to perform the operations addition, subtraction, multiplication of complex numbers.
  22. Write a program to split a 'file' in to two files, say file1 and file2. Read lines into the 'file' from standard input. File1 should consist of odd numbered lines and file2 should consist of even numbered lines.
  23. Write a program to merge two files.
  24. Write a program to implement numerical methods Lagrange's interpolation, Trapezoidal rule.
  25. Write a program to read a set of strings and sort them in alphabetical order.
  26. Write a program to read two strings and perform the following operations without using built-in string Library functions and by using your own implementations of functions.
    - i. String length determination
    - ii. Compare Two Strings
    - iii. Concatenate them, if they are not equal
    - iv. String reversing
  27. Write programs using recursion for finding Factorial of a number, GCD, LCM, and solving Towers of Hanoi problem.
  28. Write a program to exchange two numbers using pointers.
  29. Write a program to read student records into a file. Record consists of rollno, name and marks of a student in six subjects and class. Class field is empty initially. Compute the class of a student. The calculation of the class is as per JNTUA rules. Write the first class, second class, third class and failed students lists separately to another file.
  30. A file consists of information about employee salary with fields employeedid, name, Basic, HRA, DA, IT, other-deductions, Gross and Net salary. Initially only employeedid, name, and basic have valid values. HRA is taken as 10% of the basic, DA is taken as 80% of basic, IT is 20% of the basic, other deductions is user specified. Compute the Gross and Net salary of the employee and update the file.
  31. Write a program to perform Base (decimal, octal, hexadecimal, etc) conversion.
  32. Write a program to find the square root of a number without using built-in library function.
  33. Write a program to convert from string to number.
  34. Write a program to implement pseudo random generator.
  35. Write a program to generate multiplication tables from 11 to 20.
  36. Write a program to express a four digit number in words. For example 1546 should be written as one thousand five hundred and forty six.

37. Write a program to generate a telephone bill. The contents of it and the rate calculation etc should be as per BSNL rules. Student is expected to gather the required information through the BSNL website.
38. Write a program to find the execution time of a program.
39. Design a file format to store a person's name, address, and other information. Write a program to read this file and produce a set of mailing labels

**Note:**

1. Instructors are advised to conduct the lab in LINUX/UNIX environment also
2. The above list consists of only sample programs. Instructors may choose other programs to illustrate certain concepts, wherever is necessary. Programs should be there on all the concepts studied in Theory. Instructors are advised to change atleast 25% of the programs every year until the next syllabus revision.

**References:**

1. "How to Solve it by Computer", R.G. Dromey, Pearson.
2. "The C Programming Language", Brian W. Kernighan, Dennis M. Ritchie, Pearson.
3. "Let us C", Yeswant Kanetkar, BPB publications
4. "Pointers in C", Yeswant Kanetkar, BPB publications.
5. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A.Ananda Rao, Pearson Education.

**Outcomes:**

- Apply problem solving techniques to find solutions to problems
- Able to use C language features effectively and implement solutions using C language.
- Improve logical skills.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech I-II Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**(15A52201) ENGLISH FOR PROFESSIONAL  
COMMUNICATION**

**1. INTRODUCTION:**

English is a global language and has international appeal and application. It is widely used in a variety of contexts and for varied purposes. The students would find it useful both for social and professional development. There is every need to help the students acquire skills useful to them in their career as well as workplace. They need to write a variety of documents and letters now extending into professional domain that cuts across business and research also. The syllabus has been designed to enhance communication skills of the students of engineering and pharmacy. The prescribed book serves the purpose of preparing them for everyday communication and to face the global competitions in future.

The text prescribed for detailed study focuses on LSRW skills and vocabulary development. The teachers should encourage the students to use the target language. The classes should be interactive and learner-centered. They should be encouraged to participate in the classroom activities keenly.

In addition to the exercises from the text done in the class, the teacher can bring variety by using authentic materials such as newspaper articles, advertisements, promotional material etc.

**2. OBJECTIVES:**

1. To develop confidence in the students to use English in everyday situations.
2. To enable the students to read different discourses so that they appreciate English for science and technologies.
3. To improve familiarity with a variety of technical writings.
4. To enable the students to acquire structure and written expressions required for their profession.
5. To develop the listening skills of the students.

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### **3. SYLLABUS:**

#### **UNIT –I**

**Topics:** Group discussion, cause and effect, events and perspectives, debate, if conditional, essay writing.

**Text: LESSONS FROM THE PAST** from *MINDSCAPES*

Importance of History - Differing Perspectives - Modern Corporatism - Lessons From The Past

#### **UNIT-II**

**Topics:** Idioms, essay writing, power point presentation, modals, listening and rewriting, preparing summary, debate, group discussion, role play, writing a book review, conversation

**Text: ‘ENERGY’** from *MINDSCAPES*

Renewable and Non-Renewable Sources - Alternative Sources - Conservation -Nuclear Energy

#### **UNIT-III**

**Topics:** Vocabulary, impromptu speech, creative writing, direct and indirect speech, fixed expressions, developing creative writing skills, accents, presentation skills, making posters, report writing

**Text: ‘ENGINEERING ETHICS’** from *MINDSCAPES*

Challenger Disaster - Biotechnology - Genetic Engineering - Protection From Natural Calamities

#### **UNIT-IV**

**Topics:** Vocabulary, Conversation, Collocation, Group discussion, Note-making, Clauses, Interpreting charts and tables , Report writing.

**Text: ‘TRAVEL AND TOURISM’** from *MINDSCAPES*

Advantages and Disadvantages of Travel - Tourism - Atithi Devo Bhava - Tourism in India

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**UNIT-V**

**Topics:** Vocabulary, phrasal verbs, writing a profile, connectives, discourse markers, problem-solving, telephone skills, application letters, curriculum vitae, interviews (telephone and personal)

**Text: 'GETTING JOB-READY'** from *MINDSCAPES*

SWOT Analysis - Companies And Ways Of Powering Growth - Preparing For Interviews

**Prescribed Text**

***MINDSCAPES***: English for Technologists and Engineers, Orient Blackswan, 2014.

**REFERENCES:**

1. **Effective Tech Communication**, [Rizvi](#), Tata McGraw-Hill Education, 2007.
2. **Technical Communication**, Meenakshi Raman, Oxford University Press.
3. **English Conversations Practice**, Grant Taylor, Tata Mc GrawHill publications, 2013.
4. **Practical English Grammar**. Thomson and Martinet, OUP, 2010.

**Expected Outcomes:**

At the end of the course, students would be expected to:

1. Have acquired ability to participate effectively in group discussions.
2. Have developed ability in writing in various contexts.
3. Have acquired a proper level of competence for employability.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech I-II Sem. (ME)	L	T	P	C
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**(15A54201) MATHEMATICS – II**
**(Common to All Branches)**

**Objectives:** Our emphasis will be more on conceptual understanding and application of Fourier series, Fourier, Z and Laplace transforms and solution of partial differential equations.

**UNIT – I**

Laplace transform of standard functions – Inverse transform – First shifting Theorem, Transforms of derivatives and integrals – Unit step function – Second shifting theorem – Dirac's delta function – Convolution theorem – Laplace transform of Periodic function.

Differentiation and integration of transform – Application of Laplace transforms to ordinary differential equations of first and second order.

**UNIT – II**

Fourier Series: Determination of Fourier coefficients – Fourier series – Even and odd functions – Fourier series in an arbitrary interval – Even and odd periodic continuation – Half-range Fourier sine and cosine expansions- Parseval's formula- Complex form of Fourier series.

**UNIT – III**

Fourier integral theorem (only statement) – Fourier sine and cosine integrals. Fourier transform – Fourier sine and cosine transforms – Properties – Inverse transforms – Finite Fourier transforms.

**UNIT – IV**

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Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Method of separation of variables – Solutions of one dimensional wave equation, heat equation and two-dimensional Laplace's equation under initial and boundary conditions.

### **UNIT – V**

z-transform – Inverse z-transform – Properties – Damping rule – Shifting rule – Initial and final value theorems. Convolution theorem – Solution of difference equations by z-transforms.

### **TEXT BOOKS:**

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Engineering Mathematics, Volume - II, E. Rukmangadachari Pearson Publisher.

### **REFERENCES:**

1. Mathematical Methods by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad S. Chand publication.
2. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
3. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.

**Outcomes:**The student gains the knowledge to tackle the engineering problems using the concepts of Fourier series, various transforms and partial differential equations.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech I-II Sem. (ME)

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**(15A03201) MATERIAL SCIENCE AND ENGINEERING****Course Objective:**

*To gain and understanding of the relationship between the structure, properties, processing, testing, heat treatment and applications of metallic, non metallic, ceramic and composite materials so as to identify and select suitable materials for various engineering applications.*

**UNIT I**

**STRUCTURE OF METALS:** Bonds in Solids – Metallic bond - crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size.

**CONSTITUTION OF ALLOYS:** Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds.

**Learning outcome & Suggested Student Activities:**

*Students will get knowledge on bonds of solids and knowing the crystallization of metals. By knowing the grain size and shape through the crystallization, he may understand the effect of grain boundaries on the properties of metals and finally he determines the grain size that is very essential for analyzing the microstructures of metals.*

*Students are advised to refer the following websites [www.physics.rutgers.edu/meis/pubs/BB\\_thesis.pdf](http://www.physics.rutgers.edu/meis/pubs/BB_thesis.pdf) [www.ce.berkeley.edu/~paulmont/CE60New/alloys-steel.pdf](http://www.ce.berkeley.edu/~paulmont/CE60New/alloys-steel.pdf) for better understanding of this topic.*

**UNIT II**

**EQUILIBRIUM OF DIAGRAMS:** Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni, Al-Cu, and Fe-Fe<sub>3</sub>C

**Learning outcome & Suggested Student Activities:**

*Students will be able to construct the equilibrium diagrams by experimental methods and knowing all types of equilibrium diagrams isomorphs alloy systems, electric systems, peritectic systems solid-state transformations etc. while studying all these diagrams he may able to know about lever*



*rule and phase rule.*

*Students are advised to visit the following URLs website [www.freelance-teacher.com/videos.htm](http://www.freelance-teacher.com/videos.htm)*

*[www.susqu.edu/brake/aux/downloads/papers/foamcomp.pdf](http://www.susqu.edu/brake/aux/downloads/papers/foamcomp.pdf) for better understanding of this topic.*

### **UNIT III**

CAST IRONS AND STEELS: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

NON-FERROUS METALS AND ALLOYS: Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium and its alloys.

#### ***Learning Outcome & Suggested Student Activities:***

*Students will be able to learn the structure and properties of all cast irons, steels and Non-ferrous metal alloys of copper, Al and Titanium. Students are advised to visit any Machine shop in the industries like SAIL, Visakhapatnam steel plant etc., Students are advised to visit the following website. [www.buzzle.com](http://www.buzzle.com), [www.mhprofessional.com](http://www.mhprofessional.com) [www.eng.sut.ac](http://www.eng.sut.ac) for better understanding of this topic.*

### **UNIT IV**

HEAT TREATMENT OF ALLOYS: Effect of alloying elements on Iron – Iron carbon system, Annealing, normalizing, Hardening, TTT diagrams, tempering, Hardenability, surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys. Heat treatment of plastics

#### ***Learning outcome & Suggested Student Activities:***

*Students will be able to learn the methods of different heat treatments i.e. annealing, normalizing and hardening. He also learns the different of alloying elements on Iron-Iron carbon system, the importance of TTT diagrams, Harden ability that are very essential for melting science. Finally, he learn about the heat treatment of cryogenic environment as an advance topic.*

*Students are advised to go through the URLs <http://www.nptel.iitm.ac.in/> and [iisc.ernet.in](http://iisc.ernet.in) for video lectures, <http://www.learnerstv.com/Free-Engineering-Video-lectures-lt180-Page1.htm>*

### **UNIT V**

CERAMIC MATERIALS: Crystalline ceramics, glasses, cermets.

COMPOSITE MATERIALS: Classification of composites, various methods of component manufacture of composites, particle – reinforced

materials, fiber reinforced materials, polymer composites, metal ceramic mixtures, metal – matrix composites and Carbon – Carbon composites.

**Learning Outcome & Suggested Student Activities:**

*This unit helps the students to understand the importance of advanced composite materials in application to sophisticated machine and structure of components, These composite materials helps to develop the components with required properties which we cannot attain using the metals & metal alloys.*

*Examples of products maybe of composite materials are air cooler bodies, fiber reinforced hose pipes, boat bodies some automobile body frames etc. Students may refer the following website for better understanding [www.susqu.edu/brake/aux/downloads/papers/foamcomp.pdf](http://www.susqu.edu/brake/aux/downloads/papers/foamcomp.pdf); [Asment.ernation.org](http://Asment.ernation.org) [www.princeton.edu/~achaney/tmve/wiki100k/doc/metal\\_matrix\\_composite.html](http://www.princeton.edu/~achaney/tmve/wiki100k/doc/metal_matrix_composite.html)*

**Text Books:**

1. *Introduction to Physical Metallurgy*, Sidney H. Avner, US, 2<sup>nd</sup> Edition, 2007 Tata McGraw-Hill,
2. *Essential of Materials Science and Engineering*, Donald R. Askeland, USA, 3<sup>rd</sup> Edition, Cengage Publisher, 2013.

**Reference Books:**

1. *Material Science and Metallurgy*, U.C. Jindal, pearson educations, 2011,
2. *Elements of Materials Science and Engineering*, Lawrance H. Van Vlack, pearson educations, 6<sup>th</sup> Edition, 2002.
3. *Material Science and Metallurgy*, kodgire V.D, 12<sup>th</sup> Edition, Everest Publishing House, 2002.
4. *Engineering Mechanics of Composite Materials-* Isaac and M Daniel, Oxford University Press, 1994, 2<sup>nd</sup> Edition 2013.
5. *Mechanics of Composite Materials*, R. M. Jones, McGraw Hill Company, New York, 1975.
6. *Science of Engineering Materials*, Agarwal, TMH.
7. *Materials Science and Engineering*, William D. Callister, 8<sup>th</sup> Edition, 2010.
8. *Elements of Material science*, V. Rahghavan, PHI, 5<sup>th</sup> Editon.
9. *Engineering Materials and Their Applications – R. A Flinn and P K Trojan*, Jaico Books.
10. *Engineering materials and metallurgy*, R.K.Rajput, S.Chand, 1<sup>st</sup> Editon, 2008.

**Web References:**

[www.asminternational.org](http://www.asminternational.org)  
[www.henry.wells.edu](http://www.henry.wells.edu)  
[www.ce.berkeley.edu](http://www.ce.berkeley.edu)  
[www.sjsu.edu](http://www.sjsu.edu)

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B. Tech I-II Sem. (ME)	L	T	P	C
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**(15A56101) ENGINEERING PHYSICS**
**Objectives:**

- To evoke interest on applications of superposition effects like interference and diffraction, the mechanisms of emission of light, achieving amplification of electromagnetic radiation through stimulated emission, study of propagation of light through transparent dielectric waveguides along with engineering applications.
- To enlighten the periodic arrangement of atoms in crystals, direction of Bragg planes, crystal structure determination by X-rays and non-destructive evaluation using ultrasonic techniques.
- To get an insight into the microscopic meaning of conductivity , classical and quantum free electron model, the effect of periodic potential on electron motion, evolution of band theory to distinguish materials and to understand electron transport mechanism in solids.
- To open new avenues of knowledge and understanding semiconductor based electronic devices , basic concepts and applications of semiconductors and magnetic materials have been introduced which find potential in the emerging micro device applications.
- To give an impetus on the subtle mechanism of superconductors in terms of conduction of electron pairs using BCS theory, different properties exhibited by them and their fascinating applications. Considering the significance of microminiaturization of electronic devices and significance of low dimensional materials, the basic concepts of nanomaterials, their synthesis, properties and applications in emerging technologies are elicited.

**UNIT - I**
**PHYSICAL OPTICS, LASERS AND FIBRE OPTICS**

*Physical Optics:* Interference (Review) – Interference in thin film by reflection –Newton’s rings –Diffraction (Review) - Fraunhofer diffraction due to single slit, double slit and diffraction grating.

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*Lasers:* Characteristics of laser – Spontaneous and stimulated emission of radiation – Einstein's coefficients — Population inversion – Excitation mechanism and optical resonator – Nd:YAG laser - He-Ne laser – Semiconductor Diode laser - Applications of lasers

*Fiber optics:* Introduction - construction and working principle of optical fiber –Numerical aperture and acceptance angle – Types of optical fibers – Attenuation and losses in Optical fibers –Block diagram of Optical fiber communication system – Applications of optical fibers

## **UNIT – II**

### **CRYSTALLOGRAPHY AND ULTRASONICS**

*Crystallography:* Introduction – Space lattice –Unit cell – Lattice parameters –Bravais lattice – Crystal systems – Packing fractions of SC, BCC and FCC - Directions and planes in crystals – Miller indices – Interplanar spacing in cubic crystals – X-ray diffraction - Bragg's law – Powder method.

*Ultrasonics:* Introduction – Production of ultrasonics by piezoelectric method – Properties and detection – Applications in non-destructive testing.

## **UNIT – III**

### **QUANTUM MECHANICS AND ELECTRON THEORY**

*Quantum Mechanics:* Matter waves – de'Broglie hypothesis and properties - Schrodinger's time dependent and independent wave equations – Physical significance of wave function - Particle in one dimensional infinite potential well.

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*Electron theory:* Classical free electron theory – Equation for electrical conductivity - Quantum free electron theory – Fermi-Dirac distribution – Source of electrical resistance – Kronig-Penny model (qualitative treatment) – Origin of bands in solids – Classification of solids into conductors, semiconductors and insulators.

## **UNIT – IV**

### **SEMICONDUCTORS AND MAGNETIC MATERIALS**

*Semiconductors:* Intrinsic and extrinsic semiconductors (Qualitative treatment) – Drift & diffusion currents and Einstein's equation – Hall effect - Direct and indirect band gap semiconductors – Formation of p-n junction.

*Magnetic materials:* Introduction and basic definitions – Origin of magnetic moments – Bohr magneton – Classification of magnetic materials into dia, para, ferro, antiferro and ferri magnetic materials (Qualitative treatment) – Hysteresis - Soft and hard magnetic materials, applications of magnetic materials.

## **UNIT – V**

### **SUPERCONDUCTIVITY AND PHYSICS OF NANOMATERIALS**

*Superconductivity:* Introduction - Effect of magnetic field - Meissner effect – Type I and Type II superconductors – Flux quantization – Penetration depth - BCS theory (qualitative treatment) — Josephson effects –Applications of superconductors.

*Physics of Nanomaterials:* Introduction - Significance of nanoscale and types of nanomaterials – Physical properties: optical, thermal, mechanical and magnetic properties – Synthesis of nanomaterials by Top down and bottom up approaches: ball mill, chemical vapour deposition, and sol gel –Applications of nanomaterials.

**Text Books:**

1. Engineering Physics – K.Thyagarajan, 5<sup>th</sup> Edition, MacGraw Hill Publishers, NewDelhi, 2014.
2. Physics for Engineers - N.K Verma, 1<sup>st</sup> Edition, PHI Learning Private Limited, New Delhi,2014.

**References:**

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, 10<sup>th</sup> Edition, S.Chand and Company, New Delhi, 2014.
2. Engineering Physics – D K Pandey, S. Chaturvedi, 2<sup>nd</sup> Edition, Cengage Learning, New Delhi, 2013.
3. Engineering Physics – D.K Bhattacharya, Poonam Tandon, 1<sup>nd</sup> Edition, Oxford University Press, New Delhi, 2015.

**Outcomes:**

- The different realms of physics and their applications in both scientific and technological systems are achieved through the study of physical optics, lasers and fibre optics.
- The important properties of crystals like the presence of long-range order and periodicity, structure determination using X-ray diffraction are focused along with defects in crystals and ultrasonic non-destructive techniques.
- The discrepancies between the classical estimates and laboratory observations of physical properties exhibited by materials would be lifted through the understanding of quantum picture of subatomic world.
- The electronic and magnetic properties of materials were successfully explained by free electron theory and the bases for the band theory are focused.
- The properties and device applications of semiconducting and magnetic materials are illustrated.

The importance of superconducting materials and nanomaterials along with their engineering applications are well elucidated.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech I-II Sem. (ME)

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**(15A03101) ENGINEERING DRAWING****Objectives:**

- To gain and understanding of the basics of geometrical constructions of various planes and solids, understanding system of graphical representation of various objects and various views to draft and read the products to be designed and eventually for manufacturing applications.
- To learn about various projections, to understand complete dimensions and details of object.
- Ultimately student must get imaginary skill to put an idea of object, circuit, assembly of parts in black & white, to design a product and to understand the composition, which can be understood universally.

**UNIT I**

**Introduction to Engineering Drawing:** Principles of Engineering Graphics and their Significance- Conventions in Drawing-Lettering – BIS Conventions. Curves used in Engineering Practice. a) Conic Sections including the Rectangular Hyperbola- General method only, b) Cycloid, Epicycloid and Hypocycloid

**UNIT II**

**Scales:** Plain, Diagonal and Vernier;

**Projection of Points:** Principles of orthographic projection – Convention – First angle projections, projections of points.

**UNIT III**

**Projections of Lines:** lines inclined to one or both planes, Problems on projections, Finding True lengths.

**Projections of Planes:** Projections of regular plane surfaces- plane surfaces inclined to both planes.

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**UNIT IV**

**Projections of Solids:** Projections of Regular Solids with axis inclined to both planes.

**Developments of Solids:** Development of Surfaces of Right Regular Solids-Prism, Cylinder, Pyramid, Cone.

**UNIT V**

**Isometric and Orthographic Projections:** Principles of isometric projection- Isometric Scale- Isometric Views- Conventions- Isometric Views of lines, Planes, Simple solids (cube, cylinder and cone). Isometric projections of spherical parts. Conversion of isometric Views to Orthographic Views.

**Text Books:**

1. *Engineering Drawing, N.D. Bhatt, Charotar Publishers*
2. *Engineering Drawing, K.L. Narayana& P. Kannaih, Scitech Publishers, Chennai*

**References:**

1. *Engineering Drawing, Johle, Tata McGraw-Hill Publishers*
2. *Engineering Drawing, Shah and Rana, 2/e, Pearson Education*
3. *Engineering Drawing and Graphics, Venugopal/ New age Publishers*
4. *Engineering Graphics, K.C. John, PHI, 2013*
5. *Engineering Drawing, B.V.R. Gupta, J.K. Publishers*



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**Outcomes:**

- Drawing 2D and 3D diagrams of various objects.
- Learning conventions of Drawing, which is an Universal Language of Engineers.
- Drafting projections of points, planes and solids.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech I-II Sem. (ME)	L	T	P	C
	0	0	4	2

**(15A03202) MATERIAL SCIENCE and ENGINEERING LAB**

1. Mounting and preparation of Specimen.
2. Preparation and study of the Micro Structure of Ferrous metal
3. Preparation and study of the Microstructure of Non - Ferrous metals (Cu, Al..... etc)
4. Preparation and study of the Microstructure of Mild Steel, Low carbon Steels, High carbon steels
5. Study of the Micro Structures of Cast Irons.
6. Study of the Micro Structures of Non-Ferrous alloys.
7. Study of the Micro structures of Heat treated steels.
8. Hardeneability of steels by Jominy End Quench Test.
9. To find out the hardness of various treated and untreated steels.
10. Fracture testing of materials.
11. Fatigue testing of materials.
12. Creep Testing of materials.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech I-II Sem. (ME)

L	T	P	C
0	0	4	2

**(15A56102) ENGINEERING PHYSICS LABORATORY****Objectives:**

- Will recognize the important of optical phenomenon like Interference and diffraction.
- Will understand the role of optical fiber parameters and signal losses in communication.
- Will recognize the importance of energy gap in the study of conductivity and hall effect in a semiconductor
- Will understand the applications of B H curve.
- Will acquire a practical knowledge of studying the crystal structure in terms of lattice constant.
- Will recognize the application of laser in finding the particle size and its role in diffraction studies.
- Will learn to synthesis of the nanomaterials and recognize its importance by knowing its nano particle size and its impact on its properties.

**Any 10 of the following experiments has to be performed during the I year I semester**

1. Determination of radius of curvature of a Plano-convex lens by forming Newton's rings.
2. Determination of wavelength of given source using diffraction grating in normal incidence method.
3. Determination of Numerical aperture, acceptance angle of an optical fiber.
4. Energy gap of a Semiconductor diode.
5. Hall effect – Determination of mobility of charge carriers.
6. B-H curve – Determination of hysteresis loss for a given magnetic material.
7. Determination of Crystallite size using X-ray pattern (powder) using debye-scheerer method.
8. Determination of particle size by using laser source.
9. Determination of dispersive power of a prism.
10. Determination of thickness of the thin wire using wedge Method.

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11. Laser : Diffraction due to single slit
  12. Laser : Diffraction due to double slit
  13. Laser: Determination of wavelength using diffraction grating
  14. Magnetic field along the axis of a current carrying coil – Stewart and Gee's method.
  15. Synthesis of nanomaterial by any suitable method.

**References:**

1. Engineering Physics Practicals – NU Age Publishing House, Hyderabad.
2. Engineering Practical physics – Cengage Learning, Delhi.

**Outcomes:**

- Would recognize the important of optical phenomenon like Interference and diffraction.
- Would have acquired the practical application knowledge of optical fiber, semiconductor, dielectric and magnetic materials, crystal structure and lasers by the study of their relative parameters.

Would recognize the significant importance of nanomaterials in various engineering fields.

B. Tech I-II Sem. (ME)	L	T	P	C
	0	0	4	2

**(15A99201) ENGINEERING & I.T. WORKSHOP**
**ENGINEERING WORKSHOP**
**Course Objective:**

*The budding Engineer may turn out to be a technologist, scientist, entrepreneur, practitioner, consultant etc. There is a need to equip the engineer with the knowledge of common and newer engineering materials as well as shop practices to fabricate, manufacture or work with materials. Essentially he should know the labour involved, machinery or equipment necessary, time required to fabricate and also should be able to estimate the cost of the product or job work. Hence engineering work shop practice is included to introduce some common shop practices and on hand experience to appreciate the use of skill, tools, equipment and general practices to all the engineering students.*

**1. TRADES FOR EXERCISES:**

- a. Carpentry shop– Two joints (exercises) involving tenon and mortising, groove and tongue: Making middle lap T joint, cross lap joint, mortise and tenon T joint, Bridle T joint from out of 300 x 40 x 25 mm soft wood stock
- b. Fitting shop– Two joints (exercises) from: square joint, V joint, half round joint or dove tail joint out of 100 x 50 x 5 mm M.S. stock
- c. Sheet metal shop– Two jobs (exercises) from: Tray, cylinder, hopper or funnel from out of 22 or 20 guage G.I. sheet
- d. House-wiring– Two jobs (exercises) from: wiring for ceiling rose and two lamps (bulbs) with independent switch controls with or without looping, wiring for stair case lamp, wiring for a water pump with single phase starter.
- e. Foundry– Preparation of two moulds (exercises): for a single pattern and a double pattern.

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- f. Welding – Preparation of two welds (exercises): single V butt joint, lap joint, double V butt joint or T fillet joint.

## **2. TRADES FOR DEMONSTRATION:**

- a. Plumbing
- b. Machine Shop
- c. Metal Cutting

Apart from the above the shop rooms should display charts, layouts, figures, circuits, hand tools, hand machines, models of jobs, materials with names such as different woods, wood faults, Plastics, steels, meters, gauges, equipment, CD or DVD displays, First aid, shop safety etc. (though they may not be used for the exercises but they give valuable information to the student). In the class work or in the examination knowledge of all shop practices may be stressed upon rather than skill acquired in making the job.

### **References:**

1. *Engineering Work shop practice for JNTU*, V. Ramesh Babu, VRB Publishers Pvt. Ltd., 2009
2. *Work shop Manual / P.Kannaiah/ K.L.Narayana/ SciTech Publishers.*
3. *Engineering Practices Lab Manual*, Jeyapoovan, SaravanaPandian, 4/e Vikas
4. *Dictionary of Mechanical Engineering*, GHF Nayler, Jaico Publishing House.

## **I.T. WORKSHOP**

### **Course Objective:**

- To provide Technical training to the students on Productivity tools like Word processors, Spreadsheets, Presentations
- To make the students know about the internal parts of a computer, assembling a computer from the parts, preparing a computer for use by installing the operating system
- To learn about Networking of computers and use Internet facility for Browsing and Searching.

### **Learning Outcome:**

- 
- Disassemble and Assemble a Personal Computer and prepare the computer ready to use.
  - Prepare the Documents using Word processors
  - Prepare Slide presentations using the presentation tool
  - Interconnect two or more computers for information sharing
  - Access the Internet and Browse it to obtain the required information
  - Install single or dual operating systems on computer

### **Preparing your Computer ( 5 weeks)**

**Task 1: Learn about Computer:** Identify the internal parts of a computer, and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.

**Task 2: Assembling a Computer:** Disassemble and assemble the PC back to working condition. Students should be able to trouble shoot the computer and identify working and non-working parts. Student should identify the problem correctly by various methods available (eg: beeps). Students should record the process of assembling and trouble shooting a computer.

**Task 3: Install Operating system:** Student should install Linux on the computer. Student may install another operating system (including proprietary software) and make the system dual boot or multi boot. Students should record the entire installation process.

**Task 4: Operating system features:** Students should record the various features that are supported by the operating system(s) installed. They have to submit a report on it. Students should be able to access CD/DVD drives, write CD/DVDs, access pen drives, print files, etc. Students should install new application software and record the installation process.

### **Networking and Internet (4 weeks)**

**Task 5: Networking:** Students should connect two computers directly

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using a cable or wireless connectivity and share information. Students should connect two or more computers using switch/hub and share information. Crimping activity, logical configuration etc should be done by the student. The entire process has to be documented.

**Task 6: Browsing Internet:** Student should access the Internet for Browsing. Students should search the Internet for required information. Students should be able to create e-mail account and send email. They should get acquaintance with applications like Facebook, skype etc.

If Intranet mailing facility is available in the organization, then students should share the information using it. If the operating system supports sending messages to multiple users (LINUX supports it) in the same network, then it should be done by the student. Students are expected to submit the information about different browsers available, their features, and search process using different natural languages, and creating e-mail account.

**Task 7: Antivirus:** Students should download freely available Antivirus software, install it and use it to check for threats to the computer being used. Students should submit information about the features of the antivirus used, installation process, about virus definitions, virus engine etc.

### **Productivity tools (6 weeks)**

**Task 8: Word Processor:** Students should be able to create documents using the word processor tool. Some of the tasks that are to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the color, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Students should be able to prepare project cover pages, content sheet and chapter pages at the end of the task using the



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features studied. Students should submit a user manual of the word processor considered.

**Task 9: Spreadsheet:** Students should be able to create, open, save the application documents and format them as per the requirement. Some of the tasks that may be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells. Students should submit a user manual of the Spreadsheet application considered.

**Task 10: Presentations :** creating, opening, saving and running the presentations, Selecting the style for slides, formatting the slides with different fonts, colors, creating charts and tables, inserting and deleting text, graphics and animations, bulleting and numbering, hyperlinking, running the slide show, setting the timing for slide show. Students should submit a user manual of the Presentation tool considered.

### **Optional Tasks:**

**Task 11: Laboratory Equipment:** Students may submit a report on specifications of various equipment that may be used by them for the laboratories in their curriculum starting from I B.Tech to IV. B.Tech. It can vary from department to department. Students can refer to their syllabus books, consult staff members of the concerned department or refer websites. The following is a sample list. Instructors may make modifications to the list to suit the department concerned.

- Desktop computer
- Server computer
- Switch (computer science related)
- Microprocessor kit
- Micro controller kit
- Lathe machine
- Generators
- Construction material

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- Air conditioner
  - UPS and Inverter
  - RO system
  - Electrical Rectifier
  - CRO
  - Function Generator
  - Microwave benches

**Task 12: Software:** Students may submit a report on specifications of various software that may be used by them for the laboratories in their curriculum starting from I B.Tech to IV. B.Tech. The software may be proprietary software or Free and Open source software. It can vary from department to department. Students can refer to their syllabus books, consult staff members of the concerned department or refer websites. The following is a sample list. Instructors may make modifications to the list to suit the department concerned.

- Desktop operating system
- Server operating system
- Antivirus software
- MATLAB
- CAD/CAM software
- AUTOCAD

### References:

1. Introduction to Computers, Peter Norton, Mc Graw Hill
2. MOS study guide for word, Excel, Powerpoint & Outlook Exams”, Joan Lambert, Joyce Cox, PHI.
3. Introduction to Information Technology, IITL Education Solutions limited, Pearson Education.
4. Networking your computers and devices, Rusen, PHI
5. Trouble shooting, Maintaining & Repairing PCs”, Bigelows, TMH



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech II-I Sem. (ME)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**(15A54301) MATHEMATICS-III**  
**(Common to All Branches)**

**Objectives:**

- This course aims at providing the student with the concepts of Matrices, Numerical Techniques and Curve fitting.

**UNIT – I**

Elementary row transformations-Rank – Echelon form, normal form – Consistency of System of Linear equations. Linear transformations. Hermitian, Skew-Hermitian and Unitary matrices and their properties. Eigen Values, Eigen vectors for both real and complex matrices. Cayley – Hamilton Theorem and its applications – Diagonalization of matrix. Calculation of powers of matrix and inverse of a matrix. Quadratic forms – Reduction of quadratic form to canonical form and their nature.

**UNIT – II**

Solution of Algebraic and Transcendental Equations: The Bisection Method – The Method of False Position– Newton-Raphson Method, Solution of linear simultaneous equation: Crout's triangularisation method, Gauss - Seidal iteration method.

**UNIT – III**

**Interpolation:** Newton's forward and backward interpolation formulae – Lagrange's formulae. Gauss forward and backward formula, Stirling's formula, Bessel's formula.

**UNIT – IV**

Curve fitting: Fitting of a straight line – Second degree curve – Exponential curve-Power curve by method of least squares. Numerical Differentiation for Newton's interpolation formula. Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule.

**UNIT – V**

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Euler's Method-Runge-Kutta Methods. Numerical solutions of Laplace equation using finite difference approximation.

**TEXT BOOKS:**

3. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
4. Introductory Methods of Numerical Analysis, S.S. Sastry, PHI publisher.

**REFERENCES:**

2. Engineering Mathematics, Volume - II, E. Rukmangadachari Pearson Publisher.
3. Mathematical Methods by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S. Chand publication.
3. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
4. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.

**Outcomes:** The student will be able to analyze engineering problems using the concepts of Matrices and Numerical methods.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech II-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>
<b>(15A52301) MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS</b>				

**Course Objectives:** The objective of this course is to equip the student with the basic inputs of Managerial Economics and Economic Environment of business and to impart analytical skills in helping them take sound financial decisions for achieving higher organizational productivity.

### **Unit I: INTRODUCTION TO MANAGERIAL ECONOMICS**

Managerial Economics – Definition- Nature- Scope - Contemporary importance of Managerial Economics - Relationship of Managerial Economics with Financial Accounting and Management. **Demand Analysis:** Concept of Demand-Demand Function - Law of Demand - Elasticity of Demand- Significance - Types of Elasticity - Measurement of elasticity of demand - Demand Forecasting- factors governing demand forecasting- methods of demand forecasting.

### **UNIT II: THEORY OF PRODUCTION AND COST ANALYSIS**

**Production Function-** Least cost combination- Short-run and Long- run production function- Isoquants and Isocosts, MRTS - Cobb-Douglas production function - Laws of returns - Internal and External economies of scale - **Cost Analysis:** Cost concepts and cost behavior- Break-Even Analysis (BEA) -Determination of Break Even Point (Simple Problems)-Managerial significance and limitations of Break- Even Point.

### **UNIT III: INTRODUCTION TO MARKETS AND NEW ECONOMIC ENVIRONMENT**

**Market structures:** Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition- Monopoly-Monopolistic Competition-Oligopoly-Price-Output Determination - Pricing Methods and Strategies-Forms of Business Organizations- Sole

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Proprietorship- Partnership – Joint Stock Companies - Public Sector Enterprises – New Economic Environment- Economic Liberalization – Privatization - Globalization.

#### **UNIT IV: INTRODUCTION TO FINANCIAL ACCOUNTING AND ANALYSIS**

Financial Accounting – Concept - Emerging need and Importance - Double-Entry Book Keeping- Journal - Ledger – Trial Balance - Financial Statements - Trading Account – Profit & Loss Account – Balance Sheet (with simple adjustments). Financial Analysis – Ratios – Liquidity, Leverage, Profitability, and Activity Ratios (simple problems).

#### **UNIT V: CAPITAL AND CAPITAL BUDGETING**

Concept of Capital - Over and Undercapitalization – Remedial Measures - Sources of Short term and Long term Capital - Estimating Working Capital Requirements – Capital Budgeting – Features of Capital Budgeting Proposals – Methods and Evaluation of Capital Budgeting Projects – Pay Back Method – Accounting Rate of Return (ARR) – Net Present Value (NPV) – Internal Rate Return (IRR) Method (simple problems)

**Learning Outcome:** After completion of this course, the student will be able to understand various aspects of Managerial Economics and analysis of financial statements and inputs therein will help them to make sound and effective decisions under different economic environment and market situations.

#### **TEXT BOOKS:**

1. Managerial Economics 3/e, Ahuja H.L, S.Chand, 2013.
2. Financial Management, I.M.Pandey, Vikas Publications, 2013.

#### **REFERENCES**

1. Managerial Economics and Financial Analysis, 1/e, Aryasri, TMH, 2013.
2. Managerial Economics and Financial Analysis, S.A. Siddiqui and A.S. Siddiqui, New Age International, 2013.

Accounting and Financial Management, T.S.Reddy & Y. Hariprasad Reddy, Margham Publishers.

B. Tech II-I Sem. (ME)

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(15A01308) MECHANICS OF SOLIDS

**Course Objective:**

*The objective of the subject is to learn the fundamental concepts of stress, strain and deformation of solids with applications to bars and beams. The students shall understand the theory of elasticity including strain/displacement and hooks law relationships. To accesses stresses and deformations through the mathematical models of beams for bending and bars for twisting or combination of both. The knowledge of this subject will help in the design & Theory of machines courses.*

**UNIT I**

**SIMPLE STRESSES & STRAINS:** Elasticity and plasticity – Types of stresses & strains – Hooke’s law – stress & strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson’s ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings. Principle stresses and strains-computation of principle stresses and strains on inclined planes-theory of failures- minimum principle stress, strain, shear stress and strain energy theories.

**Learning Outcome & Suggested Student Activities:**

*This unit gives the student how to measure the strength of materials based on calculating stresses, strains and deformations for basic geometries subjected to axial loading and thermal effects. Students are advised to visit the URL [http://nptel.iitm.ac.in/courses/IIT-MADRAS/Strength\\_of\\_Materials/Pdfs/1\\_1.pdf](http://nptel.iitm.ac.in/courses/IIT-MADRAS/Strength_of_Materials/Pdfs/1_1.pdf).*

**UNIT II**

**SHEAR FORCE AND BENDING MOMENT :** Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, U.D.L., uniformly



varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

**Learning outcome & Suggested Student Activities:**

This unit gives awareness for the students how to draw shear force and bending moment diagrams for calculating maximum shear force and maximum bending moment for different types of beams with different lateral loadings conditions. This topic can be downloaded from the URL [http://vedyadhara.ignou.ac.in/wiki/images/a/ad/BME-017\\_B-1\(Unit\\_4\).pdf](http://vedyadhara.ignou.ac.in/wiki/images/a/ad/BME-017_B-1(Unit_4).pdf)

**UNIT III**

**FLEXURAL STRESSES:** Theory of simple bending – Assumptions – Derivation of bending equation:  $M/I = f/y = E/R$  Neutral axis –Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections, crane hooks.

**SHEAR STRESSES:** Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I , T angle sections, shear centre.

**Learning outcome & Suggested Student Activities:**

*This unit gives knowledge to the students about the strength of the beams with different sections by bringing the relationship between the bending stress and maximum bending moment, bringing the relationship between the shear stress and maximum shear force which are calculated from previous unit. This topic can be downloaded from the following URL [http://web.mit.edu/emech/dontindex-build/full-text/emechbk\\_7.pdf](http://web.mit.edu/emech/dontindex-build/full-text/emechbk_7.pdf).*

**UNIT IV**

**TORSION OF CIRCULAR SHAFTS-** Theory of pure torsion- Derivation of torsion equations;  $T/J=q/r=N\theta/L$  – Assumptions made in the theory of pure torsion- torsional moment of resistance- polar section modulus.

**DEFLECTION OF BEAMS:** Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay’s methods – Determination of slope and deflection for cantilever and

simply supported beams subjected to point loads, - U.D.L uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams.

***Learning outcome & Suggested Student Activities:***

*This unit gives awareness to the students how to calculate the shear strength of the solid and hollow shafts which are subjected to torsional loading in power transmitting. This topic related to torsion can be download from the following URLs*

*http://www.mae.ncsu.edu/zhu/courses/mae314/lecture/Lecture4\_Torsion.pdf, and also gives better knowledge for students how to calculate deflections of beam using different methods under different boundary and loading conditions. Notes for this topic can be download from the web site http://npTEL.iitm.ac.in/courses/IIT-MADRAS/Strength\_of\_Materials/Pdfs/5\_1.pdf.*

**UNIT V**

**THIN CYLINDERS:** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in diameter, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells.

**THICK CYLINDERS:** Lamé's equation – cylinders subjected to inside & outside pressure - compound cylinders.

***Learning outcome & Suggested Student Activities:***

*This unit gives application to mechanics of solids for students in which how to calculate different stresses and strains for the thin and thick cylinders in identifying safe design for boiler shells and thick shells as such in like domestic cylinders, air compressor and high pressure vessels used in thermal plants etc. Notes for this topic can be download from the site*

*http://www.ewp.rpi.edu/hartford/users/papers/engr/ernesto/poworp/Project/4.%20Supporting\_Material/Books/32658\_09 & 10.pdf.*

***Text Books:***

1. *Strength of Materials* by R.Subramaniam, oxford publishers.
2. *Strength of Materials* by R.K. Bansal, Laxmi Publishers, 5<sup>th</sup> Edition,2012.
3. *Mechanics of Materials*,Andrews Pytel,Jaam Kiusallaas & M.M.M.Sarcar (Second Edition),Cengage Learning Publishers.

**Reference Books:**

1. *Strength of Materials* by S. Ramamrutham, Dhanpat Rai Publishers
2. *Strength of Materials* by R.K. Rajput, S.Chand& Company, 5<sup>th</sup> Edition,2012.
3. *Strength of Materials* by Dr. Sadhu Singh, Khanna Publishers, 10<sup>th</sup> Edition,2013.
4. *Strength of Materials* by M.Chakraborti, S.K.Kataria& Sons, 2<sup>nd</sup> Edition,2011.
5. *Strength of Materials* by S S Rattan, The McGraw-Hill Companies, 2<sup>nd</sup> Editon,2011.

**Suggestions:**

- Students are advised to buy a text book for understanding problems then they may buy *Strength of materials* by R.K.Bansal, Laxmi Publishers& For further more problems *Strength of Materials* by R.K. Rajput, S.Chand& Company
- Students may go around some of the small scale industries and domestic orientated jobs gives better knowledge on to check strength of materials.
- Some basic knowledge regarding Engineering mechanics, Mathematics and Physics are required for understanding this subject.

**Web Resources:**

<http://nptel.iitm.ac.in/>

[www.learnerstv.com/Free-Engineering-video-lecture-courses.htm](http://www.learnerstv.com/Free-Engineering-video-lecture-courses.htm)

[http://en.wikibooks.org/wiki/Strength\\_of\\_Materials](http://en.wikibooks.org/wiki/Strength_of_Materials)

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech II-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**(15A03301) ENGINEERING DRAWING FOR MECHANICAL ENGINEERS**

**Course Objective:** To enhance the student's knowledge and skills in engineering drawing of solids with interpenetration of solids and to present isometric and perspective projections.

**Unit –I**

**Sections and Developments of Solids:** Section Planes and Sectional View of Right Regular Solids-Prism, cylinder, Pyramid and Cone. True shapes of the sections and their development of Surfaces

**Unit –II**

Isometric projection: Isometric views of Sectional Planes, and Sectional Solids, Objects.

**Unit –III**

Conversion of Pictorial views to orthographic views –Conventions.

**Unit –IV**

**Interpenetration of Right Regular Solids:** Projections of Curves of intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone, Square Prism Vs Square Prism.

**Unit –V**

**Perspective Projections:** Perspective View of Plane Figures and simple Solids, Visual Ray Method, Vanishing point method.

**Text Books:**

1. *Engineering Drawing*, N.D. Bhat, Charotar Publishers
2. *Engineering Drawing*, K.L. Narayana & P. Kannaih, Scitech Publishers, Chennai.

**References:**

1. *Engineering Drawing*, Johle, Tata McGraw-Hill Publishers, 2014
2. *Engineering Drawing*, N.S Patha sarathy, vela murali, Oxford University Press, 2015
3. *Engineering Graphics* D.A.Hindoliya, BSP publications, 2014
4. *Engineering Graphics*, K.C.John, PHI, 2014

**Suggestions:**

*Student is expected to buy a book mentioned under 'Text books' for better understanding. Student should prepare rough sketches for all the problems given at the end of each chapter to improve his / her imaginations.*

*Student should also practice Auto CAD or any other drawing software to help understanding better.*

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech II-I Sem. (ME)**

L	T	P	C
3	1	0	3

**(15A03302) ENGINEERING MECHANICS**

**OBJECTIVE:** *This course will serve as a basic course by introducing the concepts of basic mechanics which will help as a foundation to various courses.*

**UNIT – I**

**Introduction of Engineering Mechanics** – Basic concepts - System of Forces – Moment of Forces and its Application – Couples and Resultant of Force System – Equilibrium of System of Forces - Degrees of Freedom – Free body diagrams –Types of Supports – Support reactions for beams with different types of loading – concentrated, uniformly distributed and uniformly varying loading.

**UNIT – II**

**Friction :** Types of friction– laws of Friction – Limiting friction- Cone of limiting friction– static and Dynamic Frictions – Motion of bodies – Wedge and Screw jack

**UNIT – III**

**Centroid and Center of Gravity:** Centroids of simple figures – Centroids of Composite figures – Centre of Gravity of bodies – Area moment of Inertia - Parallel axis and perpendicular axis theorems - Moments of Inertia of Composite Figures.

**Mass Moment of Inertia:** Moment of Inertia of Simple solids – Moment of Inertia of composite masses.( Simple problems only)

**UNIT – IV**

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**Kinematics:** Rectilinear and Curvilinear motion – Velocity and Acceleration – Motion of A Rigid Body – Types and their Analysis in Planar Motion.

**Kinetics:** Analysis as a particle and Analysis as a Rigid Body in Translation – Central Forces of motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies

## UNIT – V

**Analysis of Perfect Frames:** Types of frames – cantilever frames and simply supported frames – Analysis of frames using method of joints, method of sections and tension coefficient method for vertical loads, horizontal loads and inclined loads.

**Mechanical Vibrations:** Definitions, Concepts-Simple Harmonic motion-Free vibrations-Simple, Compound and Torsional pendulum- Numerical problems

### **Text Books:**

- (1) *Engineering Mechanics* by Jayakumar, Kumar, PHI, 2014
- (2) *Singer's Engineering Mechanics Statics and Dynamics*, Vijay Kumar Reddy, Suresh Kumar. BS Publications 2015
- (3) *Engineering Mechanics – B. Bhattacharyya*, Oxford University Publications, 2015

### **References:**

- (1) *Engineering Mechanics* by Seshigiri Rao, Rama Durgaiah, Universities Press, 2005
- (2) *Engineering Mechanics* by Shames & Rao – Pearson Education.
- (3) *Engineering Mechanics* by Fedrinand L.Singer – Harper Collings Publishers.
- (4) *Engineering Mechanics (Statics and Dynamics)* by Pytel, Kiusalaas; Cengage, 2015
- (5) *Engineering Mechanics* by S.Timoshenko, D.H.Young and J.V.Rao, Tata McGraw-Hill Company
- (6) *Engineering Mechanics* by Chandramouli, PHI publications.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech II-I Sem. (ME)**

L	T	P	C
3	1	0	3

**(15A03303) THERMODYNAMICS**
**Course Objective:**

*By this subject students will get the awareness on basic thermodynamic principles, skills to perform the analysis and design of thermodynamic systems, First law and second law of thermodynamics and its applications to a wide variety of systems, principles of psychrometry and properties of pure substances. And also understand the concept of various air standard cycles with the help of P-v and T-s Diagrams.*

**UNIT I**

**BASIC CONCEPTS:** Macroscopic and Microscopic Approaches, Thermodynamic System, State, Property, Process and Cycle, Quasi Static Process, Thermodynamic Equilibrium, Quasi-static Process, Zeroth Law of Thermodynamics,

**WORK & HEAT TRANSFER:** Work transfer, types of work transfers, Point and Path Functions, Heat transfer, Comparison of Work and Heat transfers.

**Learning Outcome & Suggested Student Activities:**

*Students can able to understand thermodynamic property, cycle, constraints of equilibrium, reversibility and energy transfer in the form of Work and Heat with various applications. Students are advised to collect different types of thermometers, measure the temperature of a given room/substance and compare the values. Following URL is very useful for better understanding <http://www.nptel.iitm.ac.in>. Students may refer text book of Fundamentals of Engineering Thermodynamics By Michael J. Moran, Howard N. Shapiro.*

**UNIT II**

**FIRST LAW OF THERMODYNAMICS:** First Law applied to a process and a cycle, Energy - a property, Forms and transformation of Energy, Internal Energy and Enthalpy, PMM I.

**FLOW SYSTEMS:** Control Volume, Steady Flow Process, Mass balance and Energy Balance, Applications of Steady Flow Processes.

**Learning Outcome & Suggested Student Activities:**

*Student will learn how energy transformation occurs from one form into another form in open and closed systems and applying steady flow energy equation and mass balance equation to various applications.*

*Student is advised to observe the Nozzle, Diffuser, Throttling device, Turbine and compressor in laboratories or local industries and understand their working principles practically. Notes of First law of thermodynamics can be downloaded from the website <http://nptel.iitm.ac.in/courses/103101004/downloads/chapter-3.pdf>.*

**UNIT III**



Second Law of Thermodynamics: Heat Engine, Statements of Second law and their equivalence, Refrigeration and Heat Pump, Reversibility and Irreversibility, Carnot cycle and Carnot's Theorem, Thermodynamic Temperature Scale, Efficiency of Heat Engine, PMM II

Entropy: Clausius' Theorem, Entropy as a property, T-s Plot, Clausius Inequality, Principle of Entropy Increase and its applications. Available Energy, Quality of Energy, definitions of Dead state, Availability.

**Learning Outcome & Suggested Student Activities:**

*Student will identify the major difference in working of a heat engine, refrigerator and heat pump. to calculate the maximum efficiency of a cycle. Also student can learn calculating entropy change for a process, maximum available energy. Student is advised to visit laboratories of Heat Engines, Refrigeration and Air conditioning and observe how they work. Student may refer text book Fundamentals of Classical Thermodynamics - G.J.VanWylen& Sonntag*

#### UNIT IV

Pure Substances: P-v, P-T, T-s diagrams of Pure Substances, Mollier Diagram, Dryness Fraction, Use of Steam Tables for Thermodynamic Properties

Thermodynamic Relations: Maxwell's equations, TDS equations, Joule-Kelvin Effect, Clausius-clapeyron equation.

**Learning Outcome & Suggested Student Activities:**

*After the completion of the unit, student will be able to understand the method drawing phase equilibrium diagrams like P-v, h-s, T-s and P-T of a pure substance. Student can learn the usage of steam tables and mollier diagrams in solving problems. Also, the student will learn the cooling / heating effect of throttling process. Thermodynamic relations.*

*Student is advised to do the experiment on water (To cool / heat water) from atmospheric conditions and observe freezing / boiling point temperatures, changes in volume etc. Repeat the same experiment under different pressure.*

#### UNIT V

Properties of Gases and Gas Mixtures: Ideal Gas, Equation of State, Avogadro's Law, Internal Energy and Enthalpy of Ideal Gas, Entropy Change of Ideal Gas, Mixture of Gases- Dalton's Law of Partial Pressure, Specific Heats, Internal Energy and Enthalpy of Gas Mixtures

Gas Power Cycles: Carnot Cycle, Sterling Cycle, Ericson Cycle, Otto Cycle, Diesel Cycle, Dual Cycle, their applications, comparison of Otto, Diesel and Dual cycles, Second Law Analysis of Gas Power Cycles

**Learning Outcome & Suggested Student Activities:**

*Student will learn basic laws of ideal gas and gas mixtures. After studying Gas Power Cycles, student will understand the concept of ideal cycles for different engines and their working principle. Student can know drawing P-V and T-S diagrams for various air standard cycles and calculating work output, efficiency, mean effective pressure of each cycle.*

*Student is advised to conduct experiments in I.C Engines lab to find out the actual thermal efficiencies of Diesel and Petrol Engines and compare them with respect to ideal cycles.*

**Text Books:**

1. *Engineering Thermodynamics*, P.K Nag, TMH Publishers, New Delhi, 5<sup>th</sup> Edition, 2013.
2. *Engineering Thermodynamics* by P. Chattopadhyaya, Oxford, 1<sup>st</sup> Revised, 2016

**Reference Books:**

1. *Thermodynamics for Engineers*, Kenneth A. Kroos, Marle C. Potter, V. Pandurangadu.
2. *Fundamentals of Thermodynamics – Sonntag, Borgnakke and van wylen*, John Wiley & sons
3. *Thermodynamics – An Engineering Approach – Yunus Cengel & Boles*, TMH, 2011.
4. *Thermodynamics – J.P. Holman*, McGrawHill, 2<sup>nd</sup> Edition company New York 1975.
5. *An introduction to Thermodynamics*, YVC Rao, Universities press, 2009 Revised Edition,
6. *Engineering Thermodynamics – J.B. Jones & R.E. Dugan*, PHI, 1<sup>st</sup> Edition, 2009.

**NOTE:** Steam tables, Mollier Diagrams should be supplied



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech II-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**(15A03304) COMPUTER AIDED DRAFTING LAB****LIST OF EXPERIMENTS:**

- I Introduction to Computer Aided Drafting software packages.
- II. Practice on basic elements of a Computer Aided Drafting packages
- III. Practice on features of a Computer Aided Drafting package
- IV Drafting of Solids, Intersection of Solids
- V Drafting of Perspective views
- VI Drafting of Orthographic views of simple parts

Note: Any of the standard Software Packages like – AUTO CAD, Pro-E, Uni – Graphics, Catia .... Etc may be used

**References:**

1. Computer – Aided Engineering Drawing, S. Trymbaka Murthy. University Press.
2. Engineering Graphics for Degree, K.C. John. PHI Publications.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech II-II Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**(15A54401) PROBABILITY AND STATISTICS**

**(Common to CSE, IT, Civil, Mech.)**

**Objectives:** To help the students in getting a thorough understanding of the fundamentals of probability and usage of statistical techniques like testing of hypothesis, Statistical Quality Control and Queuing theory

**UNIT – I**

Basic concepts of Probability – Random variables – Expectation – Discrete and continuous Distributions – Distribution functions. Binomial and poisson distributions Normal distribution – Related properties.

**UNIT – II**

Test of Hypothesis: Population and Sample - Confidence interval of mean from Normal distribution - Statistical hypothesis - Null and Alternative hypothesis - Level of significance. Test of significance - Test based on normal distribution - Z test for means and proportions.

**UNIT – III**

Small samples - t- test for one sample and two sample problem and paired t-test, F-test and Chi-square test (testing of goodness of fit and independence).

**UNIT – IV**

Statistical Quality Control: Concept of quality of a manufactured product -Defects and Defectives - Causes of variations - Random and assignable - The principle of Shewhart Control Chart-Charts for attribute and variable quality characteristics- Constructions and operation of  $\bar{X}$  - Chart, R-Chart,

p - Chart and C-Chart.

**UNIT – V**

Queuing Theory: Pure Birth and Death process, M/M/1 & M/M/S & their related simple problems.

**TEXT BOOKS:**

1. Probability & Statistics by E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher.
2. Probability & Statistics for engineers by Dr. J. Ravichandran WILEY-INDIA publishers.

**REFERENCES:**

1. Probability & Statistics by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S.Chand publications.
2. Statistical methods by S.P. Gupta, S.Chand publications.
3. Probability & Statistics for Science and Engineering by G.Shanker Rao, Universities Press.
4. Probability and Statistics for Engineering and Sciences by Jay L.Devore, CENGAGE.
5. Probability and Statistics by R.A. Jhonson and Gupta C.B.

**Outcomes:** The student will be able to analyze the problems of engineering & industry using the techniques of testing of hypothesis, Statistical Quality Control and Queuing theory and draw appropriate inferences.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech II-II Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>
<b>(15A99301) BASIC ELECTRICAL AND ELECTRONICS ENGINEERING</b>				

**PART – A**  
**BASIC ELECTRICAL ENGINEERING**

**Objective:**

Basic Electrical Engineering contains basic Circuits, Network theorems, two port networks, DC generators & motors, Transformers, Induction motors. The objective is to study their performance aspects.

**UNIT – I Introduction to DC & AC Circuits**

Ohm's Law, R, L, C Components, Kirchhoff's Laws, Types of Sources, Simple problems on Resistive Networks, Series Parallel Circuits, Star Delta and Delta Star Transformation. Sinusoidal waveforms and Basic Definitions, Root Mean Square and average values of sinusoidal Currents and Voltages. Form Factor and Peak Factor.

**Network Theorems:** Thevenin's, Norton's, Maximum Power Transfer and Superposition Theorems for DC Excitations.

**Two Port Networks:** Two Port Network Parameters – Impedance, Admittance, Transmission and Hybrid Parameters and Their Relations.

**UNIT-II DC Machines**

**D.C Generators:** Constructional details of D.C. machines, Principle of Operation of D.C. generators, Types of D.C Generators, E.M.F Equation, O.C.C. of a D.C. Shunt Generator

**D.C Motors:** Principle of Operation of DC Motors, Torque Equation, Losses and Efficiency Calculation, Speed Control of D.C. shunt motor (Armature voltage control and Field flux control). Swinburne's Test and Applications.

**UNIT-III AC Machines**

**1-phase Transformers:** Principle of Operation, Constructional Details, E.M.F. equation, Losses and Efficiency, OC & SC Tests, Regulation of Transformers.

**3-Phase Induction Motors:** Principle of Operation, Slip, Torque (Simple Problems), Slip-Torque characteristics.

**3-phase Alternators:** Principle of Operation-Constructional Details-EMF Equation.

**OUTCOME:**

After going through this course the student acquires knowledge on basics of Electrical Circuits, Network theorems, two port networks, DC generators & motors, Transformers, Induction motors and Alternators.

**TEXT BOOKS:**

1. Basic Electrical Engineering, V. N. Mittle and Arvind Mittle, Mc Graw Hill (India) Pvt. Ltd., 2<sup>nd</sup> Edition, 2005.
2. Basic Electrical Engineering, T.K.Nagsarkar and M.S. Sukhija, Oxford University Press, 2<sup>nd</sup> Edition, 2011.

**REFERENCES:**

1. Basic Electrical Engineering, M.S.Naidu and S. Kamakshiah, Tata Mc Graw Hill, 3<sup>rd</sup> Edition, 2009.
2. Electrical and Electronic Technology, Hughes, Pearson Education.

**PART-B****UNIT I**

**Semiconductor Devices:** Intrinsic semiconductors-Electron-Hole Pair Generation, Conduction in Intrinsic Semiconductors, Extrinsic Semiconductors-N-Type and P-Type Semiconductors, Comparison of N-Type and P-Type Semiconductors. The p-n Junction – Drift and Diffusion Currents, The p-n Junction Diode-Forward Bias, Reverse Bias, Volt-Ampere Characteristics- Diode Specifications, Applications of Diode, Diode as a Switch. Diode as a Rectifier-Half-wave Rectifier, Full-Wave Rectifier, Full-Wave Bridge Rectifier, Rectifiers with Filters, Zener Diode- Volt-Ampere Characteristics, Zener Diode as Voltage Regulator.

**UNIT II**

**BJT and FETs:** Bipolar Junction Transistor (BJT) – Types of Transistors, Operation of NPN and PNP Transistors, Input-Output Characteristics of BJT-CB, CE and CC Configurations, Relation between  $I_c$ ,  $I_b$  and  $I_e$ . Transistor Biasing- Fixed Bias, Voltage Divider Bias, Transistor Applications- Transistor as an Amplifier, Transistor as a Switch,. Junction Field Effect Transistor (JFET)- Theory and Operation of JFET, Output Characteristics, Transfer Characteristics, Configurations of JFET-CD, CS and CG Configurations, JFET Applications- JFET as an Amplifier, JFET as a Switch, Comparison of BJT and JFET,MOSFET-The Enhancement and Depletion MOSFET, Static Characteristics of MOSFET, Applications of MOSFET.

**UNIT III**

**Oscillators and Op-Amps:** Sinusoidal Oscillators, Barkhausen Criteria for Oscillator Operation, Components of an Oscillator-Transistor Amplifier Circuits, Feedback Circuits and Oscillator Circuits, Classification of Oscillators, LC Tuned, RC Phase Shift Oscillator circuits.

**Operational Amplifiers(Op-Amps)**-Symbol of an Op-Amp, single Input and Dual Input Op-Amps(Differential Amplifier), Characteristics of an Ideal Op-Amp, Basic Forms of Op-Amps-Inverting & Non-Inverting Amplifiers, Applications of Op-Amps, summing, Differential, Integrator, differentiator Amplifier.



**TEXT BOOKS:**

1. Basic Electrical and Electronics Engineering, M.S.Sukhija, T.K.Nagsarkar, Oxford University Press, 1<sup>st</sup> Edition, 2012.
2. Basic Electrical and Electronics Engineering, S.K Bhattacharya, Pearson Education, 2012.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech II-II Sem. (ME)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**(15A03401) MACHINE DRAWING**
**Course Objective:**

*To make the students to understand the concepts of I.S. conventions, methods of dimensioning, the title boxes, to draw the machine elements and simple parts.*

*To make the students to understand and draw assemblies of machine parts and to draw their sectional views*

**UNIT I**

Machine Drawing Conventions: Need for drawing conventions- introduction to IS conventions

Conventional representation of material, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs. Parts not usually sectioned.

Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.

Title boxes, their size, location and details-common abbreviations & their liberal usage

**Learning Outcome & Suggested Student Activities:**

*This unit is useful to prepare the students for representing their ideas at International standards and will be able to convey in without much effort globally with ease. Students will acquire skills to draft on a drawing sheet without much effect. Students are advised to visit machine shop.*

**UNIT II**

Drawing of Machine Elements and simple parts: Selection of Views, additional views for the following machine elements and parts with drawing proportions:

Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws, Keys, cottered joints and knuckle joint, Rivetted joints for plates, flanged & protected flanged joint. Shaft coupling, spigot and socket pipe joint. Journal, and foot step bearings.

**Learning Outcome & Suggested Student Activities:**

*Students can represent various details of an object quickly without much time and ambiguity. These drawings can be easily prepared and understood by both the people in a manufacturing industry and the consumers too. Students are advised to visit machine shop.*

**UNIT III**

Assembly Drawings: Drawings of assembled views for the part drawings of the following.

Engine parts- stuffing boxes, cross heads, Eccentrics, Petrol Engine-connecting rod, piston assembly.

Other machine parts- Screw jack, Machine Vice, single tool post.

Valves: Steam stop valve, feed check valve. Non return valve.

**Learning Outcome & Suggested Student Activities:**

Students can understand the working principles of an assembly or subassembly so that he/she will be able to produce the final product by procuring the units from various sources/suppliers and still produce any useful product serving effectively. It is not necessary that all the components to be made locally only. Students are advised to visit body building and assembly unit.

Note: First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

**Text Books:**

1. Machine Drawing – N Siddeswar, P. Kannaiah, VVS Sastry, Mc Graw Hill, 2015
2. Machine Drawing- K.L. Narayana, P.Kannaiah & K.Venkata Reddy, New Age Publishers, 4<sup>th</sup> Edition, 2012.

**Reference Books:**

1. Machine Drawing- P.S. Gill, S.K. Kataria & Sons, 17<sup>th</sup> Edition, 2012.
2. Machine Drawing- Dhawan, S.Chand Publications, 1<sup>st</sup> Revised Edition, 1998.
3. Machine Drawing – Ajeet Singh, McGraw Hill, 2012
4. Machine Drawing- Luzzader, PHI Publishers, 11<sup>th</sup> Edition.
5. Textbook of Machine Drawing-K.C.John, 2009, PHI learning, 1<sup>st</sup> Edition.

**NOTE:**

- The End exam will be for 4 hrs in the following format
- All answers should be on the drawing sheet only. Answers on the drawing sheet only will be valued.
- First Angle Projections

Q1 Questions set on section I of the syllabus 2 out of 3 or 2 out of 4 to be

answered with a weightage of 4 marks each-08 marks.

Q2 Questions set on section II of the syllabus 2 out of 3 to be answered with a

weightage of 10 marks each-20 marks.

Q3 Drawing of assembled views of section III items of syllabus with a weightage of

42 marks

**Suggestions:**

Student should buy a book mentioned under Text books and study all the exercises given at the end of each chapter to equip him/her with the required ammunition.

Student should visit an automobile shop while the unit is being disassembled / assembled.

Student should go through the exercises given under assembly drawings refereeing to various books in the library to improve his assimilation capacity.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B. Tech II-II Sem. (ME)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**(15A03402) KINEMATICS OF MACHINES**

**Course Objective:**

*The objective of this course is to cover the kinematics and dynamics of planar single degree of freedom mechanisms. After this course the student should have general mathematical and computational skills to enable the kinematics and dynamics analysis of machine elements including linkages, cams and gears and also becomes familiar with gear terminology and drawing of the cam profiles.*

**UNIT I**

**MECHANISMS AND MACHINES:** Elements or Links – Classification – Rigid Link, flexible and fluid link. Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained. Mechanisms and machines – classification of mechanisms and machines – kinematic chain – inversion of mechanisms – inversions of quadric cycle chain – single and double slider crank chain. Mobility of mechanisms. Straight Line Motion Mechanisms- Exact and approximate, copiers and generated types –Peaucellier, Hart and Scott Russel – Grasshopper, Watt, Tchebicheff and Robert Mechanisms. Pantograph.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are in a position to identify different mechanisms, inversions of different kinematic chains and also to find mobility of mechanisms. To get more clarity on mechanisms and machines, the following URLs will be highly useful to the students to understand various concepts of mechanisms and machines.*  
<http://www.cs.cmu.edu/~rapidproto/mechanisms/chpt2.html>,  
<http://www.mhprofessional.com/downloads/products/0071704426/0071704426-ch01.pdf>

**UNIT II**

**STEERING MECHANISMS:** Conditions for correct steering – Davis Steering gear, Ackermanns steering gear. Hooke’s Joint (Universal coupling) -Single and double Hooke’s joint — applications – Simple problems.  
**Belt, Rope and Chain Drives :** Introduction, Belt and rope drives, selection of belt drive- types of belt drives, materials used for belts and ropes, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains- length, angular speed ratio, classification of chains.

**Learning outcome & Suggested Student Activities:**

*After completion of this chapter students are able to understand the mechanism of Hooke’s joint, steering mechanisms and belt friction. And are also able to solve numerical problems on Hooke’s joint, belt and rope drives. Students can go through the*

*textbooks for the problems on Hooke's joint, belt and rope drives. The following URLs will be highly useful to the students to understand various concepts of steering mechanisms and belt friction.*

*[http://nptel.iitm.ac.in/courses/Webcourse-](http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/pdf/mod13les1.pdf)*

*[contents/IIT%20Kharagpur/Machine%20design1/pdf/mod13les1.pdf](http://www.youtube.com/watch?v=YzGM8Uc2HB0)*

*<http://www.youtube.com/watch?v=YzGM8Uc2HB0>*

### **UNIT III**

#### **KINEMATICS**

Velocity and Acceleration Diagrams- Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method – Slider crank mechanism, four bar mechanism. Acceleration diagrams for simple mechanisms, Coriolis acceleration, determination of Coriolis component of acceleration. Kleins construction. Analysis of slider crank mechanism for displacement, velocity and acceleration of slider using analytical method Instantaneous Centre Method: Instantaneous centre of rotation, centrode and axode – relative motion between two bodies – Three centres in-line theorem – Locating instantaneous centres for simple mechanisms and determination of angular velocity of points and links.

#### **Learning outcome & Suggested Student Activities:**

*After completion of this unit student are able to draw velocity and acceleration diagrams of simple plane mechanisms by using relative velocity method and instantaneous center method. Students can go through the textbooks given for the problems on analysis of mechanisms. The following URLs will be highly useful to the students to understand various concepts of velocity and acceleration diagrams.*

*<http://www.freestudy.co.uk/dynamics/velaccdiag.pdf>*

*[http://ebooks.library.cornell.edu/k/kmoddl/pdf/013\\_005.pdf](http://ebooks.library.cornell.edu/k/kmoddl/pdf/013_005.pdf)*

### **UNIT IV**

GEARS: Higher pairs, friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Forms of tooth-cycloidal and involute profiles. Velocity of sliding – phenomena of interference – Methods to avoid interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact. Introduction to Helical, Bevel and worm gearing.

GEAR TRAINS: Introduction –Types of gears – Simple, compound, reverted and Epicyclic gear trains. Train value – Methods of finding train value or velocity ratio – Tabular column method for Epicyclic gear trains. Torque in epicyclic gear trains. Differential gear of an automobile.

#### **Learning outcome & Suggested Student Activities:**

*After completion of this unit student are able to know gears terminology, types of gears, length of path of contact, contact ratio and interference in gears. Further students are also able to design the gears to avoid interference and to calculate train value for different gear trains. Students may go through text books given for more number of problems on gears and gear trains. Students may also refer the books authored by R.L. Norton and also by J.E. Shigley in addition to the textbooks for this unit to get more*

clarity on this unit. The following URLs will be highly useful to the students to understand various concepts of gears and gear trains [http://www.nptel.iitm.ac.in/courses/IIT-MADRAS/Machine\\_Design\\_II/pdf/2\\_1.pdf](http://www.nptel.iitm.ac.in/courses/IIT-MADRAS/Machine_Design_II/pdf/2_1.pdf), [http://vedyadhara.ignou.ac.in/wiki/images/e/e8/BME-020\\_B-3\(Unit\\_10\).pdf](http://vedyadhara.ignou.ac.in/wiki/images/e/e8/BME-020_B-3(Unit_10).pdf) <http://www.youtube.com/watch?v=qLVwXZ2sS48>

## UNIT V

CAMS: Definitions of cam and follower – uses – Types of followers and cams – Terminology. Types of follower motion - Uniform velocity – Simple harmonic motion and uniform acceleration. Maximum velocity and maximum acceleration during outward and return strokes. Drawing of cam profiles.

ANALYSIS OF MOTION OF FOLLOWERS: Tangent cam with roller follower – circular arc (Convex) cam with flat faced and roller follower.

### **Learning outcome & Suggested Student Activities:**

After completion of this unit the students are able to draw displacement diagram and cam profile for different types of motions of the follower. And also to find the displacement, velocity and acceleration of the follower at different positions of cam with specified contours. The following URLs will be highly useful to the students to understand various concepts of drawing the cam profile for different followers. <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-Delhi/Kinematics%20of%20Machine/site/coursecontent/cntmod10.htm>, <http://www.youtube.com/watch?v=UpS8OjdXSow>

### **Text Books:**

1. *Theory of Machines*, S.S. Rattan, Tata McGraw Hill Publishers, 3<sup>rd</sup> Edition, 2013.
2. *Kinematics and dynamics of machinery*, R.L Norton ,Tata McGraw Hill Publishers, 1<sup>st</sup> Edition, 2009.

### **Reference Books:**

1. *Theory of Machines and Mechanisms*, 3<sup>rd</sup> Edition, J.E. Shiegly et. al, Oxford International Student Edition.
2. *The theory of Machines*, Ballaney, Kanna Publishers
3. *Theory of Machines*, Thomas Bevan, Pearson (P) 3<sup>rd</sup> Edition, 2012.

**NOTE :** Exam should be conducted in Drawing Hall

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**Suggestions:**

*Students may visit nearby machine tool shops and automobile workshops to know about different mechanisms, gears, gear trains, flexible drives and cams. Students are suggested to search the web and identify different URLs which provide animations of mechanisms for better visualization and understanding purpose.*

**WEB References:**

<http://nptel.iitk.ac.in>

<http://ptumech.loremate.com/tom1/node/1>

<http://www.youtube.com/watch?v=6coD3oOuhr8>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B. Tech II-II Sem. (ME)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**(15A03403) THERMAL ENGINEERING – I**

**Course Objective:**

*The objective of this subject is to impart the knowledge of engine components, working principles of IC engines, auxiliary systems, the combustion aspects of SI and CI engines in addition to the methods of improving performance. The students shall become aware on the latest developments in the field of IC engines like MPFI, CRDI etc. and also shall become familiar about the working of Reciprocating and Rotary Compressors. The student also shall apply the thermodynamic concepts in IC engines and compressors.*

**UNIT I**

I.C. ENGINES: Definition of Engine And Heat Engine, I.C Engine Classification – Parts of I.C.Engines, Working of I.C. Engines, Two Stroke & Four Stroke I.C.Engines SI & CI Engines, Valve and Port Timing Diagrams.

**Learning Outcome & Suggested Student Activities:**

*After completion of the unit, student can know working of both S.I and C.I engines with the help of indicator diagrams. Student can differentiate the working of 2-S and 4-S engines and also can draw valve and port timing diagrams. Student can know applications of IC engine in the automobile industry. Students are advised to visit nearby automobile service center/station and engines laboratory for Knowing the various engines and engine components. Student can also see various types of engines fitted to two wheelers, four wheelers, and diesel power plants. The following URLs will be highly useful to the students to understand various aspects of I.C.Engines <http://www.youtube.com/watch?v=XfJvRTOP3M>, [http://www.youtube.com/watch?v=MNrVYG\\_NdD4](http://www.youtube.com/watch?v=MNrVYG_NdD4), [http://www.youtube.com/watch?v=W8oWq2Iv\\_W4](http://www.youtube.com/watch?v=W8oWq2Iv_W4), [www.yo](http://www.youtube.com/user/Techtrixinfo)*

**UNIT II**

Fuel System: S.I. Engine: Fuel Supply Systems, carburetor types Air Filters, Mechanical and Electrical Fuel Pump – Filters– Gasoline Injection Systems..

Cooling & Lubrication Systems: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo Siphon, Water And Forced Circulation System; Lubrication Systems-Flash, Pressurized and Mist Lubrication.

Ignition System: Function Of An Ignition System, Battery coil Ignition System, Magneto Coil Ignition System, Electronic Ignition System using Contact Breaker, Electronic Ignition using Contact Triggers – Spark Advance And Retard Mechanism.

**Learning Outcome & Suggested Student Activities:**

*Student can understand the fuel supply systems, cooling, lubrication and ignition systems. Student can understand how auxiliary systems play key role in increasing the performance of an I.C engine.*



*Student is advised to visit nearby automobile service center/station for getting practical knowledge about various auxiliary systems. Student can find the radiator (air cooling and water cooling) in front of heavy vehicles and stationary engines and air cooling for two wheelers and three wheelers.*

*The following URLs will be highly useful to the students to understand various aspects of fuel supply systems, filters, cooling, lubrication systems and Ignition systems.*

*<http://www.youtube.com/watch?v=ksG4ypoMEaM>; <http://www.youtube.com/watch?v=LwrL-Cn9HT8>; [http://www.youtube.com/watch?v=O\\_Y3dM8ZApo](http://www.youtube.com/watch?v=O_Y3dM8ZApo); <http://www.youtube.com/watch?v=mmmcj53TNic>*

### **UNIT III**

Fuels and Combustion:

S I engine :Normal Combustion and Abnormal Combustion – Importance of Flame Speed and Effect of Engine Variables – Type of Abnormal Combustion, Pre-Ignition and Knocking (Explanation) – Fuel Requirements and Fuel Rating, Anti Knock Additives, Combustion Chambers.

C.I Engines: Stages Of Combustion – Delay Period And Its Importance – Effect Of Engine Variables – Diesel Knock– Combustion Chambers (DI And IDI), Fuel Requirements And Fuel Rating.

#### **Learning Outcome & Suggested Student Activities:**

Student can understand the flame propagation inside the cylinder, stages of combustion in S.I and C.I engines. Student can understand the knocking phenomenon. Student can know about Octane number and Cetane number of fuels and properties of fuel. Combustion Process is very typical process practically students can't see but student can understand the combustion process by visiting following URLs. Students are suggested to know various losses occurred through combustion chamber, at least theoretically.

*<http://www.youtube.com/watch?v=ep1NhANcCL4>;  
<http://www.youtube.com/watch?v=pqa4zCo4erY>*

### **UNIT IV**

Testing and Performance : Parameters of Performance - Measurement of Cylinder Pressure, Fuel Consumption, Air Intake, Exhaust Gas Composition, Brake Power – Determination of Frictional Losses And Indicated Power – Performance Test – Heat Balance Sheet and Chart.

#### **Learning Outcome & Suggested Student Activities:**

*Student can be familiar with indicated power, brake power and friction power and their methods of measurement. Student can understand the methods to increase the engine performance. Also, student can know calculating specific fuel consumption, A/F ratio and mean effective pressure and estimating heat losses etc. Students are advised to visit heat engines laboratory for analyzing the effect of various parameters on engine performance.*

*To better understand the above following URLs are useful.*

<http://web.iitd.ac.in/~ravimr/courses/mel345/ignou-notes.pdf>;

## UNIT V

Air Compressors: Reciprocating Compressors, Effect of Clearance volume in Compressors, Volumetric Efficiency, Single Stage and Multi Stage Compressors, Effect of Inter cooling and Pressure Drop in Multi - Stage Compressors, Problems Related to Reciprocating Compressors, Working principles of Roots blower, Vane type Blower, Centrifugal Compressor - Axial Flow Compressors, Working Principle of Rotary Compressors.

### **Learning Outcome & Suggested Student Activities:**

*Student can differentiate the working of reciprocating and rotary air compressors. Student can calculate work done by single and multistage reciprocating air compressors. Student can understand how intercooling reduces the work done / kg of air.*

*To gain further practical knowledge students are advised to visit laboratory/automobile workshop to see different types of compressors. The following URLs will be highly useful to the students to understand the air compressors.*

<http://www.ustudy.in/node/5106> ; <http://www.youtube.com/watch?v=Ue7BkzBARXw>

<http://www.youtube.com/watch?v=6zYHUXSG3HE>;

<http://www.youtube.com/watch?v=OuK6nGibFqY>

**Students are advised to refer the text book of “Internal Combustion Engine Fundamentals” by John B. Heywood.**

### **Text Books:**

1. *Internal Combustion Engines / V. Ganesan- TMH, 4<sup>th</sup> Edition, 2012*
2. *Thermal Engineering / Rajput / Lakshmi Publications, 9<sup>th</sup> Edition, 2013*

### **Reference Books:**

1. *I.C. Engines fundamentals, Heywood, McGrawHill, 1<sup>st</sup> Edition, 2011*
2. *IC Engines – Mathur & Sharma – DhanpathRai & Sons, , 2010*
3. *Engineering fundamentals of IC Engines – Pulkrabek, Pearson, PHI, 2<sup>nd</sup> Edition, 2009*
4. *Thermal Engineering, Rudramoorthy – TMH, 10<sup>th</sup> Edition, 2010*
5. *Thermodynamics & Heat Engines, B. Yadav, Central publishing house., Allahabad, 2002*
6. *Thermal Engineering – R.S. Khurmi & J.K.Gupta – S.Chand, 15<sup>th</sup> Edition, 2012*

### **WEB Resources:**

<http://autoclub.rso.siuc.edu/frange.html>

<http://www.howstuffworks.com/engine1.htm>

<http://inventors.about.com/library/inventors/blinternalcombustion.htm>

<http://www.animatedengines.com/>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech II-II Sem. (ME)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**(15A03404) MANUFACTURING TECHNOLOGY**
***Course Objective:***

*By this subject the students will understand how manufacturers use technology to change raw materials into finished products. The students shall also introduce the basic concepts of casting, pattern preparation, gating system and knowledge on basic features of various welding and cutting processes. And also to study the concepts of surface treatment process, their characteristics and applications*

**UNIT I**

**CASTING:** Definition, elements, Steps involved in making a casting– Types of patterns - Patterns and Pattern making — Materials used for patterns, pattern allowances and their Construction. Principles of Gating, Gating ratio and design of Gating systems, time of filling the cavity. Design of core prints, buoyancy principle. Moulds: definition, mould materials, types of moulds, moulding methods, moulding machines, tests. Solidification of casting – Concept – Solidification of pure metal and alloys, short & long freezing range alloys.

***Learning Outcome & Suggested Student Activities:***

*Students can understand the elements of casting, construction of patterns and gating systems, moulds, methods of moulding, moulding machines and solidification of castings of various metals. Students are advised to visit URLs <http://www.nptel.iitm.ac.in/> and [iitr.ac.in](http://iitr.ac.in), [www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm](http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm).*

**UNIT II**

**SPECIAL CASTING PROCESSES:** Process Mechanics, characteristics, parameters and applications of Centrifugal, Die, and Investment casting.

**RISERS** – Types, function and design, casting design considerations, Design of feeding systems i.e., sprue, runner, gate and riser, moulding flasks

**METHODS OF MELTING:** Crucible melting and cupola operation, steel making processes.

Casting inspection and defects

***Learning Outcome & Suggested Student Activities:***

*Students can understand the different types of special casting methods and their applications, design of risers and feeding systems, crucible melting, cupola operation and steel making process. The students may also be able to design a casting process on his own. The students are also advised to visit a Casting Industry nearby to get practical exposure.*

**UNIT III**

A) **WELDING** : Classification of welding processes types of welds and welded joints and their characteristics, design of welded joints, Gas welding, ARC welding, Forge welding, resistance welding, Thermit welding and Plasma (Air and water ) welding.

B) **CUTTING OF METALS**: Oxy – Acetylene Gas cutting, water plasma. Cutting of ferrous, non-ferrous metals

**Learning Outcome & Suggested Student Activities:**

*Students can understand the different types of welding processes, welds and weld joints, their characteristics, cutting of ferrous and non-ferrous metals by various methods. The students are advised to visit nearby welding shop for better understanding of welding process.*

**UNIT IV**

Mechanics, characteristics, process parameters, applications of Inert Gas welding, TIG & MIG welding, Friction welding, Induction welding, Explosive welding, Laser welding, Soldering & Brazing and adhesive bonding. Heat affected zones in welding; welding defects – causes and remedies – destructive and nondestructive testing of welds

**Learning Outcome & Suggested Student Activities:**

*Students can understand about advanced welding process, heataffected zone(HAZ), Defects and Identification Methods. The students are advised to visit nearby welding shop and MFT Lab in the college.*

**UNIT V**

**SURFACE ENGINEERING**: Surface treatment processes and their characteristics and applications. (a) Overlay coatings (b) Diffusion coatings (c) Thermal or mechanical modification of surfaces

**Learning Outcome & Suggested Student Activities:**

*Students can understand the various surface treatment processes. Student is advised to visit the nearby surface coating industry.*

**Text Books:**

1. *Manufacturing Technology, Vol I P.N. Rao, Tata Mc Graw Hill, 4<sup>th</sup> Edition, 2013*
2. *Manufacturing Technology, Kalpakjain, Pearson education, 4<sup>th</sup> Edition, 2002*

**Reference Books:**

1. *Production Technology, K.L Narayana, I.K. International Pub, 3<sup>rd</sup> Edition, 2013*
2. *Manufacturing Process Vol. I, H.S.Shah Pearson, 2013,*
3. *Principles of Metal Castings, Rosenthal, Tata Mc Graw Hill ,2<sup>nd</sup> Edition, 2001*
4. *Welding Process, Parmar.*
5. *Manufacturing Technology, R.K. Rajput, Laxmi Pub, 1<sup>st</sup> Edition, 2007*
6. *Workshop Technology – B.S.RaghuVamshi – Vol I.*

**WEB References:***NPTEL Lectures*

[http://teacher.buet.ac.bd/shabnam/14250\\_ch3.pdf](http://teacher.buet.ac.bd/shabnam/14250_ch3.pdf)

[http://me.emu.edu.tr/majid/MENG364/2\\_casting.pdf](http://me.emu.edu.tr/majid/MENG364/2_casting.pdf)

<http://en.wikipedia.org/wiki/Metalworking>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech II-II Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**(15A03405) THERMAL ENGINEERING LABORATORY**

1. Valve / Port Timing Diagrams of an I.C. Engines
2. Performance Test on a 4 -Stroke Diesel Engines
3. Performance Test on 2-Stroke Petrol engine
4. Evaluation of Engine friction by conducting Morse test on 4-Stroke Multi cylinder Engine
5. Retardation and motoring test on 4- stroke engine
6. Heat Balance of an I.C. Engine.
7. Air/Fuel Ratio and Volumetric Efficiency of an I.C. Engines.
8. Performance Test on Variable Compression Ratio Engines for CI Engines
9. Performance Test on Reciprocating Air – Compressor Unit
10. Study of Boilers
11. Dismantling / Assembly of Engines to identify the parts and their position in an engine.
12. Engine Emission Measurement for SI & CI Engines.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech II-II Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**(15A03406) MANUFACTURING TECHNOLOGY LABORATORY****Minimum of 12 Exercises need to be performed****I. METAL CASTING LAB:**

- Pattern Design and making - for one casting drawing.
- Sand properties testing - Exercise -for strengths, and permeability – 1
- Moulding: Melting and Casting - 1 Exercise

**II. WELDING LAB:**

- Arc Welding: Lap & Butt Joint - 2 Exercises
- Spot Welding - 1 Exercise
- TIG Welding - 1 Exercise
- Plasma welding and Brazing - 2 Exercises (Water Plasma Device)

**III. MECHANICAL PRESS WORKING:**

- Blanking & Piercing operation and study of simple, compound and progressive press tool.
- Hydraulic Press: Deep drawing and extrusion operation.
- Bending and other operations

**IV. PROCESSING OF PLASTICS:**

- Injection Moulding
- Blow Moulding

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech III-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**15A01510 FLUID MECHANICS AND HYDRAULIC MACHINES**
**UNIT - I**

**FLUID STATICS** : Dimensions and units: physical properties of fluids – specific gravity, porosity surface tension – vapor pressure and their influence on fluid motion – atmospheric gauge and vacuum pressure – measurement of pressure – Piezometer, U-tube differential manometers.

**FLUID KINEMATICS** : stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotational flows-equation of continuity for one dimensional flow.

**Fluid dynamics:** surface and body forces – Euler's and Bernoulli's equations for flowing stream line, momentum equation and its application on force on pipe bend.

**UNIT – II**

**CONDUIT FLOW:** Reynold's experiment – Darcy Weisbach equation – Minor losses in pipes – pipes in series and pipes in parallel – total energy line-hydraulic gradient line. Measurement of flow: pitot tube, venturimeter and orifice meter, Flow nozzle and Turbine current meter.

**UNIT – III**

**TURBO MACHINERY** : hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done efficiency, flow over radial vanes.

**HYDROELECTRIC POWER STATIONS:** Elements of hydro electric power station-types-concept of pumped storage plants-storage requirements.

**UNIT – IV**

**HYDRAULIC TURBINES:** Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design-draft tube- theory- functions and efficiency.

**PERFORMANCE OF HYDRAULIC TURBINES** : Unit and specific quantities, characteristics, governing of turbines, selection of type of turbine, cavitation and surge tank.

**UNIT – V**

**CENTRIFUGAL PUMPS** : Classification- working-work done – manometric head – loss efficiencies – specific speed – pumps in series and parallel – performance characteristic curves and NPSH.



**TEXT BOOKS :**

1. Fluid Mechanics, Hydraulic and Hydraulic Machines by Modi & Seth, Standard book house.
2. A Text of Fluid Mechanics and Hydraulic Machines by Dr.R.K.Bansal – Laxmi Publications (P) Ltd., New Delhi.
3. Mechanics of Fluids by Potter, Wiggert, Ramadan, M.M.M.SARCAR, Cengage Publishers.

**REFERENCE BOOKS :**

1. Fluid Mechanics and Machinery by D.Rama Durgaiah, New Age International.
2. Principles of Fluid Mechanics and Fluid Machines by M.Narayana Pillai, Universities Press.
3. Fluid mechanics and fluid machines by Rajput, S.Chand & Co.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech III-I Sem. (ME)**

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**15A03501 THERMAL ENGINEERING – II**
**Course Objective:**

*This subject is designed to provide a sound knowledge in various aspects of thermal equipments. This subject has an increasingly dominant role to play in the vital areas of power generation, Automobiles, R&AC and energy sector. The course contents aims at developing the necessary analytical and technical contents among engineers in these areas. The students shall become familiar with steam power plant, boilers, function of nozzle, gas turbines and jet propulsions.*

**UNIT I**

**BASIC CONCEPTS:** Rankine Cycle - Schematic Layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat Addition, Methods to Improve Cycle Performance – Regeneration – Reheating- Combined- Cycles.

**Learning Outcome & Suggested Student Activities:**

*Student can be able to illustrate the power generation through Rankine cycle. Student can able understand efficiency enhancement methods of Reheating and regeneration. Student can able to understand the key role of quality of steam after evaporation. Students are advised to be acquainted with the terms related to steam, steam tables and mollierchart. Also, students are advised to visit the thermal power station to get real expose.*

**UNIT II**

**BOILERS:** Classification Based on Working Principles & Pressures of Operation - L.P & H.P. Boilers – Mountings and Accessories.

**DRAUGHT:** Classification – Height Of Chimney for Given Draught and Discharge, Condition for Maximum Discharge, Efficiency of Chimney – Artificial Draught, Induced and Forced Draught.

**Learning Outcome & Suggested Student Activities:**

*Student can able to understand the working of different high pressure and low pressure boilers. Student can distinguish mountings and accessories. The student can calculate the chimney height for maximum discharge. Student can know the draughts and its application in the steam generator. Students are advised to visit the Boilers in the power generation units to get better expose. And visit the following URLs will be highly useful to the students to understand various aspects of thermal power plants and boilers.*

*[https://www.youtube.com/watch?v=Ota2\\_LUuar0](https://www.youtube.com/watch?v=Ota2_LUuar0),*

*<https://www.youtube.com/watch?v=8GSUgwombdE>*

**UNIT III**

STEAM NOZZLES: Function of Nozzle – Applications - Types, Flow through Nozzles, Thermodynamic Analysis – Assumptions -Velocity of Nozzle at Exit-Ideal And Actual Expansion in Nozzle, Velocity Coefficient, Condition for Maximum Discharge, Critical Pressure Ratio.

Criteria for Design of Nozzle Shape: Super Saturated Flow and its Effects, Degree of Super Saturation and Degree of Under Cooling - Wilson Line –Shock at The Exit.

CONDENSERS: Classification, Air Leakage Vacuum Efficiency, condenser efficiency, problems.

**Learning Outcome & Suggested Student Activities:**

*Student can be able to distinguish the ideal flow and actual flow through nozzle. Student can know the importance of maximum discharge through nozzle. Student can able to entail the concept of Critical pressure ratio in calculations. Student can able to understand the effect of meta stable flow/ super saturation flow through nozzle.*

*Students are advised to visit the thermal power stations to acquire the practical expose and visit URL <http://www.youtube.com/watch?v=cdUNmzcu2rA>*

**UNIT IV**

IMPULSE TURBINE: Mechanical Details – Velocity Diagram – Effect of Friction – Power Developed, Axial Thrust Blade or Diagram Efficiency – Condition for Maximum Efficiency. De-Laval Turbine - Its Features. Methods To Reduce Rotor Speed - Velocity Compounding And Pressure Compounding, Velocity And Pressure Variation Along The Flow – Combined Velocity Diagram For A Velocity Compounded Impulse Turbine.

REACTION TURBINE: Mechanical Details – Principle of Operation, Thermodynamic Analysis of A Stage, Degree of Reaction –Velocity Diagram – Parson's Reaction Turbine – Condition for Maximum Efficiency.

**Learning Outcome & Suggested Student Activities:**

*At the end of unit, student can able to distinguish the working of impulse and reaction turbines. Student can able to construct the velocity triangle and combined velocity triangle and can learn its importance in determining the power produced by the turbine. Student can know why to reduce the rotor speed and methods to reduce.*

*Students are advised to visit thermal power stations for better understanding the working of turbines. Students are suggested to participate in science exhibitions based on the concept of thermal power plants. Student is advised to visit following URLs <http://www.youtube.com/watch?v=y2dOmpZgYW8&list=PLBD7B1EEF7CCB7D9D> , [https://www.youtube.com/watch?v=1b1Q3V\\_79I](https://www.youtube.com/watch?v=1b1Q3V_79I)*

**UNIT V**

**GAS TURBINES:** Simple Gas Turbine Plant – Ideal Cycle, Essential Components – Parameters of Performance – Actual Cycle – Regeneration, Inter Cooling and Reheating – Closed And Semi-Closed Cycles – Merits and Demerits, Brief Concepts of Compressors, Combustion Chambers and Turbines used in Gas Turbine Plants

**JET PROPULSION:** Principle of Operation – Classification of Jet Propulsive Engines – Working Principles with Schematic Diagrams and Representation on T-S Diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo Jet, Turbo Prop, Pulse Jet Engines – Schematic Diagram, Thermodynamic Cycle. Introduction to Rocket Propulsion.

**Learning Outcome & Suggested Student Activities:**

After the study of the unit, Student can be familiar with the basic components of a gas turbine power plant. Student can illustrate the power generation using Joule Cycle. Student can know the methods to increase the specific power output and efficiency of the cycle. Also, Student can able to know the working of various propulsive devices. Student can aware of using thrust equations in solving problems. Students advised to visit Gas power generation plants.

<http://www.youtube.com/watch?v=hnVWpOV5chs>, <http://www.youtube.com/watch?v=p1TqwAKwMuM>, <http://www.youtube.com/watch?v=MUXP3PCDRTE>

**Text Books:**

1. Thermal Engineering, R.K. Rajput, 9/e, Lakshmi Publications, 2013
2. Basic and Applied Thermodynamics, P.K. Nag, TMH, 2<sup>nd</sup> Edition, 2012.

**Reference Books:**

1. Gas Turbines, V. Ganesan, TMH
2. Thermodynamics and Heat Engines, R.Yadav, Central Publishing House, Allahabad, 2002.
3. Thermal Engineering, Mahesh M Rathore, McGrawHill, 2010
4. Gas Turbines and Propulsive Systems, P.Khajuria&S.P.Dubey, Dhanpatrai
5. Thermal Engineering, R.S Khurmi & JS Gupta, S.Chand, 2012.
6. Thermal Engineering Data Book, B.S. Reddy and K.H. Reddy, I.K. International, 2007.
7. Steam Tables SI Units- Dr.B.Umamaheswar Gowd and A. Nagraju, Siri Publ.

**NOTE:** Steam tables and Mollier charts to be supplied for exam.

**Web References:**

<http://www.iscid.org/encyclopedia/Tthermodynamics>. <http://www.transtutors.com/>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech III-I Sem. (ME)**

L	T	P	C
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**15A03502 DYNAMICS OF MACHINERY**
**Course objective:**

*To understand the method of static force analysis and dynamic force analysis of mechanism, undesirable effects of unbalance in rotors and engines. To understand the concept of vibratory systems and their analysis and also the principles of governors.*

**UNIT I**

**FRICTION:** Inclined plane, friction of screws and nuts, pivot and collar, uniform pressure, uniform wear. Friction circle and friction axis, lubricated surfaces, boundary friction, film lubrication.

**CLUTCHES:** Friction clutches- Single Disc or plate clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch.

**BRAKES AND DYNAMOMETERS:** Simple block brakes, Band brake, internal expanding brake, braking of vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the basic concepts of friction in pivots and collars with uniform pressure and uniform wear, and also to solve the numerical problems on brakes, clutches and dynamometers.*

*Students may go through text books given for more number of problems on friction, brakes and clutches. The following URLs will be highly useful to the students to understand various concepts of friction and its application.*

*<http://nptel.iitm.ac.in/video.php?subjectId=112104121>,*

*<http://www.youtube.com/watch?v=FA04XFpJgwE>*

**UNIT II**

**PRECESSION:** Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aeroplanes and ships.

**TURNING MOMENT DIAGRAMS AND FLY WHEELS:** Turning moment diagrams for steam engine, IC Engine and multi cylinder engine. Crank effort - coefficient of Fluctuation of energy, coefficient of Fluctuation of speed – Fly wheels and their design, Fly wheels for Punching machines.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students can apply gyroscopic principles on Aeroplane, ship, four wheel and two wheel vehicles. Students are able to design a flywheel for IC engine.*

*Students may go through text books given for more number of problems on gyroscopic*

*effects and flywheels. The following URLs will be highly useful to the students to understand various concepts of gyroscopic couple and turning moment diagrams.*

*<http://www.youtube.com/watch?v=FydJu1A1oeM&list=PL46AAEDA6ABAFCA78&index=7>*

*<http://www.youtube.com/watch?v=swgvKwyOnYk&list=PL46AAEDA6ABAFCA78&index=16>*

### UNIT III

GOVERNORS: Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung governors with auxiliary springs. Sensitiveness, isochronism and hunting. Effort and power of a governor.

#### **Learning outcome & Suggested Student Activities:**

*The outcome of this unit is to study the basics and definitions related to governors and forces acting on various governors. After completion of this unit students are able to solve numerical problems on different governors.*

*Students may go through text books given for more number of problems on governors.*

*The following URLs will be highly useful to the students to understand various concepts on governors.*

*<http://nptel.iitm.ac.in/video.php?subjectId=112104121>,*

*<http://www.youtube.com/watch?v=OG1AiaNTT6s>*

### UNIT IV

BALANCING: Balancing of rotating masses - single and multiple – single and different planes.

BALANCING OF RECIPROCATING MASSES: Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples – V-engine, multi cylinder in-line and radial engines for primary and secondary balancing.

#### **Learning outcome & Suggested Student Activities:**

*After completion of this unit students can solve numerical problems on balancing of rotating masses and reciprocating masses in V-engine and multi cylinder engines.*

*Students may go through text books given for more number of problems on balancing of rotating masses and balancing of reciprocating masses in locomotives and IC engines.*

*The following URLs will be highly useful to the students to understand various concepts of balancing of masses.*

*<http://www.youtube.com/watch?v=aRuIDXMuNDc&list=PL46AAEDA6ABAFCA78&index=8>*

*<http://nptel.iitm.ac.in/video.php?subjectId=112104121>*

### UNIT V

VIBRATION: Free and forced vibration of single degree of freedom system, Role of damping, whirling of shafts and critical speeds. Simple problems on free, forced and damped vibrations. Vibration Isolation & Transmissibility. Transverse vibrations of

beams with concentrated and distributed loads. Dunkerly's method, Raleigh's method. Torsional vibrations - two and three rotor systems.

**Learning outcome & Suggested Student Activities:**

*Upon completion of this unit, the student will perform detailed analysis of the response of one degree of freedom systems with free and forced vibrations, evaluate the critical speed of the shaft and simple vibration calculations of rotor systems. Students may go through text books given for more number of problems on single degree of freedom system, transverse and torsional vibrations. The following URLs will be highly useful to the students to understand various concepts on vibrations.*

*<http://nptel.iitm.ac.in/video.php?subjectId=112104121>*

*<http://www.youtube.com/watch?v=irudCaBrij0&list=PL46AAEDA6ABAFC78&index=30>*

**Text Books:**

1. *Theory of Machines, S.S. Rattan, MGH Publishers, 3<sup>rd</sup> Edition, 2013.*
2. *Kinematics and Dynamics of Machinery R.L. Norton, Tata McGraw Hill.*

**Reference Books:**

1. *Theory of Machines, Thomas Bevan, Pearson, 3<sup>rd</sup> Edition, 2012.*
2. *The theory of Machines, Ballaney, Kanna Publishers*
3. *Theory of Machines and Mechanisms of Shigley et.al. Oxford International Student Edition.*

**NOTE:** End Exam Should be conducted in Drawing Hall

**Suggestions:**

*Students may visit near by machine tool shops and automobile work shops to know about clutches, bearings, brakes, dynamometers, flywheel, centrifugal governors and balancing equipment like wheel balancing. Students are suggested to search the web and identify different URLs which provide animations of mechanisms for better visualization and understanding purpose.*

**Web References:**

*Machine Dynamics by Prof. Amitabha Ghosh, IITK, Kanpur - <http://nptel.iitm.ac.in/video.php?subjectId=112104114>*

*Machine Dynamics by Prof. C. Amarnath, Prof. K. Kurien Issac, Prof. P. Seshu of IITB, Mumbai*

*<http://www.cdeep.iitb.ac.in/nptel/Mechanical/Dynamics%20of%20Machines/TOC.html>*

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech III-I Sem. (ME)**

L	T	P	C
3	1	0	3

**15A03503 MACHINE TOOLS**
**Course Objective:**

*The objectives of this course are to introduce to demonstrate the fundamentals of machining processes and machine tools.*

*To develop knowledge and importance of metal cutting parameters, tool materials, cutting fluids and tool wear mechanisms.*

*To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes and acquire knowledge on advanced manufacturing processes. The students will have the knowledge and hands-on experience that will enable them to work in a typical machine shop.*

**UNIT I**

Elementary treatment of metal cutting theory – Elements of cutting process – Geometry of single point tool and angles, chip formation and types of chips – built up edge and its effects, chip breakers. Mechanics of orthogonal cutting –Merchant's Force diagram, cutting forces – cutting speeds, feed, depth of cut, heat generation, tool life, coolants, machinability –economics of machining. cutting Tool materials and cutting fluids –types and characteristics .

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the basic concepts of the philosophy of metal cutting and the mechanism of chip formation. Student will understand the interface in the machining zone between the tool and the work piece and how the physical and mechanical parameters dictate the cutting performance.*

**UNIT II**

Engine lathe – Principle of working- specification of lathe – types of lathes – work holders and tool holders –Taper turning, thread turning and attachments for Lathes.Turret and capstan lathes – collet chucks – other work holders – tool holding devices – box and tool layout. Principal features of automatic lathes – classification – Single spindle and multi-spindle automatic lathes– tool layout and cam design.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the basic concepts of turning. Student shall be made familiar with various tooling accessories used in turning and understand different constructions of lathe depending on the nature of operation.*



**UNIT III**

Drilling and Boring Machines – Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring tools – machining time calculation.

Shaping, Slotting and Planning machines –Principles of working – Principal parts – specification, classification, Operations performed. Machining time calculations

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the basic principle of drilling, shaping and planning operation, parts of the drilling, shaping and planning machines and tool holding devices, operations performed on drilling, shaping and planning and machining calculations.*

**UNIT IV**

Milling machine – Principles of working – specifications – classifications of milling machines – Principal features – machining operations, Types and geometry of milling cutters– methods of indexing – Accessories to milling machines.

Grinding machine –Theory of grinding – classification– cylindrical and surface grinding machine – Tool and cutter grinding machine – special types of grinding machines – Grinding wheel: Different types of abrasives – bonds, specification and selection of a grinding wheel. Static and dynamic balancing of a wheel Truing and Dressing of wheels. Lapping, Honing and Broaching machines – comparison of grinding, lapping and honing. machining time calculations.

**Learning outcome &Suggested Student Activities:**

*After completion of this unit students are able to understand the principle of milling, grinding, Lapping, Honing and Broaching operation, parts of the milling machine and types of milling and grinding machines.*

**UNIT V**

Principles of design of Jigs and fixtures and uses, 3-2-1 Classification of Jigs & Fixtures – Principles of location and clamping – Types of clamping & work holding devices, Typical examples of jigs and fixtures

Unit built machine tools – multispindle heads. power units-principal of working types of UBMTS, characterization, applications

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the design of Jigs and fixtures and uses, Classification of Jigs & Fixtures – Principles of location and clamping. Some examples of jigs and fixtures. The outcome of this unit is to understand the basic principle of unconventional machining methods USM,AJM,EDM,LBM,EBM,CM and ECM and machining of the USM,AJM,EDM,LBM,EBM,CM and ECM.*

**Text Books:**

1. *Workshop Technology – Vol II*, B.S.RaghuVamshi, Dhanpat Rai & Co, 10<sup>th</sup> edition, 2013
2. *Production Technology* by R.K. Jain and S.C. Gupta, Khanna Publishers, 17<sup>th</sup> edition, 2012

**Reference Books:**

1. *Manufacturing Technology-Kalpakzian- Pearson*
2. *Metal cutting Principles* by Milton C.Shaw, oxford Second Edn, 2<sup>nd</sup> edition, 2012
3. *Production Technology* by H.M.T. (Hindustan Machine Tools),TMH, 1<sup>st</sup> edition, 2001
4. *Production Technology* by K.L.Narayana, IK International Pub.
5. *Machining and machine tools* by AB. Chattopadyay, WileyEdn,2013
6. *Unconventional Machining process* by V.K.Jain, Allied Pub.
7. *Manufacturing technology Vol II* by P.N. Rao, Tata McGraw Hill, 4<sup>th</sup> edition, 2013
8. *Machine Technology Machine tools and operations* by Halmi A Yusuf&Harson, CRC Press Taylor and Francies .

**Web Resources:**

[www.hgfarley.com](http://www.hgfarley.com)

[www.kennametal.com/](http://www.kennametal.com/) - United States

[www.mini-lathe.com/links.htm](http://www.mini-lathe.com/links.htm); [machinedesign.com/.../designer-s-guide-to-metalcutting-machinery-0608](http://machinedesign.com/.../designer-s-guide-to-metalcutting-machinery-0608) -

[www.metalwebnews.com/wc.html](http://www.metalwebnews.com/wc.html)

[www.britannica.com/EBchecked/topic/463000/planer](http://www.britannica.com/EBchecked/topic/463000/planer)

[www.americanmachinist.com](http://www.americanmachinist.com)

[www.machinetools.net.tw/parts/taiwan\\_voltage\\_regulator.htm](http://www.machinetools.net.tw/parts/taiwan_voltage_regulator.htm)

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech III-I Sem. (ME)

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3	1	0	3

**15A03504 DESIGN OF MACHINE MEMBERS – I****Course Objective:**

*The primary objective of this course is to demonstrate how engineering design is used for many principles learned in previous engineering science courses and to show how these principles are practically applied. This subject will help to the students to learn to analyze and design basic machine elements in mechanical systems. By this subject students will become familiar on design principles, materials selection, stresses developed in machine elements under different loads. The students will also get knowledge on design of the permanent and temporary joints, shafts and keys.*

**UNIT I**

INTRODUCTION: General considerations of design, design process. Selection of Engineering Materials - properties –Manufacturing considerations in the design. BIS codes of materials, preferred numbers and interchangeability.

STRESSES IN MACHINE MEMBERS: Simple stresses – Combined stresses – Torsional and bending Stresses – impact stresses – stress -strain relation – Theories of failure – factor of safety.

**Learning Outcome & Suggested Student Activities:**

*After completion of this unit students are capable to apply design procedures using theories of failure for different elements. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of machine design.*  
<http://machinedesign.com/>  
<http://www.youtube.com/watch?v=qVj4VvMmQjc&list=PL3D4EECEFAA99D9BE&index=6>

**UNIT II**

DESIGN FOR FLUCTUATING LOADS: Stress concentration –notch sensitivity – Design for fluctuating stresses – Estimation of Endurance strength – Goodman's line – Soderberg's line. Design of components for finite and infinite life.

**Learning Outcome & Suggested Student Activities:**

*After completion of this chapter students are able to design simple components under cyclic loading using Goodman's and Soderberg's criteria. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of cyclic loading design.* <http://machinedesign.com/>  
<http://www.youtube.com/watch?v=SLqkITQfN1I&list=PL3D4EECEFAA99D9BE&index=8>

**UNIT III**

DESIGN OF RIVETED JOINTS: Types of riveted joints, design of riveted joints. Boiler shell riveting design and eccentric loading design of riveted joints.

DESIGN OF BOLTED JOINTS: Forms of Screw threads. Stresses in Screw fasteners. Design of bolts with pre-stresses, Design of bolted joints under eccentric loading, Bolts of uniform strength.

**Learning Outcome & Suggested Student Activities:**

*After completion of this unit students are able to design riveted joints with different configuration, boiler shell joint design and eccentric loading design of riveted joints. Further students are able to design bolted joints with direct loading and eccentric loading. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of joints. <http://machinedesign.com/> <http://www.youtube.com/watch?v=Z38Aq9ykUCM&list=PL3D4EECEFAA99D9BE&index=16>*

**UNIT IV**

DESIGN OF COTTERS AND KNUCKLE JOINTS: Design of Cotter joints: spigot and socket, sleeve and cotter, jib and cotter joints- Knuckle joints

DESIGN OF SHAFTS: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads.

**Learning Outcome & Suggested Student Activities:**

*After completion of this unit students are able to design cotter joint, knuckle joint and shafts. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of shafts, <http://machinedesign.com/> <http://www.youtube.com/watch?v=4nIQwVqruRo&list=PL3D4EECEFAA99D9BE&index=20>*

**UNIT V**

DESIGN OF KEYS AND COUPLINGS: Design of Rigid couplings: Muff, Split muff and Flange couplings- Design of flexible couplings.

**Learning Outcome & Suggested Student Activities:**

*After completion of this unit students are able to design various rigid and flexible shaft couplings. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of couplings. <http://machinedesign.com/> <http://www.youtube.com/watch?v=4nIQwVqruRo&list=PL3D4EECEFAA99D9BE&index=21>*

**Text Books:**

1. MachineDesign, Schaum'sseries, TMH Publishers, NewDelhi, 1<sup>st</sup> edition, 2011
2. MachineDesign, R.S. Kumi and J.K. Gupta ,S.ChandPublishers, NewDelhi

**Reference Books:**

1. *Machine Design*, R.K. Jain, Khanna Publishers, New Delhi.
2. *Machine Design*, Sadhu Singh, Khanna Publishers, New Delhi
3. *Mechanical Engineering Design*, Joseph E. Shigely, TMH Publishers, New Delhi, 9<sup>th</sup> edition, 2011 R
4. *Design of Machine Elements*, M.F. Spotts, PHI Publishers, New Delhi.
5. *Machine Design*, Pandya and Shah, Charotar Publishers, Anand, 17<sup>th</sup> edition, 2009
6. *Machine Design*, R.L. Norton, Tata McGraw Hill Publishers, 2<sup>nd</sup> edition, 2002
7. *Machine Design by Groover* – CBS Publications, 5<sup>th</sup> edition, 2012.
8. *Machine Design Data Book*, V B Bhandari, McGraw Hill, 2014

**NOTE:** Design data books are not permitted in the examinations.

**Web Resources:**

<http://www.leamerstv.com/Free-Engineering-Video-lectures-ltv077-page1.htm>

<http://www.fastenal.com/content/feds/pdf/Article%20-%20Bolted%20Joint%20Design.pdf>

[http://people.rit.edu/megite Lec%203%20Fatigue%20Failure%20031004\\_for\\_students.ppt](http://people.rit.edu/megite/Lec%203%20Fatigue%20Failure%20031004_for_students.ppt)

<http://engineershandbook.com/Tables/materials.htm>

[www.nptel.iitm.ac.in/video](http://www.nptel.iitm.ac.in/video)

**Suggestions:**

1. Students may visit nearby automobile workshops and machine tool shops or IC Engine Lab/Automobile Lab to know about different machine elements like shafts, keys, couplings and riveted and bolted joints.
2. In addition to the text books students may also go through the reference books authored by V.B.

Bhandari, by Pandya and Shah for more number of numerical problems.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech III-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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**15A03505 ENTREPRENEURSHIP  
(MOOCS-I)**

**UNIT 1:** Introduction to Entrepreneurship Definition Types of Entrepreneur, Entrepreneurial Traits, Entrepreneur vs. Manager, Entrepreneur vs Intrapreneur. The Entrepreneurial decision process. Ethics and Social responsibility of Entrepreneurs. Opportunities for Entrepreneurs in India and abroad.

Creating and Starting the Venture, Sources of new Ideas, Methods of generating ideas, creative problem solving, product planning and development process.

**UNIT II:** The Business Plan Nature and scope of Business plan, Writing Business Plan, Evaluating Business plans, Using and implementing business plans. Marketing plan, financial plan and the organizational plan, Launching formalities.

**UNIT III:** Financing and Managing the new venture, Sources of capital, venture capital , angel investment, Record keeping, recruitment, motivating and leading teams, financial controls. Marketing and sales controls. E-commerce and Entrepreneurship, Internet advertising.

**UNIT IV:** New venture Expansion Strategies and Issues, Features and evaluation of joint ventures, acquisitions, merges, franchising. Public issues, rights issues, bonus issues and stock splits.Choosing location and layout, Issues related to Selection of layout.

**UNIT V:** Production and Marketing Management Thrust of production management, Selection of production Techniques, plant utilization and maintenance, Designing the work place, Inventory control, material handling and quality control.Marketing functions, market segmentation, market research and channels of distribution, Sales promotion and product pricing. Global aspects of Enterprenership.

**Text Books:**

- 1.Entrepreneurship, Robert Hisrich, & Michael Peters, TMH, 5th Edition
2. Entrepreneurship, Dollinger, Pearson, 4/e 2004.

**REFERENCES:**

1. Dynamics of Entrepreneurial Development and management, Vasant Desai, Himalaya Publishing House, 2004.
2. Harvard Business Review on Entrepreneurship. HBR Paper Back, 1999.
3. Entrepreneurial Management, . Robert J.Calvin., TMH, 2004.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech III-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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**15A03506 NANO TECHNOLOGY  
(MOOCS-I)**

**Course objective**

On successful completion of the course, students should be able to: Understand the basic scientific concepts of nanoscience. Understand the properties of nano materials, characterization of materials, synthesis and fabrication. Understand the applications of nano technology in various science, engineering and technology fields.

**UNIT-I**

**INTRODUCTION:** History of nano science, definition of nano meter, nano materials, nano technology. Classification of nano materials. Crystal symmetries, crystal directions, crystal planes. Band structure.

**PROPERTIES OF MATERIALS:**

Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.

**UNIT-II**

**SYNTHESIS AND FABRICATION:** Synthesis of bulk polycrystalline samples, growth of single crystals. Synthesis techniques for preparation of nano particle – Bottom Up Approach – sol gel synthesis, hydro thermal growth, thin film growth, PVD and CVD; Top Down Approach – Ball milling, micro fabrication, lithography. Requirements for realizing semiconductor nano structures, growth techniques for nano structures.

**UNIT-III**

**CHARACTERIZATION TECHNIQUES:** X-Ray diffraction and Scherrer method, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, atomic force microscopy, piezoresponse microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, Raman spectroscopy.

**UNIT-IV****CARBON NANO TECHNOLOGY:**

Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nano crystalline diamond films, graphene, applications of carbon nano tubes.

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**UNIT-V****APPLICATIONS OF NANO TECHNOLOGY:**

Applications in material science, biology and medicine, surface science, energy and environment. Applications of nano structured thin films, applications of quantum dots.

**TEXT BOOK:**

1. Nano science and nano technology / M.S Ramachandra Rao, Shubra Singh/Wiley publishers.
2. Introduction to Nanotechnology by Risal Singh, Shipra Mital Gupta, Oxford Higher Education, First Publication 2016.

**REFERENCE BOOKS:**

1. Introduction to Nano Technology /Charles P. Poole, Jr., Frank J.Owens/Wiley publishers.
2. Nanotechnology /Jermy J Ramsden/Elsevier publishers
3. Nano Materials/A.K.Bandyopadhyay/ New Age
4. Nano The Essentials, T.Pradeep, McGrawHill, 2014
5. Nanotechnology the Science of Small / M.A Shah, K.A Shah/Wiley Publishers.

**Course outcomes:**

- Upon successful completion of this course the student shall be able to:
- Identify the essential concepts used in nanotechnology. Identify the materials, properties, syntheses and fabrication, characterization and applications in various fields.



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech III-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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<b>15A03507</b>	<b>MICRO ELECTRO MECHANICAL SYSTEMS (MEMS) (MOOCS-I)</b>			

**Course Objectives:**

1. To learn basics of Micro Electro Mechanical Systems (MEMS).
2. To learn about various sensors and actuators used in MEMS
3. To learn the principle and various devices of MOEMS, Fluidic, bio and chemical systems

**UNIT – I**

**INTRODUCTION:** Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA.

**MECHANICAL SENSORS AND ACTUATORS:** Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

**UNIT – II**

**THERMAL SENSORS AND ACTUATORS:** Thermal energy basics and heat transfer processes, thermistors, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

**UNIT – III**

**MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS:** Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

**MAGNETIC SENSORS AND ACTUATORS:** Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOEMS, mag MEMS actuators

**UNIT – IV**

**MICRO FLUIDIC SYSTEMS:** Applications, considerations on micro scale fluid, fluid actuation methods, dielectrophoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps.

**RADIO FREQUENCY (RF) MEMS:** RF – based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

**UNIT - V**

**CHEMICAL AND BIO MEDICAL MICRO SYSTEMS:** Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluorescence detection, calorimetric spectroscopy.

**TEXT BOOK:**

1. MEMS/Nitaigour Premchand Mahalik/TMH Publishing co.
2. MEMS and NEMS/Sergey Edwrd Lyshevski/CRC Press, Indian Edition, 2013

**REFERENCE BOOKS:**

1. Foundation of MEMS/Chang Liu/Prentice Hall Ltd.
2. RF MEMS Theory, Design and Technology Gabriel M. Rebeiz, Wiley-India,2010
3. MEMS and Micro Systems: Design and Manufacture/Tai-Ran Hsu/TMH Publishers.
4. Introductory MEMS/ Thomas M Adams, Richard A Layton/Springer International Publishers.

**Course outcomes:**

Upon successful completion of this course the student shall be able to know the importance and various devices of MEMS and their applications.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech III-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>15A01511</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>FLUID MECHANICS AND HYDRAULIC MACHINES LABORATORY</b>				

**OBJECTIVE:** *The object of the course to make the students understand the fluid flow concepts and get familiarity with flow measuring devices.*

**SYLLABUS :**

1. Calibration of Venturimeter
2. Calibration of Orifice meter
3. Determination of Coefficient of discharge for a small orifice by a constant head method.
4. Determination of Coefficient of discharge for an external mouth piece by variable head method.
5. Calibration of contracted Rectangular Notch and /or Triangular Notch.
6. Determination of Coefficient of loss of head in a sudden contraction and friction factor.
7. Verification of Bernoulli's equation.
8. Impact of jet on vanes.
9. Study of Hydraulic jump.
10. Performance test on Pelton wheel turbine.
11. Performance test on Francis turbine.
12. Efficiency test on centrifugal pump.

**LIST OF EQUIPMENT :**

1. Venturimeter Setup.
2. Orifice meter setup.
3. Small orifice setup.
4. External mouthpiece setup.
5. Rectangular and Triangular notch setups.
6. Friction factor test setup.
7. Bernoulli's theorem setup.
8. Impact of jets.
9. Hydraulic jump test setup.
10. Pelton wheel and Francis turbines.
11. Centrifugal pumps.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech III-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**15A03508 MACHINE TOOLS LABORATORY**

1. Demonstration of construction & operations of general purpose machines:  
Lathe, Drilling machine, Milling machine, Shaper, Planning machine, Slotting machine, Cylindrical Grinder, Surface grinder and Tool & cutter grinder.
2. Job on Step turning and taper turning on lathe machine
3. Job on Thread cutting and knurling on -lathe machine.
4. Job on Drilling and Tapping
5. Job on Shaping and Planning
6. Job on Slotting
7. Job on Milling (groove cutting/ gear cutting)
8. Job on Cylindrical and Surface Grinding
9. Job on Grinding of Tool angles.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech III-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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**15A99501 SOCIAL VALUES & ETHICS (AUDIT COURSE)**

*(Common to all Branches)*

**UNIT - I**

**Introduction and Basic Concepts of Society: Family and Society:** Concept of family, community, PRIs and other community based organizations and society, growing up in the family – dynamics and impact, Human values, Gender Justice.

**Channels of Youth Moments for National Building: NSS & NCC:** History, philosophy, aims & objectives; Emblems, flags, mottos, songs, badge etc.; Organizational structure, roles and responsibilities of various NSS functionaries. **Nehru Yuva Kendra (NYK):** Activities – Socio Cultural and Sports.

**UNIT – II**

Activities of NSS, NCC, NYK:

**Citizenship:** Basic Features Constitution of India, Fundamental Rights and Fundamental Duties, Human Rights, Consumer awareness and the legal rights of the consumer, RTI.

**Youth and Crime:** Sociological and psychological Factors influencing youth crime, Peer Mentoring in preventing crimes, Awareness about Anti-Ragging, Cyber Crime and its prevention, Juvenile Justice

**Social Harmony and National Integration:** Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building.

**UNIT – III**

**Environment Issues:** Environment conservation, enrichment and Sustainability, Climate change, Waste management, Natural resource management (Rain water harvesting, energy conservation, waste land development, soil conservations and afforestation).

**Health, Hygiene & Sanitation:** Definition, needs and scope of health education, Food and Nutrition, Safe drinking water, Sanitation, Swachh Bharat Abhiyan.

**Disaster Management:** Introduction to Disaster Management, classification of disasters, Role of youth in Disaster Management. Home Nursing, First Aid.

**Civil/ Self Defense:** Civil defense services, aims and objectives of civil defense, Need for self defense training – Teakwondo, Judo, karate etc.,

**UNIT – IV**

**Gender Sensitization:** Understanding Gender – Gender inequality – Role of Family, Society and State; Challenges – Declining Sex Ratio – Sexual Harassment – Domestic Violence; Gender Equality – Initiatives of Government – Schemes, Law; Initiates of NGOs – Awareness, Movements;

**UNIT - V**

**Physical Education :** Games & Sports: Health and Recreation – Biological basis of Physical activity – benefits of exercise – Physical, Psychological, Social; Physiology of Muscular Activity, Respiration, Blood Circulation.

**Yoga:** Basics of Yoga – Yoga Protocol, Postures, Asanas, Pranayama: Introduction of Kriyas, Bandhas and Mudras.

**TEXT BOOKS:**

1. NSS MANUAL
2. SOCIETY AND ENVIRONMENT: A.S.Chauha, Jain Brothers Publications, 6<sup>th</sup> Edition, 2006
3. INDIAN SOCIAL PROBLEM: G.R.Madan, Asian Publisher House
4. INDIAN SOCIAL PROBLEM: Ram Ahuja, Rawat Publications
5. HUMAN SOCIETY: Kingsley Davis, Macmillan
6. SOCIETY: Mac Iver D Page, Macmillan
7. SOCIOLOGY – THEMES AND PERSPECTIVES: Michael Honalambos, Oxford University Press
8. CONSTITUTION OF INDIA: D.D.Basu, Lexis Nexis Butterworth Publishers
9. National Youth Policy 2014 (available on [www.yas.nic.in](http://www.yas.nic.in))
10. TOWARDS A WORLD OF EQUALS: A.Suneetha, Uma Bhrugudanda, Duggirala Vasantha, Rama Melkote, Vasudha Nagraj, Asma Rasheed, Gogu Shyamala, Deepa Streenivas and Susie Tharu
10. LIGHT ON YOGA : B.K.S.Iyengar, Penguin Random House Publishers

[www.un.org](http://www.un.org)

[www.india.gov.in](http://www.india.gov.in)

[www.yas.nic.in](http://www.yas.nic.in)

<http://www.who.int/countries/ind/en/>

<http://www.ndma.gov.in>

<http://ayush.gov.in/event/common-yoga-protocol-2016-0>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech III-II Sem. (ME)**

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**15A03601 OPERATIONS RESEARCH**
**Course Objective:**

*The subject should enable the students to the nature and scope of various decision making situations within business contexts, understand and apply operation research techniques to industrial applications,*

*To make the student capable of Formulating the various real life decision making problems as Mathematical programming problems. Students to learn the fundamental Techniques of Operations Research and to choose a suitable OR technique to solve problem on hand.*

**UNIT I**

Introduction to OR and Linear Programming-1

OR definition– Classification of Models –Types of Operations Research models;

Linear Programming- Problem Formulation, Graphical Method, Simplex Method, Two–Phase Simplex Method, Big-M Method

Special Cases of LP- Degeneracy, Infeasibility and Multiple Optimal Solutions;

**Learning Outcome & Suggested Student Activities:**

*At the end of the Unit, the student will be able to create mathematical models of the real life situations and capable of obtaining best solution using Graphical Method and Simplex Method.*

*(The student must refer to any of the text books and practice solving several problems as it is very common to make mistakes while solving due to lack of practice). The student should take up a real life problem and formulate it as a mathematical programming problem.*

*Further, the students may visit the following URL for live online tutorial for LPP formulation*

<http://www.mathsdoctor.tv>

**UNIT II**

Linear programming-2: Duality- Principle, Economic Interpretation of Duality, Dual Simplex Method

Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution- North-West Corner Rule, Least Cost Method, Vogel's Approximation Method;

Optimality Testing.

Special Cases -Unbalanced Transportation Problem, Degenerate Problem;

Assignment Problem – Formulation; Optimal Solution -Traveling Salesman problem.

**Learning Outcome & Suggested Student Activities:**

*At the end of this Unit, the student must be able to implement the theory of duality for simplifying the solution procedure for certain LPPs, and solve the special cases of LPP such as Transportation and Assignment problems. A large number of problems are to be solved by the student in order to gain much required capability of handling the problems without mistakes.*

*The following URLs will be useful to the students for in-depth knowledge*

*<http://nptel.iitm.ac.in/video.php?subjectId=112106134>,*

*[http://www.Math.harvard.edu/archive/20\\_spring\\_05/handouts](http://www.Math.harvard.edu/archive/20_spring_05/handouts)*

**UNIT III**

Game Theory: Introduction – Minimax (Maximin) Criterion and Optimal Strategy, Saddle Point, Solution of Games with Pure Strategy – Games with Mixed Strategies– Dominance Principle– Graphical Method, Algebraic methods, sub matrices method.

Queuing Theory: Introduction – Terminology, Service Channel, Arrival Pattern, Population, Departure Pattern (Service Pattern), Queue Discipline, Birth & Death Process, Balking, Reneging, Jockeying; Single Channel Models with Poisson Arrivals, Exponential Service Times with finite queue length and non-finite queue length; Multichannel Models with Poisson Arrivals, Exponential Service Times with finite queue length and non finite queue length.

**Learning Outcome & Suggested Student Activities:**

*At the end of this Unit, the student will have knowledge of choosing the best strategy out of the available strategies which is an essential skill for any business manager to successfully face the competition. The following web link will direct the students to the video lecture on Game Theory.*

*[http://www.youtube.com/watch?feature=player\\_detailpage&v=h0bdo06qNVw](http://www.youtube.com/watch?feature=player_detailpage&v=h0bdo06qNVw)*

*The student will be capable of identifying the suitable Queuing Model for real world waiting lines and make estimations like Average Waiting Times, Average Queue Length, Probability of Waiting in the queue etc.*

*The students may watch the following web video for better understanding of the subject.*

*[http://www.youtube.com/watch?feature=player\\_detailpage&v=xGkpXk-AnWU#t=104s](http://www.youtube.com/watch?feature=player_detailpage&v=xGkpXk-AnWU#t=104s)*

*The students should refer to any OR text book for more number of practice problems.*

**UNIT IV**

Sequencing - Assumptions-n-jobs-2 Machines model, n-jobs-3-machines models & n jobs – m Machines models.

PERT & CPM: Introduction to Project Management, Activities, Events, Predecessor Relationships, AOA Diagram, Early Start, Early Finish, Late Start & Late Finish Times, Earliest Occurrence and Latest Occurrence of the Event, Total Float, Free Float, Independent Float



CPM- Deterministic Model- Critical Path, Crashing, Optimal Project Duration, Least Possible Project Duration

PERT- Probabilistic Model- Various types of Activity Time Estimates, Standard Deviation and Variance of the Activities and Projects, and Probability of Completing the Project within scheduled time

**Learning Outcome & Suggested Student Activities:**

*At the end of this Unit, student will be able to represent any project in the form of a network and estimate the parameters like Project Completion Time, Project Costs, and Optimum Duration of the Project, Probabilities of completing Projects as per schedule etc by applying either CPM or PERT technique as per the suitability.*

*The following URL will lead us to a video lecture on this Unit*

*[http://www.youtube.com/watch?feature=player\\_detailpage&v=H58TPQNr2kM](http://www.youtube.com/watch?feature=player_detailpage&v=H58TPQNr2kM)*

**UNIT V**

Dynamic Programming : Introduction – Bellman’s Principle of Optimality – Applications of Dynamic Programming- Capital Budgeting Problem – Shortest Path Problem – Solution of Linear Programming Problem by DP

Replacement Models: Introduction –Types of Replacement Problem, Determination of Economic Life of an Asset, and Simple Probabilistic Model for Items which completely fail-Individual Replacement Model, Group Replacement Model.

**Learning Outcome & Suggested Student Activities:**

*At the end of this Unit, the student will be aware of applying Dynamic Programming technique to solve the complex problems by breaking them into a series of sub-problems. The following URL contains a video lecture on Dynamic Programming and the students are advised to go through*

*[http://www.youtube.com/watch?feature=player\\_detailpage&v=ug7O1ISZyg0](http://www.youtube.com/watch?feature=player_detailpage&v=ug7O1ISZyg0)*

*Further, the student will gain knowledge in different types of maintenance, failure patterns and the economic replacement policies which are very much important for the continuous functioning of machinery in an organization. The students may visit the following websites for better understanding of the subject.*

*<http://www2.ensc.sfu.ca/undergrad/courses/ENSC201/Unit09/lecture9.html>*

*<http://pakaccountants.com/what-is-depreciated-replacement-cost/>*

**Text Books:**

1. Operation Research, J.K.Sharma,MacMilan, 5<sup>th</sup> edition, 2013.
2. Introduction to Operations Research, H.A.Taha, PHI, 9<sup>th</sup> edition, 2013.

**Reference Books:**

1. *Operations Research*, Dr. C.Nadhamuni Reddy & Sri Gopal Krishna, Kumool Publishers
2. *Operations Research* by R Panneerselvam, PHI, 2<sup>nd</sup> edition, 2012.
3. *Operations Research*, Wagner, PHI Publications , 2<sup>nd</sup> edition.
4. *Operations Research*, S.R.Yadav, A.K.Malik, Oxford, 2015
5. *Operations Research*, A.M.Natarajan,P.Balasubramani,A. Tamilarasi,Pearson Education, 8<sup>th</sup> edition, 2011.

**Web References:**

<http://www2.informs.org/Resources/>

<http://www.mit.edu/~orc/>

<http://www.ieor.columbia.edu/>

<http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm>

<http://www.wolfram.com/solutions/OperationsResearch/>

<http://nptel.iitm.ac.in/video.php?subjectId=112106134>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech III-II Sem. (ME)

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**15A03602 DESIGN OF MACHINE MEMBERS– II****Course Objective:**

*To aware the student about basic concepts of curved beams with different cross sections, design of power transmission elements, understand the design concepts of various types of springs, various types of bearings and gears.*

*To know the students how to apply design concepts in designing of IC engine parts like Piston, cylinder, connecting rod and crank shaft.*

**UNIT I**

DESIGN OF CURVED BEAMS: Stresses in curved beams, Expression for radius of neutral axis for rectangular, circular, trapezoidal and T-Section. Design of crane hooks, C-clamps.

DESIGN OF POWER TRANSMISSIONS SYSTEMS: Design of Flat belt drives, V-belt drives & rope drives. Selection of wire ropes, design procedure for chain drives.

**Learning Outcome & Suggested Student Activities:**

*After completion of this unit students are able to design crane hooks, C-clamps and various belt, rope and chain drives. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of power transmission elements.*

*<http://machinedesign.com/>*

*<http://www.youtube.com/watch?v=PEKfS2Q1WqM&list=PL3D4EECEFAA99D9BE&index=19>*

*<http://www.youtube.com/watch?v=nMsB6Soz4Hc&list=PL3D4EECEFAA99D9BE&index=30>*

**UNIT II**

DESIGN OF MECHANICAL SPRINGS: Stress and deflections of helical Springs- Springs for fatigue loading – Natural frequency of helical springs-Energy storage capacity- Helical Torsion springs- Design of leaf springs.

DESIGN OF POWER SCREWS: Design of screw- Square, ACME and Buttress screws- Efficiency of the screw. Design of compound screw, differential screw, ball screw- possible failures

**Learning Outcome & Suggested Student Activities:**

After completion of this unit, students are able to design helical springs for two wheel vehicle and laminated springs for trucks. Also students can apply design concepts in designing power screws. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of springs and power screws.

<http://machinedesign.com/>

<http://www.youtube.com/watch?v=PEKFS2Q1WqM&list=PL3D4EECEFAA99D9BE&index=19>

<http://www.youtube.com/watch?v=46quOD7V-cQ&list=PL3D4EECEFAA99D9BE&index=28>

**UNIT III**

DESIGN OF BEARINGS: Types of Journal bearings – Lubrication – bearing materials – journal bearing design – Ball and roller bearings – Static loading of ball & roller bearings, bearing life –Failure of bearings.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to design journal bearings, ball bearings and roller bearings and to know the advantages of rolling contact bearings against sliding contact bearings. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of bearings.

<http://machinedesign.com/>

<http://www.mae.ncsu.edu/klang/courses/mae442/Transmission/Journal%20Bearing.ppt>

[http://nhbb.com/files/catalog\\_pages/HiTech\\_Catalog.pdf](http://nhbb.com/files/catalog_pages/HiTech_Catalog.pdf)

**UNIT IV**

DESIGN OF SPUR & HELICAL GEARS: Spur gears- Helical gears – Bending strength – Design analysis of spur and Helical gears – Estimation of centre distance, module and face width. Check for dynamic and wear considerations.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to design spur and helical gears for different input conditions. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of gears.

<http://machinedesign.com/>

[http://nptel.iitm.ac.in/courses/IIT-MADRAS/Machine\\_Design\\_II/pdf/2\\_9.pdf](http://nptel.iitm.ac.in/courses/IIT-MADRAS/Machine_Design_II/pdf/2_9.pdf)

<http://www.youtube.com/watch?v=8bml2pK6Ra0>

**UNIT V**

DESIGN OF IC ENGINE PARTS: Pistons– Design of piston. Cylinder, Connecting Rod. Crank shafts- Center and over hung cranks.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to know various forces acting on I C engine parts and failure criteria to be adopted for various parts. In addition to text books, the following URLs will be highly useful to the students to understand various concepts of design of IC Engine parts.

<http://machinedesign.com/>

[http://umpir.ump.edu.my/1778/1/Design\\_Of\\_Cooecting\\_Rod\\_Of\\_Internal\\_Combustion\\_Engine\\_A\\_Topology\\_Optimization\\_Approach.pdf](http://umpir.ump.edu.my/1778/1/Design_Of_Cooecting_Rod_Of_Internal_Combustion_Engine_A_Topology_Optimization_Approach.pdf)

<http://www.d-p.com.gr/pistons/piston-designs.html>

**Text Books:**

1. Mechanical Engineering Design, Joseph E. Shigely, TMH Publishers, New Delhi, 9<sup>th</sup> edition, 2010.
2. Machine Design, R.L. Norton, Tata McGraw Hill Publishers, 2<sup>nd</sup> edition, 2012.

**Reference Books:**

1. Machine Design, Schaum's series, TMH Publishers, New Delhi, 1<sup>st</sup> edition, 2011
2. Design of Machine Elements, V.B. Bhandari, TMH Publishers, New Delhi, 2<sup>nd</sup> edition, 2013.
3. Machine Design, Sadhu Singh, Khanna Publishers, New Delhi
4. Design of Machine Elements, M.F. Spotts, PHI Publishers, New Delhi.
5. Machine Design, Pandya and Shah, Charotar Publishers, Anand, 17<sup>th</sup> edition, 2012.

**NOTE:** Design data books are permitted in the examinations.

**Web References:**

<http://www.uni.edu/~rao/Md-17%20Shaft%20Design.pdf>

<http://www.uni.edu/~rao/Md-15%20Keys%20and%20Couplings.pdf>

<http://etidweb.tamu.edu/ftp/ENTC463/Notes/ENTC463Key%20and%20Coupling.pdf>

<http://www.science.howstuffworks.com/transport/engines.../bearing1.html>

<http://www.fi.edu/time/Journey/Time/Escapements/gearint.html>

**Suggestions:**

1. students may visit nearby automobile workshops and machine tool shops to know about different machine elements like gears, bearings, springs, power screws, flexible drives and I C engine parts.
2. In addition to the text books students may also go through the reference books authored by V.B. Bhandari, by Pandya and Shah for more number of numerical problems.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech III-II Sem. (ME)**

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**15A03603 HEAT TRANSFER**
**Course Objective:**

*The students will gain the ability to get an in-depth understanding of the principles governing the transfer of heat, the techniques, tools and skills required to solve typical thermal related problems, the analysis of energy flows in complicated systems and the design of efficient heat transfer equipments. Enables the student to utilize analogies to solve heat transfer problems. Further students gain hands-on experience in heat transfer experimentation through a number of laboratory tests.*

**UNIT I**

Introduction: Modes and Mechanisms of Heat Transfer – Basic Laws of Heat Transfer – General Applications of Heat Transfer.

Conduction Heat Transfer: Fourier Rate Equation – General Heat Conduction Equation In Cartesian, Cylindrical and Spherical Coordinates.

Simplification and Forms of the Field Equation – Steady, Unsteady and Periodic Heat Transfer – Boundary and Initial Conditions.

One Dimensional Steady State Heat Conduction: In Homogeneous Slabs, Hollow Cylinders and Spheres – Overall Heat Transfer Coefficient – Electrical Analogy – Critical Radius/Thickness of Insulation – With Variable Thermal Conductivity – With Internal Heat Sources or Heat Generation

**Learning Outcome & Suggested Student Activities:**

*After the completion of the unit, student can able to grasp the concept of steady state conduction. Student can learn representing conduction equation in various forms. Student can imply concept successfully to problems encounter in day to day life. The following URL's will be highly useful to students.*

*<http://k12videos.mit.edu/content/heat-transfer/>;*

*<http://www.youtube.com/watch?v=9WwSaIP5pbs>*

*<http://www.youtube.com/watch?v=HIYCR7gXXFo;>*

*<http://www.youtube.com/watch?v=S57nls503fA>*

*<http://energy.concord.org/ir/experiments-page3.html>*

**UNIT II**

Heat Transfer in Extended Surface (Fins) – efficiency, effectiveness and temperature distribution on Long Fin, Fin with Insulated Tip and Short Fin, Application to Errors in Temperature Measurement.

One Dimensional Transient Heat Conduction: In Systems with Negligible Internal Resistance – Significance of Biot and Fourier Numbers – Chart Solutions of Transient Conduction Systems – Problems on Semi-infinite Body.

**Learning Outcome & Suggested Student Activities:**

*After the completion of the chapter, student is expected understand the concept of extended surfaces and its applications. Also, student can aware transient heat conduction and how it vary w.r.t time. Student is expected to develop the ability to formulate practical conduction heat transfer problems by transforming the physical system into a Mathematical model and selecting an appropriate solution technique and evaluating the significance of results.*

*The following URLs will be highly useful to the students*  
<http://www.youtube.com/watch?v=cMmREKOhIV8>  
<http://www.youtube.com/watch?v=HiX7DKUIAOM>

**UNIT III**

Convective Heat Transfer: Dimensional Analysis – Buckingham  $\Pi$  Theorem and Its Application for Developing Semi – Empirical Non-Dimensional Correlations for Convective Heat Transfer – Significance of Non-Dimensional Numbers – Concepts of Continuity, Momentum And Energy Equations.

Forced Convection: External Flows: Concepts of Hydrodynamic and Thermal Boundary Layer and Use of Empirical Correlations for Convective Heat Transfer for Flow Over – Flat Plates, Cylinders and Spheres.

Internal Flows: Division of Internal Flow through Concepts of Hydrodynamic and Thermal Entry Lengths – Use of Empirical Relations for Convective Heat Transfer in Horizontal Pipe Flow, Annular Flow.

Free Convection: Development of Hydrodynamic and Thermal Boundary Layer along a Vertical Plate – Use of Empirical Relations for Convective Heat Transfer on Plates and Cylinders in Horizontal and Vertical Orientation.

**Learning outcome & Suggested Student Activities:**

*At the end of the chapter, Student will have the ability to formulate practical forced and natural convection heat transfer problems by transforming the physical system into a mathematical model, selecting an appropriate solution technique and evaluating the significance of results. Students will also demonstrate an ability to analyze the performance.*

*The following URLs will be highly useful to the students*  
<http://www.youtube.com/watch?v=HIYCR7gXXFo>  
<http://www.youtube.com/watch?v=S57nls503fA>;  
<http://energy.concord.org/ir/experiments-page3.html>

**UNIT IV**

Heat Transfer with Phase Change:

Boiling: Pool Boiling – Regimes, Determination of Heat Transfer Coefficient in Nucleate Boiling, Critical Heat Flux and Film Boiling.

Condensation: Filmwise and Dropwise Condensation – Nusselt's Theory of Condensation on a Vertical Plate – Film Condensation on Vertical and Horizontal Cylinders Using Empirical Correlations.

Heat Exchangers: Classification of Heat Exchangers – Overall Heat Transfer Coefficient and Fouling Factor – Concepts of LMTD and NTU Methods – Problems using LMTD And NTU Methods.

**Learning outcome & Suggested Student Activities:**

*After the completion of the chapter, student will be able to calculate heat transfer in condensation and boiling systems, turbulent and laminar film condensation. Student can understand the concepts of critical heat flux and different models of critical heat flux. Student can able to grasp the fundamentals of heat exchangers and its analysis. The following URLs will be highly useful to the students to understand simple heat exchangers.*

*MIT: Professor Z. S. Spakovszky's Lecture Notes on Thermodynamics & Propulsion: "Section 18.5: Heat Exchangers" (HTML)*

*Lecture: YouTube: Stanford University: Professor Channing Robertson's Introduction to Chemical Engineering: "Lecture 12: Heat Exchangers"*

*<http://www.youtube.com/watch?v=Gu1ApKpcxQc>*

**UNIT V**

Radiative Heat Transfer: Emission Characteristics and Laws of Black-Body Radiation – Irradiation – Total and Monochromatic Quantities– Laws of Planck, Wien, Kirchoff, Lambert, Stefan And Boltzmann – Heat Exchange Between Two Black Bodies – Concepts of Shape Factor – Emissivity – Heat Exchange Between Gray Bodies – Radiation Shields – Electrical Analogy for Radiation Networks.

**Learning outcome & Suggested Student Activities:**

*At the end of the unit, student can have knowledge on fundamental laws of radiative heat transfer. Also, student can understand the concept of radiative heat transfer between black bodies and grey bodies. Student can know radiation shields and their applications. Student can determine shape factor for different geometries and can know its importance in determining radiative heat transfer.*

*The following URLs will be highly useful to the students - <http://energy.concord.org/ir/experiments-page5.html>*



**Text Books:**

1. *Fundamentals of Engg. Heat and Mass Transfer*, R.C. Sachdeva, 4/e, New Age International, 2010.

**Reference Books:**

1. *Heat Transfer*, P.K.Nag, 3/e, TMH, 2011
2. *Heat Transfer*, S.P.Sukhatme, University Press, 4<sup>th</sup> edition, 2005
3. *Heat Transfer*, Holman.J.P, 10/e, TMH, 2012
4. *Heat and Mass Transfer*, R.K.Rajput, S.Chand& Company Ltd, 2001
5. *Fundamentals of Heat and Mass Transfer*, Kondandaraman, C.P., 3/e, New Age Publ.
6. *Heat and Mass Transfer*, D.K.Dixit, McGrawHill, 2016
7. *Thermal Engineering Data Book*, B.S.Reddy and K.H.Reddy Rev/e, I.K. International, 2007

**NOTE:** Heat transfer Data books are permitted for Exam.

**Suggestion:**

1. Student is advised to visit heat transfer laboratory to understand the concept of three modes of heat transfer.

**Web References:**

IIT video lecturers (NPTEL)

<http://www.wisc-online.com/Objects/ViewObject.aspx?ID=SCE304>

<http://web.cecs.pdx.edu/~gerry/heatAnimations/sphereTransient#TOC>

<http://rpaulsingh.com/animated%20figures/animationlisttopic.htm>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech III-II Sem. (ME)**

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**15A03604 FINITE ELEMENT METHODS**
**Course objective:**

*The subject should enable the students to learn the principles involved in discretization in finite element approach, form stiffness matrices and force vectors for simple elements, find the various approach followed in finite element approach, use the various elements for discretization and learn about shape functions.*

*To learn the application of FEM to various structural problems incorporating temperature.*

*and boundary conditions and heat transfer problems.*

**UNIT I**

INTRODUCTION: Equilibrium equations in elasticity subjected to body force, traction forces and point loads, stress strain relations in 3D elasticity, plane stress and plane strain, Boundary conditions, Initial conditions. Governing equation for Steady state heat conduction with convective boundary conditions.

Approximate methods for solving the differential equations: Rayleigh-Ritz method, Weighted residual methods, Galerkin's method.

Integral formulation: Principle of a minimum potential energy, principle of virtual work, Generalized Finite element approach in solving these problems.

Solution methods for solving simultaneous equations.

**Learning Outcome & Suggested Student Activities:**

*After completion of this unit students are able to know introductory basic principles and approaches for solving FEM problems in different fields. In addition to text books, the following URLs will be highly useful to the students to understand basic approaches to formulate and solving of FEM problems.*

*<http://www.youtube.com/watch?v=NYiZQszx9cQ&list=PLA4CBD0C55B9C3878&index=1>*

*<http://www.youtube.com/watch?v=RQBXWF9b-Fs&list=PLA4CBD0C55B9C3878>*

**UNIT II**

Problems with One-dimensional geometry:

Bars: Formulation of stiffness matrix, Load vectors, Incorporation of boundary conditions: Elimination approach and penalty approach.

Trusses: Plane truss and space truss elements, Example problems involving plane truss elements. Examples involving multipoint constrains. Stress calculations.

Beams & Frames: Bending of beams, Interpolation functions, formulation of stiffness matrix and load vectors. Plane frames, space frames. Transformations of stiffness and load vectors.

**Learning Outcome & Suggested Student Activities:**

*After completion of this unit students are able to formulate FEM model for simple problems. In addition to text books, the following URLs will be highly useful to the students to formulate FEM models for simple problems using different elements.*

[http://web.iitd.ac.in/~achawla/public\\_html/429/fem/overview.pdf](http://web.iitd.ac.in/~achawla/public_html/429/fem/overview.pdf)

[http://www.cmmacs.ernet.in/cmmacs/Lect\\_notes/sangeeta1.pdf](http://www.cmmacs.ernet.in/cmmacs/Lect_notes/sangeeta1.pdf)

<http://www.mecheng.iisc.ernet.in/~suresh/me237/fea/Chapter4.pdf>

**UNIT III**

INTERPOLATION MODELS: Polynomial form of interpolation functions - linear, quadratic and cubic, simplex, complex, Multiplex elements, Selection of the order of the interpolation polynomial, Convergence requirements, 2D Pascal Triangle, Linear interpolation polynomials in terms of global coordinates for triangular (2D simplex) elements, Linear interpolation polynomials in terms of local coordinates for triangular (2D simplex) elements, quadrilateral element.

HIGHER ORDER AND ISOPARAMETRIC ELEMENTS: Lagrangian interpolation, Higher order one dimensional elements- quadratic, Cubic element and their shape functions, properties of shape functions, Shape functions of 2D quadratic triangular element in natural coordinates, 2D quadrilateral element shape functions – linear, quadratic, Biquadric rectangular element Tetrahedral and hexahedral elements.

**Learning Outcome & Suggested Student Activities:**

*After completion of this unit students are able to write interpolation functions to higher order isoparametric elements. In addition to text books, the following URLs will be highly useful to the students to understand basic concepts of isoparametric elements.*

<http://www.kochmann.caltech.edu/ae108a/IsoparametricElements.pdf>

<http://www.me.mtu.edu/~bettig/MEEM4405/Lecture08.pdf>

<http://site.iugaza.edu.ps/marafa/files/FEM-Chapter-10.pdf>

**UNIT IV**

FINITE ELEMENT APPLICATION IN SOLID MECHANICS:

Problem modeling and Finite element analysis in 2D plane elasticity with triangular and quadrilateral elements, Isoparametric, subparametric and superparametric elements. Interpolation, Jacobian, matrices relating strain and nodal displacements, stiffness matrix formulation, Consistent and lumped load vectors, Numerical integration Gaussian quadrature.

Axi-symmetric triangular elements: formulation of stiffness and load vectors.

Introduction to 3D stress analysis.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to derive element matrices for applying the principles to find stresses in beams and trusses and temperature distribution in composite walls and fins. In addition to text books, the following URLs will be highly useful to the students to develop and solve FEM models using beam and truss elements.

<http://www.youtube.com/watch?v=UeatU9OpDNA&list=PLA4CBD0C55B9C3878>

[http://uqu.edu.sa/files2/tiny\\_mce/plugins/filemanager/files/4041296/ComputerApplicationsInStructures/LeturesTutorialsDownloadedFromWeb/Lecture%20%20Truss%20and%20Beam%20FEM.pdf](http://uqu.edu.sa/files2/tiny_mce/plugins/filemanager/files/4041296/ComputerApplicationsInStructures/LeturesTutorialsDownloadedFromWeb/Lecture%20%20Truss%20and%20Beam%20FEM.pdf)

<http://www.engineering.uiowa.edu/~sxiao/class/058-153/lecture-24.pdf>

[www.rpi.edu/~des/CST.ppt](http://www.rpi.edu/~des/CST.ppt)

**UNIT V****HEAT TRANSFER AND FLUID MECHANICS PROBLEMS:**

Steady state heat conduction with convective and heat flux boundary conditions, Functional approach, Galerkin approach formulation of element characteristic matrices and vectors in 1D and 2D problems. Temperature distribution in composite walls one dimensional and two dimensional fins and extended surfaces.

Two dimensional potential flow problems: Potential function formulation and stream function formulation.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to solve bars, trusses, beams and heat transfer problems using FEM and also to apply boundary conditions in realistic problems. In addition to text books, the following URLs will be highly useful to the students to develop and solve FEM models using different elements. The students are also advised to use FEM software to solve all application problems.

<http://www.mecheng.iisc.ernet.in/~suresh/me237/fea/Chapter6.pdf>

<http://www.colorado.edu/engineering/cas/courses.d/IFEM.d/IFEM.Ch22.d/IFEM.Ch22.pdf>

**Text Books:**

1. Introduction to Finite Element in Engineering, Tirupati Chandrapatla and Bellagundu, Pearson Education, New Delhi.
2. Finite Element Methods, S. S. Rao, Pergamom Press, New York

**Reference Books:**

1. *Finite Element Method* by R. Dhanaraj, K. Prabhakaran Nair Oxford University Press
2. *Introduction to FEM*, J. N. Reddy, TMH Publishers, New Delhi.
3. *Finite Element Analysis*, C.S. Krishna Moorthy, TMH Publishers, New Delhi.
4. *Fundamentals of Finite Element Analysis*, David V. Hutton , TMH Publishers, New Delhi.
5. *Introduction to the Finite Element Methods*, Desai and Abel , CBS Publishers, New Delhi.
6. *Finite and Boundary Methods in Engineering*, O.P.Gupta, Oxford and IBH Publishers, New Delhi.
7. *Finite Element Modeling for Stress Analysis*, R. D. Cook, John. Wiley & Sons, 1995.

**WEB REFERENCES**

1. *Finite Element Method IIT Kanpur Course*, Prof. C.S. Upadhyay  
<http://nptel.iitm.ac.in/video.php?subjectId=112104115>
2. *Computational Methods in Design and Manufacturing* by Dr. R. Krishnakumar,  
Department of Mechanical Engineering, IIT Madras  
<http://nptel.iitm.ac.in/video.php?subjectId=112106135>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech III-II Sem. (ME)**

L	T	P	C
3	1	0	3

**15A03605 METAL FORMING PROCESSES**
**Course Objective:**

*Metal forming processes are highly non linear because they involve geometric, material and contact non linearity. And so this subject introduce the concepts of one, two and three dimensional stress analysis, theory of plasticity, strain hardening, hot and cold working process. The students also will get the awareness on various types of rolling mills, forgings, extrusions, wire drawing processes, sheet metal operations, concepts on plastic manufacturing processes and rapid manufacturing process and its applications.*

**UNIT 1**

Stress, strain, Two dimensional stress analysis and three dimensional stress analysis, relation between engineering stress and true stress, relation between engineering strain and true strain, yield criteria, yield locus, theory of plasticity, Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth, Comparison of properties of Cold and Hot worked parts

**Learning Outcome & Suggested Student Activities:**

*Students can understand the basic concept on one, two and three dimensional stress analysis, theory of plasticity, strain hardening, hot and cold working process. The students are advised to visit the URLs <http://www.nptel.iitm.ac.in/iitkgp.ac.in>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm>.*

**UNIT II**

**ROLLING:** Bulk deformation processes – Economics of bulk forming, principles and theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements, applications and, limitations, defects in rolled products – machinery and Equipment.

**FORGING PROCESSES:** Principles of forging –Types Forging – Smith forging, Drop Forging – Roll forging – Forging hammers: Rotary forging – forging defects, Forces in forging of strip, disc and power requirements, applications, Equipment and their selection.

**Learning Outcome & Suggested Student Activities:**

*Students can understand the principles of rolling and forging processes, their applications and defects. The students are advised to visit URLs <http://www.nptel.iitm.ac.in/iitkgp.ac.in>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm>*

**UNIT III**

**EXTRUSION PROCESSES:** Basic extrusion process and its characteristics. Mechanics of hot and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion Hydrostatic extrusion, forces in extrusion of cylindrical and non cylindrical components – characteristics and defects in extruded parts.

**Wire Drawing:** Process Mechanics and its characteristics, determination of degree of drawing, drawing force, power, and number of stages-defects in products.

**Learning Outcome & Suggested Student Activities:**

Students can understand the fundamentals of extrusion process and wire drawing processes and their industrial applications. The students are advised to visit the URLs <http://www.nptel.iitm.ac.in/iitkgp.ac.in>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm>.

**UNIT IV**

**Sheet Metal Working – Economical Considerations - Stamping, forming and other cold working processes:** Blanking and piercing – Bending and forming – Drawing and its types – Cup drawing and Tube drawing – coining – Hot and cold spinning. Force and power requirement in sheet metal operations, defects in sheet metal products – Equipment, tooling and their characteristics.

**Learning Outcome & Suggested Student Activities:**

Students can understand the various press working processes, their advantages and disadvantages. The students are advised to refer the text book Workshop Technology by **Hajra Choudhary**. **Students are advised to visit nearby sheet metal works industries.**

**UNIT V**

**Processing of plastics, injection and blow moulding, calendaring, thermo forming, compression moulding, transfer moulding, High energy rate forming methods Rapid manufacturing:** - Introduction – concepts of rapid manufacturing, information flow for rapid prototyping, classification of rapid prototyping process, sterer holography fused deposition modeling, selective laser sintering, Applications of rapid prototyping process

**Learning Outcome & Suggested Student Activities:**

Students can understand the concept of plastic manufacturing process, rapid manufacturing process and its applications. Students are advised to visit the following URLs <http://www.nptel.iitm.ac.in/iitkgp.ac.in>, <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv234-Page1.htm>.

**Text Books:**

1. *Manufacturing Technology, Schmid and kalpakjin, Pearson Education.*
2. *Manufacturing Technology, Foundry forming and welding, Vol I , P.N. Rao, TMH*

**Reference Books:**

1. *Production Technology*, R.K. Jain, Khanna Publishers, 17<sup>th</sup> edition, 2012
2. *Process and materials of manufacturing* –Lindberg, PE
3. *Principles of Metal Castings*, Rosenthal.
4. *Welding Process*, Parmar
5. *Manufacturing Technology*, R.K. Rajput, Laxmi Pub
6. *Rapid Prototyping Principles and Applications*, RafiqNoorani, Wiely Pub.

**Web Resources:**

[www.casde.iitb.ac.in/store/events/2003/IAT-Pune.../DFMA.ppt](http://www.casde.iitb.ac.in/store/events/2003/IAT-Pune.../DFMA.ppt)  
[www.rose-hulman.edu/~stienstr/ME470/DFA.ppt](http://www.rose-hulman.edu/~stienstr/ME470/DFA.ppt)  
[www.design4manufacturability.com/DFM\\_article.htm](http://www.design4manufacturability.com/DFM_article.htm)



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech III-II Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>
<b>15A03606</b>	<b>NONCONVENTIONAL SOURCES OF ENERGY (CBCC- I)</b>			

**Course Objective:**

To create awareness to the student about basic concepts of non-conventional source of energy, to understand the process of collection, storage, conversion and applications of Solar Energy, Wind Energy, Bio Mass, OTEC. To learn about direct conversion methods.

**UNIT – I**

**PRINCIPLES OF SOLAR RADIATION:** Role and potential of new and renewable source, the solarenergy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data.

**UNIT-II**

**SOLAR ENERGY COLLECTION:** Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

**UNIT-III**

**SOLAR ENERGY STORAGE AND APPLICATIONS:** Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

**WIND ENERGY:** Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

**UNIT-IV**

**BIO-MASS:** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gasyield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

**GEOTHERMAL ENERGY:** Resources, types of wells, methods of harnessing the energy, potential in India.

**UNIT-V**

**OCEAN ENERGY:** OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

**DIRECT ENERGY CONVERSION:** Need for DEC, Carnot cycle, limitations, and principles of DEC.

Thermo-electric generators, Seebeck, Peltier and Joule Thomson effects, Figure of merit, materials, applications,

MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator,

MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principles, faraday's law's, thermodynamic aspects, selection of fuels and operating conditions.

**Outcomes:**

- *Understanding various Non-conventional sources of Energy.*
- *Able to learn how to use renewable energies instead of conventional fuels.*

**TEXT BOOKS:**

1. *Non-Conventional Energy Sources /G.D. Rai*
2. *Energy Resources Utilization and Technologies, Anjaneyulu Yerramilli, Francis Tului, BS Publications, 2012*

**REFERENCES :**

1. *Renewable Energy Sources/ Twidell & Weir*
2. *Non Conventional Energy Resources, B.H.Khan, McGrawHill, 2015*
3. *Solar Power Engineering/B.S.Magal Frank Kreith & J.F.Kreith.*
4. *Principles of Solar Energy/ Frank Krieth & John F Kreider.*
5. *Non-Conventional Energy/ Ashok V Desai/ Wiley Eastern*

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech III-II Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**15A03607 TOTAL QUALITY MANAGEMENT  
(CBCC-I)**

**Course Objective:**

*To understand the concept of quality, cost of quality, international quality standards.*

*To learn the principles of Total quality management, techniques for problem solving.*

*To learn about various tools of quality management used in various industrial applications.*

**UNIT – I**

TQM – overview , concepts, elements – History-Quality management philosophies- Juran, Deming, Crosby , Feigenbaum, Ishikawa– Stages of Evolution– continuous improvement

– objectives – internal and external customers.

Quality standards – Need of standardization - Institutions – bodies of standardization, ISO 9000 series – ISO 14000 series – other contemporary standards – ISO certification process-Third party audit.

**UNIT – II**

Process management- Quality measurement systems (QMS) – developing and implementing QMS – nonconformance database- TQM tools & techniques- 7 QC tools- 7 New QC tools.

Problem Solving techniques - Problem Solving process – corrective action – order of precedence

**UNIT – III**

System failure analysis approach – flow chart – fault tree analysis – failure mode assessment and assignment matrix – organizing failure mode analysis – pedigree analysis.

Quality circles – organization – focus team approach – statistical process control – process chart – Ishikawa diagram – preparing and using control charts.

**UNIT IV**

Quality Function Development (QFD) – elements of QFD – benchmarking-Types- Advantages & limitations of benchmarking – Taguchi Analysis – loss function - Taguchi design of experiments. Poka-yoke, Kaizen, Deming cycle.

**UNIT – V**

Value improvement elements – value improvement assault – supplier teaming.  
Business process reengineering & elements of Supply chain management.  
Six sigma approach – application of six sigma approach to various industrial situations.

**Outcomes:**

- *Understanding the concepts of TQM.*
- *Able to use tools and techniques for problem solving.*
- *To formulate quality circles to find solutions to problems in industry.*
- *Analyze various quality problems and contribute towards continuous improvement in the system.*

**TEXT BOOKS:**

1. Total Quality Management, D.R.Kiran, BS Publications, 2016
2. Total Quality Management by Besterfield, Pearson.

**REFERENCE BOOKS:**

1. Quality management by Howard Giltow-TMH
2. Quality management by Evans.
3. Quality management by Bedi
4. Total Quality Management by Joseph & Susan Berg
5. Total Quality Management-Toward the Emerging Paradigm, Bounds, Yorks, Adams, Ranney, McGraHill, 1994

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech III-II Sem. (ME)**

L	T	P	C
3	1	0	3

**15A03608 MECHATRONICS  
(CBCC- I)**

**Course Objective:**

*To make the students to learn about the Basic electronics, electrical and mechanical components used to control the machines and industries. Various types of sensors, signal conditioning systems and various pneumatic and hydraulic components used in control systems. Micro controllers, PLCS and PLC program and programmable motion control systems.*

**UNIT I**

INTRODUCTION: Definition – Trends - Control Methods: Stand alone, PC Based (Real Time Operating Systems, Graphical User Interface, Simulation) - Applications: SPM, Robot, CNC, FMS, CIM.

**Learning outcome & Suggested Student Activities:**

*This unit helps the students to understand the importance of mechatronics subject and controlling the various machines, robots etc. Students may observe CNC machines in CAD/CAM lab to understand the mechatronics concepts.*

*Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter- 1, by the authors - W .Bolton, publishers - Pearson Education Press, 3rd edition, 2005. Students may refer the following website*

*www.nptel.iitm.ac.in/ECE/mechatronics www.ustudy.in/mech/mechs en.wikipedia.org/wiki/mechatronics for better understanding of this topic.*

**UNIT II**

SIGNAL CONDITIONING: Introduction – Hardware - Digital I/O , Analog input – ADC , resolution , speed channels Filtering Noise using passive components – Resistors, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering.

**Learning outcomes & Suggested Student Activities:**

*This unit helps the students to understand how to convert the analog signals into useful required form. These signal condition systems may be observed in electronics and communication engineering department labs.*

*Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter – 3, by the authors - W Bolton, publishers- Pearson Education Press, 3rd edition, 2005.*

*Students may refer the following website [www.nptel.iitm.ac.in/ECE/mechatronics](http://www.nptel.iitm.ac.in/ECE/mechatronics) [www.saylor.org/courses/me302](http://www.saylor.org/courses/me302) for better understanding of this topic.*

**UNIT III**

PRECISION MECHANICAL SYSTEMS: Pneumatic Actuation Systems - Electro-pneumatic Actuation Systems - Hydraulic Actuation Systems - Electro-hydraulic Actuation Systems - Timing Belts – Ball Screw and Nut - Linear Motion Guides - Linear Bearings - Bearings- Motor / Drive Selection.

**Learning outcome & Suggested Student Activities:**

*In this unit the students learn about the pneumatic and hydraulic systems and about some precision mechanical component which are useful in the field of automation. This automation system can be observed in many processing industries and manufacturing industries to handle the materials and control the machines (or) process. Student may refer text book - Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter-5, 6 & 7 by the authors - W .Bolton, publishers - Pearson Education Press, 3rd edition, 2005. Students may refer the following website [www.pic-design.com](http://www.pic-design.com), [www.sdp-si.com](http://www.sdp-si.com), [www.csio.res.in](http://www.csio.res.in),*

**UNIT IV**

ELECTRONIC INTERFACE SUBSYSTEMS: Motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers, over current sensing, resettable fuses, Power Supply - Bipolar transistors/ mosfets.

ELECTROMECHANICAL DRIVES: Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - PWM's - Pulse Width Modulation – Variable Frequency Drives.

**Learning outcome & Suggested Student Activities:**

The objective of this unit is to make the student aware of electronic systems, electromechanical drives used in automation. Some of the systems may be observed electrical and electronics labs for better understanding. Student may refer text book - *Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter- 7* by the authors – W. Bolton, publishers- Pearson Education Press, 3rd edition, 2005. Students may refer the following website [www.pic-design.com](http://www.pic-design.com), [www.sdp-si.com](http://www.sdp-si.com), [www.csio.res.info](http://www.csio.res.info) better understanding of this topic.

**UNIT V**

**MICROCONTROLLERS OVERVIEW:** 8051 Microcontroller , micro processor structure - Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors – Applications, Programming –Assembly.

**PROGRAMMABLE LOGIC CONTROLLERS:** Basic Structure - Programming: Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling -Analog input / output - PLC Selection, interface – R232 etc.,- Applications.

**Learning outcome & Suggested Student Activities:**

This unit helps the student to know about microcontrollers and to programming of programmable logic controls. Students may visit pharmaceutical industries, thermal power plants etc. To observe the PLC based control systems. to know about the interface between processing equipment and central system.

Student may refer text book - *Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, Chapter- 15, 14 & 19* by the authors - W .Bolton, publishers- Pearson Education Press, 3rd edition, 2005. Students may refer the following website [www.authorstream.com](http://www.authorstream.com), [www.atmel.in](http://www.atmel.in), [www.lifehacker.com](http://www.lifehacker.com)

**Text Books:**

1. *Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering* , W Bolton, Pearson Education Press, 3rd edition, 2005.
2. *Mechatronics*, M.D.Singh, J.G.Joshi, PHI.

**Reference Books:**

1. *Mechatronics Principles, concepts and applications.* Nitaigour premchand mahalik, MC Graw Hill Edu.
2. *Mechatronics Source Book*, Newton C Braga, Thomson Publications, Chennai.
3. *Mechatronics*, N. Shanmugam, Anuradha Agencies Publisers.
4. *Mechatronics System Design*, Devdas shetty, Richard, Thomson.
5. *Mechatronics Er.* R.K. Rajput. S. Chand Publications.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech III-II Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>
<b>15A01608</b>	<b>INTELLECTUAL PROPERTY RIGHTS (CBCC – I)</b>			

**COURSE OBJECTIVE:**

*This course introduces the student to the basics of Intellectual Property Rights, Copy Right Laws Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations.*

**UNIT – I**

Introduction To Intellectual Property: Introduction, Types Of Intellectual Property, International Organizations, Agencies And Treaties, Importance Of Intellectual Property Rights.

**UNIT – II**

Trade Marks : Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.

**UNIT – III**

Law Of Copy Rights : Fundamental Of Copy Right Law, Originality Of Material, Rights Of Reproduction, Rights To Perform The Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice Of Copy Right, International Copy Right Law.  
Law Of Patents : Foundation Of Patent Law, Patent Searching Process, Ownership Rights And Transfer

**UNIT – IV**

Trade Secrets : Trade Secrete Law, Determination Of Trade Secrete Status, Liability For Misappropriations Of Trade Secrets, Protection For Submission, Trade Secrete Litigation.  
Unfair Competition : Misappropriation Right Of Publicity, False Advertising.

**UNIT – V**

New Developments Of Intellectual Property: New Developments In Trade Mark Law ; Copy Right Law, Patent Law, Intellectual Property Audits.  
International Overview On Intellectual Property, International – Trade Mark Law, Copy Right Law, International Patent Law, International Development In Trade Secrets Law.



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**TEXT BOOKS & REFERENCES:**

1. Intellectual Property Rights, Deborah. E. Bouchoux, Cengage Learning.
2. Intellectual Property Rights– Unleashmy The Knowledge Economy, Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,

**Course Outcomes:**

*On completion of this course, the student will have an understanding of the following:*

- a) *Intellectual Property Rights and what they mean*
- b) *Trade Marks and Patents and how to register them*
- c) *Laws Protecting the Trade Marks and Patents*
- d) *Copy Right and laws related to it.*

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B. Tech III-II Sem. (ME)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**15A03609 HEAT TRANSFER LABORATORY**

**NOTE:** *Thermal Engineering data books are permitted in the examinations*

1. Thermal conductivity of insulating powder material through Concentric Sphere apparatus.
2. Thermal conductivity of insulating material through lagged pipe apparatus
3. Overall heat transfer co-efficient through Composite Slab Apparatus
4. Thermal Conductivity of metal (conductor).
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer coefficient in forced convection.
8. Heat transfer coefficient in natural convection
9. Experiment on Parallel and counter flow heat exchanger.
10. Emissivity of a gray body through Emissivity apparatus.
11. Experiment on Stefan Boltzman Apparatus.
12. Heat transfer in drop and film wise condensation.
13. Experiment on Critical Heat flux apparatus.
14. Study of heat pipe and its demonstration.
15. Study of Two – Phase flow.

**Note:** *Any 10 of the above 15 experiments are to be conducted.*

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech III-II Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>15A03610 COMPUTER AIDED ENGINEERING LAB (CAE LAB)</b>				

**I. Introduction to Analysis Software Package**
**II. Structural analysis: (Any Six exercises)**

1. Analysis of a rectangular plate with a hole.
2. Analysis of a truss member under loading.
3. Analysis of a bracket plate with axial loading
4. Analysis of a bracket plate with eccentric loading
5. Static Analysis of Prismatic bar
6. Static Analysis of a Corner Bracket
7. Static Analysis of beam
8. Analysis of Thermally Loaded support Structure
9. Analysis of Hinged support member
10. Analysis of Tapered plate under transverse load

**III. Thermal analysis:(Any two exercises)**

1. Analysis of a square plate considering conduction.
2. Analysis of a square plate considering conduction and convection.
3. Analysis of a compound bodies considering conduction and convection.

**IV. Computational Fluid Dynamics (Any four exercises)**

1. Determine the flow of incompressible gas through an S-bend for laminar flow.
2. Determine the flow of incompressible gas through an S-bend for turbulent flow.
3. Determine that of incompressible water flowing over a cylinder.
4. Determine air flow over a simple geometry (aerofoil) in a wind tunnel (2-D).
5. Determine heat transfer from the heated fin within a rectangular enclosure containing air.
6. Determine how to solve a natural convection problem (in an infinitely long concentric cylinders).
7. Determine liquid enters through two inlets with different temperatures (multiphase flow) and leaves one outlet.

**Software can be used:** ANSYS, ALG Nastran, Star-CCM+, Fluent, FIRE. CFX.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech III-II Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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<b>15A52602</b>	<b>ADVANCED ENGLISH LANGUAGE COMMUNICATION SKILLS (AELCS) LAB (Audit Course)</b>			

## 1. INTRODUCTION

With increased globalization and rapidly changing industry expectations, employers are looking for the wide cluster of skills to cater to the changing demand. The introduction of the Advanced Communication Skills Lab is considered essential at 3<sup>rd</sup> year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information and to organise ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Taking part in social and professional communication.

## 2. OBJECTIVES:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.
- To prepare all the students for their placements.

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### 3. SYLLABUS:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

#### UNIT-I: COMMUNICATION SKILLS

1. Reading Comprehension
2. Listening comprehension
3. Vocabulary Development
4. Common Errors

#### UNIT-II: WRITING SKILLS

1. Report writing
2. Resume Preparation
3. E-mail Writing

#### UNIT-III: PRESENTATION SKILLS

1. Oral presentation
2. Power point presentation
3. Poster presentation

#### UNIT-IV: GETTING READY FOR JOB

1. Debates
2. Group discussions
3. Job Interviews

#### UNIT-V: INTERPERSONAL SKILLS

1. Time Management
2. Problem Solving & Decision Making
3. Etiquettes

### 4. LEARNING OUTCOMES:

- Accomplishment of sound vocabulary and its proper use contextually
- Flair in Writing and felicity in written expression.
- Enhanced job prospects.
- Effective Speaking Abilities

### 5. MINIMUM REQUIREMENT:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infra-structural facilities to accommodate at least 60 students in the lab:

- Spacious room with appropriate acoustics.
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system

- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
- T. V, a digital stereo & Camcorder
- Headphones of High quality

#### 6. SUGGESTED SOFTWARE:

The software consisting of the prescribed topics elaborated above should be procured and G

1. **Walden Infotech: Advanced English Communication Skills Lab**
2. **K-VAN SOLUTIONS-Advanced English Language Communication Skills lab**
3. **DELTA's key to the Next Generation TOEFL Test: Advanced Skills Practice.**
4. **TOEFL & GRE( KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)**
5. **Train2success.com**

#### 7. BOOKS RECOMMENDED:

1. **Objective English for Competitive Exams**, Hari Mohana Prasad, 4<sup>th</sup> edition, Tata Mc Graw Hill.
2. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, O U Press 3<sup>rd</sup> Edn. 2015.
3. **Essay Writing for Exams, Audrone Raskauskiene, Irena Ragaisience & Ramute Zemaitience,OUP, 2016**
4. **Soft Skills for Everyone**, Butterfield Jeff, Cengage Publications, 2011.
5. **Management Shapers Series** by Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. **Campus to Corporate**, Gangadhar Joshi, Sage Publications, 2015
7. **Communicative English**,E Suresh Kumar & P.Sreehari, Orient Blackswan, 2009.
8. **English for Success in Competitive Exams**, Philip Sunil Solomon OUP, 2015

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech IV-I Sem. (ME)**

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**15A52601 MANAGEMENT SCIENCE**

**Course Objective:** *The objective of the course is to equip the student the fundamental knowledge of management science and its application for effective management of human resource, materials and operation of an organization. It also aims to expose the students about the latest and contemporary developments in the field of management.*

**UNIT –I**

**Introduction to Management:** Concept-Nature and Importance of Management, Functions-Evaluation of Scientific Management, Modern management-Motivation Theories-Leadership Styles-Decision Making Process-Designing Organization Structure-Principles and Types of Organization.

**UNIT- II**

**Operations Management:** Plant location and Layout, Methods of production, Work-Study-Statistical Quality Control through Control Charts, Objectives of Inventory Management, Need for Inventory Control-EOQ&ABC Analysis(Simple Problems)**Marketing Management:** Meaning,Nature, Functions of Marketing, Marketing Mix, Channels of distribution- Advertisement and sales promotion-Marketing strategies-Product Life Cycle.

**UNIT –III**

**Human Resource Management(HRM):** Significant and Basic functions of HRM- Human Resource Planning(HRP), Job evaluation, Recruitment and Selection, Placement and Induction-Wage and Salary administration. Employee Training and development-Methods-Performance Appraisal-Employee Grievances-techniques of handling Grievances.

**UNIT –IV**

**Strategic Management:** Vision, Mission, Goals and Strategy- Corporate Planning Process-Environmental Scanning-SWOT analysis-Different Steps in Strateg Formulation, Implementation and Evaluation. **Project Management:** Network Analysis- PERT, CPM, Identifying Critical Path-Probability-Project Cost Analysis, Project Crashing (Simple Problems).

**UNIT-V**

**Contemporary Management Practices:** Basic concepts of MIS-Materials Requirement Planning(MRP),Just-In-Time(JIT)System, Total Quality Management(TQM)-Six Sigma

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and Capability Maturity Models(CMM) evies, Supply Chain Management, Enterprise Resource Planning(ERP),Performance Management, Business Process Outsourcing(BPO), Business Process Re-Engineering and Bench Marking, Balance Score Card.

**Learning Outcome:** This course enables the student to know the principles and applications of management knowledge and exposure to the latest developments in the field. This helps to take effective and efficient management decisions on physical and human resources of an organization. Beside the knowledge of Management Science facilitates for his/her personal and professional development.

**TEXT BOOKS:**

1. A.R Aryasri: Management Science, TMH, 2013
2. Kumar /Rao/Chalill 'Introduction to Management Science' Cengage, Delhi, 2012.

**REFERENCE BOOKS:**

1. A.K.Gupta "Engineering Management",S.CHAND, New Delhi, 2016.
2. Stoner, Freeman, Gilbert, Management, Pearson Education,New Delhi, 2012.
3. Kotler Philip & Keller Kevin Lane: Marketing Mangement , PHI,2013.
5. Koontz & Weihrich: Essentials of Management, 6/e, TMH, 2005.
6. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
7. Memoria & S.V.Gauker, Personnel Management, Himalaya, 25/e, 2005
8. Parnell: Strategic Management, Biztantra, 2003.
9. L.S.Srinath: PERT/CPM,Affiliated East-West Press, 2005.



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech IV-I Sem. (ME)**

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**15A03701 AUTOMOBILE ENGINEERING**
**Course Objective:**

*The students acquires sufficient knowledge to classify Engines, Chassis, Fuel Supply Systems, Cooling Methods, Lubrication Methods, Ignition Systems, Generating Systems, Suspension Systems, transmission system, steering mechanism and braking methods.*

*The students get the working knowledge of assembly of various components of layout and of various electrical equipment of an automobile.*

**UNIT I**

Introduction: Components of a Four Wheeler Automobile – Chassis and Body – Power Unit –Power Transmission – Rear Wheel Drive, Front Wheel Drive, Four Wheel Drive – Types of Automobile Engines, Engine Construction, Turbo Charging and Super Charging – Oil Filters, Oil Pumps – Crank Case Ventilation.

**Learning outcome & Suggested Student Activities:**

*Student can understand the function of each and every component of an automobile. Student can understand the use of turbo charging and super charging. Students may refer the following website [auto.howstuffworks.com](http://auto.howstuffworks.com), [www.em.gov.au](http://www.em.gov.au) for better understanding of this topic.*

**UNIT II**

Transmission System: Clutches- Principle- Types: Cone Clutch, Single Plate Clutch, Multi Plate Clutch, Magnetic and Centrifugal Clutches, Fluid Fly Wheel – Gear Box-Types: Sliding Mesh, Constant Mesh, Synchromesh, Epi-Cyclic, Over Drive, Torque Converter.

Propeller Shaft – Hotch – Kiss Drive, Torque Tube Drive, Universal Joint, Differential, Rear Axles.

**Learning outcome & Suggested Activities:**

*Student can be able to grasp the knowledge on emission standards, emission control techniques and electrical systems. Student can identify thrust areas for carrying their dissertation in future. Students may refer the following website [www.dec.ny.gov](http://www.dec.ny.gov), [www.studymode.com](http://www.studymode.com), [www.ehow.com](http://www.ehow.com), [www.automotiveservices.blogspot.com](http://www.automotiveservices.blogspot.com) for better understanding of this topic.*

**UNIT III**

Steering System: Steering Geometry – Camber, Castor, King Pin Rake, Combined Angle Toe-In, Center Point Steering. Types Of Steering Mechanism – Ackerman Steering Mechanism, Davis Steering Mechanism, Steering Gears – Types, Steering Linkages.

**Learning outcome & Suggested Student Activities:**

*At the end of the unit, student can have broad knowledge on each and every component of transmission system of a automobile. Students may refer the following websites [en-wikipedia.org/wiki/transmission](http://en-wikipedia.org/wiki/transmission), [www.youtube.com](http://www.youtube.com), [www.youtube.com](http://www.youtube.com), [jalopink.com](http://jalopink.com), [www.geansandstuff.com](http://www.geansandstuff.com) for better understanding of this topic.*

**UNIT IV**

Suspension System: Objects of Suspension Systems – Rigid Axle Suspension System, Torsion Bar, Shock Absorber, Independent Suspension System.  
Braking System: Mechanical Brake System, Hydraulic Brake System, Pneumatic and Vacuum Brake Systems.

**Learning outcome & Suggested Student Activities:**

*After the completion of the chapter, student can able to understand purpose and methods of steering systems and their applications. Students may refer the following website [www.scribd.com](http://www.scribd.com), [www.youtube.com](http://www.youtube.com), [leemyles.com](http://leemyles.com) [www.howcanworks.com](http://www.howcanworks.com), [www.forza.se/sider/of/listton/bi/stein1.pdf](http://www.forza.se/sider/of/listton/bi/stein1.pdf) for better understanding of this topic.*

**UNIT V**

Emissions from Automobiles – Pollution Standards National and International – Pollution Control– Techniques – Multipoint Fuel Injection for SI Engines- Common Rail Diesel Injection, Emissions from Alternative Energy Sources– Hydrogen, Biomass, Alcohols, LPG, CNG - Their Merits And Demerits.  
Electrical System: Charging Circuit, Generator, Current – Voltage Regulator – Starting System, Bendix Drive, Mechanism of Solenoid Switch, Lighting Systems, Horn, Wiper, Fuel Gauge – Oil Pressure Gauge, Engine Temperature Indicator.

**Learning outcome & Suggested Student Activities:**

*At the end of the unit. Student can have ample knowledge on suspension system and braking system of an automobile. Students may refer the following website [www.youtube.com](http://www.youtube.com), [www.howcanworks.com](http://www.howcanworks.com), [www.forza.se/sider/of/listton/bi/stein1.pdf](http://www.forza.se/sider/of/listton/bi/stein1.pdf) for better understanding of this topic.*

**Text Books:**

1. *Automotive Mechanics – Vol. 1 & Vol. 2*, Kirpal Singh, Standard Publishers Distributors, 13<sup>th</sup> edition, 2013.
2. *Automobile Engineering*, William Crouse, TMH, 10<sup>th</sup> edition, 2006.

**Reference Books:**

1. *Automobile Engineering*, R.K.Rajput, Laxmi Pub, 1<sup>st</sup> edition, 2013.
2. *Automobile Engineering*, K.K.Ramalingam/Scitech Pub, 2<sup>nd</sup> edition.
3. *Automotive engines*, Newton, Steeds & Garret.

**Books in Digital Libraray:**

[www.nptel.iitm.ac.in](http://www.nptel.iitm.ac.in)

**Suggestions:**

*Student is requested to visit the research and development cell of Automobile manufacturing companies and A.R.A.I emission testing centers.*

*For better understanding of these systems students may visit the Automobile service centre and APSRTC workshop.*

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech IV-I Sem. (ME)**

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**15A03702 CAD/CAM**
**Course objective:**

*The objective of the this subject is to enable the students to understand and handle design problems in symmetric manner, gain practical experience in handling 2-D drafting and 3-D modeling software systems, apply CAD in real life applications, understand the concepts G and M codes and manual part programming and know the applications of CNC machines. Further the students will become familiar on principles of computer graphics, geometric modeling, NC and CNC machines, group technology and FMS.*

**UNIT I**

Overview of CAD/CAM: Product cycle, CAD, CAM and CIM. CAD Tools, CAM Tools, Utilization in an Industrial Environment, Evaluation criteria. CAD standards, CAD data structure, Data base management systems.

Computer Graphics: Co-ordinate systems, Graphics package functions, 2D and 3D transformations, homogeneous transformations, clipping, hidden line / surface removal colour, shading.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the basic concepts Automation, components of CAD/CAM, input and output components of CAD, Steps involved in computer aided design.*

**UNIT II**

Geometric Modeling: Representation techniques, Parametric and non parametric representation, various construction methods, wire frame modeling, synthetic curves and their representations, surface modeling, synthetics surfaces and their representations.

Solid modeling, solid representation, fundamentals, introduction to boundary representations, constructive solid geometry, analytical solid modeling.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the geometric model of the component in CAD technology of computer graphics. The techniques of raster technology, scan conversion, clipping, removal of hidden lines and hidden surfaces, color, shading and texture.*

**UNIT III**

Numerical Control: NC, NC Modes, NC Elements, NC Machine tools and their structure, Machining centre, types and features. Controls in NC, CNC systems, DNC systems. Adaptive control machining systems, types of adaptive control.

CNC Part Programming: Fundamentals, NC word, NC Codes, canned cycles, cutter radius compensation, length compensation, computed assisted part programming using APT: Geometry statements, motion statements, post process statements, auxiliary statements, macro statement program for simple components.

**Learning outcomes & Suggested Student Activities:**

*Geometric Modelling constitutes the most important and complex part in most of CDA software packages. Hence the students should focus on various requirements of information that are generated during geometric modeling stage, various types and its applications. Mathematical representations of curves used in geometric construction.*

**UNIT IV**

Group Technology & FMS: Part Family, Classification and Coding, advantages & limitations, Group technology machine cells, benefits. FMS: Introduction, components of FMS, material handling systems, Computer control systems, advantages.

Computer Aided Quality Control: Terminology in Quality control, Inspection and testing, Contact inspection methods - optical and non optical, integration of CAQC with CAD and CIM

**Learning outcome & Suggested Student Activities:**

*CNC has revolutionized the manufacturing automation. The flexibility of manufacturing achieved with the use of CNC and associated Technology. The students should aimed to understand the principle of NC, CNC, Machining Centre and various methods of part programming. The student is advised to visit manufacturing industry where the CNC machines are using and also interact with CNC programmer in industry.*

**UNIT V**

Computer Aided Processes Planning: Retrieval type and Generative type, benefits, Machinability data systems, Computer generated time standards.

Computer integrated production planning: Capacity planning, shop floor control, MRP-I, MRP-II, CIMS benefits. Trends in Manufacturing systems: Concepts of Reconfigurable manufacturing, Sustainable manufacturing and lean manufacturing.

**Learning outcomes & Suggested Student Activities:**

*Understanding the need of GT as a means of bringing the benefits of mass production to relatively smaller production. Understanding the need of computers in process planning and QC. Understanding the definition and concept of FMS, and its elements etc.*

**Text Books:**

1. CAD/CAM, A Zimmers&P.Groover, PE, PHI
2. CAD/CAM-Principles and applications, P.N. Rao, TMH, 3<sup>rd</sup> edition, 2010

**Reference Books:**

1. Computer Aided Design & Manufacturing, Lalit Narayan/Mallikarjuna Rao/M.M.M.Sarcar.PHI(2015)
2. Automation, Production systems & Computer integrated Manufacturing ,Groover, P.E
3. CAD/CAM/CIM, Radhakrishnan and Subramaniah, New Age, 3<sup>rd</sup> edition, 2008
4. Principles of Computer Aided Design and Manufacturing, FaridAmirouche, Pearson
5. CAD/CAM Theory and Practice, R. Sivasubramaniam, TMH
6. Computer Aided Design and Manufacturing, K.Lalit Narayan , PHI, 2008.
7. Computer Aided Manufacturing, T.C. Chang, Pearson, 3<sup>rd</sup> edition, 2008
8. A text book of CAD/CAM, CSP Rao, Hitech Publ.

**Web References:**

- [http://www.cadcamfunda.com/cam\\_computer\\_aided\\_manufacturing](http://www.cadcamfunda.com/cam_computer_aided_manufacturing)  
<http://wings.buffalo.edu/eng/mae/courses/460-564/Course-Notes/cnc-classnotes.pdf>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech IV-I Sem. (ME)**

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**15A03703 METROLOGY AND MEASUREMENTS**
**Course objective:**

*Students will be able to understand the Limits and Fits, linear measurements and angular measurements, gauges, comparators, optical measuring methods, measurement of flatness and roughness of surface. And also learn about the screw thread and gear measuring methods, Alignment tests on machine tools.*

*Students will be able to understand various transducers to measure displacement like Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers and also learn about Calibration procedure, temperature and pressure calibration methods, the measurement of flow stress, strain measurements acceleration and vibration.*

**UNIT I**

LIMITS, FITS and TOLERANCES : Introduction, Definitions, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard system – International Standard organization system for plain work.

LIMIT GAUGES and GAUGE DESIGN: Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle. Design of Go and No Go gauges.

COMPARATORS: Principle of Measurement with Mechanical, Optical, Electrical, Electronic, Pneumatic comparators and their uses.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the Limits, Fits and Tolerance. Indian standard system – International Standard organization system. He will know the principles of working of the most commonly used instruments for measuring linear and angular distances.*

*<http://www.nptel.iitm.ac.in>*

*<http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv113-Page1.htm>*

**UNIT II**

LINEAR MEASUREMENT: Length standard, line and end & wavelength standards, slip gauges – calibration of the slip gauges, Dial indicator, micrometers, vernier height gauges.

MEASUREMENT OF ANGLES AND TAPERS: Different methods – Bevel protractor – angle gauges – spirit levels – sine bar – Sine plate, rollers and spheres used to determine the tapers.

FLATNESS MEASUREMENT: Measurement of flatness of surfaces – straight edges– surface plates – optical flat and auto collimators, interferometer and their uses.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to study the different types of Comparators, optical measuring instruments, flatness measurement methods and measuring methods of surface roughness. <http://www.nptel.iitm.ac.in/> and for notes, <http://www.learnerstv.com/Free-Engineering-Video-lectures-Itv113-Page1.htm>*

**UNIT III**

SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surface waviness- Numerical assessment of surface finish – CLA, R.M.S Values –  $R_a$ ,  $R_z$  values, Methods of measurement of surface finish-profilograph, Talysurf, BIS symbols for indication of surface finish.

SCREW THREAD MEASUREMENT: Elements of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch- profile thread gauges.

GEAR MEASUREMENT: Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch, pressure angle and tooth thickness.

MACHINE TOOL ALIGNMENT TESTS: Requirements of Machine Tool Alignment Tests, Alignment tests on lathe, milling and drilling machine tools. Preparation of acceptance charts.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand, Screw thread elements and measuring methods, Gear tooth profile measurement, CMM, Alignment tests on lathe, milling and drilling machine tools.*

**UNIT IV**

MEASUREMENT OF DISPLACEMENT: Theory and construction of various transducers to measure displacement - Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

MEASUREMENT OF SPEED: Mechanical Tachometers - Electrical tachometers - Stroboscope, Noncontact type of tachometer

STRESS & STRAIN MEASUREMENTS: Various types - electrical strain gauge - gauge factor - method of usage of resistance strain gauge for bending, compressive and tensile strains - usage for measuring torque, Strain gauge Rosettes.

MEASUREMENT OF ACCELERATION AND VIBRATION: Different simple instruments - Principles of Seismic instruments - Vibrometer and accelerometer.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand working of various instruments used for measuring for displacement, temperature and pressure.*



**UNIT V**

MEASUREMENT OF TEMPERATURE: Standards and calibration, thermal expansion methods, thermo electric sensors(thermocouples), Electrical Resistance sensors, Junction semiconductor sensors, Digital thermometers, Radiation methods.

MEASUREMENT OF PRESSURE AND SOUND: Standards and calibration, basic methods of pressure measurement, dead weight gauges and manometers, Elastic transducers, vibrating cylinder, resonant transducers, High and low pressure measurement, sound measurement.

MEASUREMENT OF FORCE, TORQUE, POWER: Standards and calibration, Basic methods of Force Measurement, Torque measurement on rotating shafts, shaft power measurement(dynamometers), Vibrating wire force transducers.

**Learning outcome & Suggested Student Activities:**

After completion of this unit students are able to understand working of various instruments used for measuring for flow, speed, stress, strain and Vibration.

**Text Books:**

- (1) *Mechanical Measurements*, Beckwith, Marangoni, Linehard, PHI, PE
- (2) *Measurement systems: Application and design*, Doebelin Earnest. O. Adaptation by Manik and Dhanesh, TMH, 2012.
- (3) *Engineering Metrology*, R.K. Jain, Khanna Publishers, 20<sup>th</sup> edition, 2013.

**Reference Books:**

- (1) *Engineering Metrology*, Mahajan, DhanpatRai, 2<sup>nd</sup> edition, 2013.
- (2) *BIS standards on Limits & Fits*
- (3) *Fundamentals of Dimensional Metrology*, Connie Dn, CENGAGE LEARNERS
- (4) *Metrology & Measurement* by Anand K Bewoor, vinay A kulkarni, Mc GrawHill, 2013.
- (5) *Instrumentation, measurement & analysis*, B.C.Nakra&KKChoudhary, TMH, 6<sup>th</sup> edition, 2011.

**Web References:**

<http://emtool box.nist.gov>

[CambridgeViscosity.com/Viscometer](http://CambridgeViscosity.com/Viscometer)

[www.e.FlukeCal.com/Calibration](http://www.e.FlukeCal.com/Calibration)

[www.inscotemperature.com/](http://www.inscotemperature.com/)

[www.solartronmetrology.com/](http://www.solartronmetrology.com/)

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech IV-I Sem. (ME)

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**15A03704 REFRIGERATION AND AIR CONDITIONING  
(CBCS- II)**
**Course Objective:**

*This subject provides insights in how thermodynamic principles are applied within the refrigeration and air conditioning industry. It gives details on how different components work and influence each other. Students will learn how real systems used in commercial , industrial refrigeration and air conditioning industries are built-up.*

*The objective this subject is to make the student to have complete knowledge on various refrigeration methods like VCR, VAR and latest developments, knowledge on various air conditioning methods like summer, winter and year round air conditioning and to make the student to understand the practical applications of refrigeration and air conditioning systems.*

**UNIT I**

Introduction to Refrigeration: Necessity and Applications, Carnot Refrigerator, First and Second Law Applied to Refrigerating Machines, Unit of Refrigeration, COP, EER, Different Refrigeration Methods

Air Refrigeration: Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems -Numerical Problems – Refrigeration Needs of Air Crafts.

**Learning Outcome & Suggested Student Activities:**

*At the end of the chapter, student can able to understand the terminologies associated with refrigeration and also understand the basic principles of Refrigeration and applications. Student can also know the aspects of various natural refrigeration methods; understand the components of Air refrigeration system and the necessity of air craft refrigeration.*

*The following URLs are very useful to the students*

*<http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20%20Lecture%201.pdf>*

*<http://www.ignou.ac.in/upload/Unit%201-32.pdf>*

*<http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20Lecture%209.pdf>*

**UNIT II**

Vapour Compression Refrigeration ( VCR ) System – Basic Cycle - Working Principle and Essential Components of The Plant – COP – Representation of Cycle On T-S and P-h Charts – Expander Vs. Throttling, Effect of Sub Cooling and Super Heating – Cycle

Analysis – Actual Cycle- Influence of Various Parameters on System Performance – Construction and Use of P-h Charts – Numerical Problems.

Refrigerants – Desirable Properties – Classification of Refrigerants Used – Nomenclature- Secondary Refrigerants- Lubricants – Ozone Depletion – Global Warming- Newer Refrigerants.

**Learning Outcome & Suggested Student Activities:**

*After the completion of the chapter, student can know the purpose and function of each of the components in the domestic refrigerator, analyzing the concepts of sub-cooling and super heating to improve the COP and also necessity of replacements for CFCs and HCFCs with new refrigerants. Following URLs are highly useful to the students*

*[http://www.nptel.iitm.ac.in/courses/IITMADRAS/Applied\\_Thermodynamics/Module\\_6/6\\_Simple\\_Vapor\\_Compression\\_RS.pdf](http://www.nptel.iitm.ac.in/courses/IITMADRAS/Applied_Thermodynamics/Module_6/6_Simple_Vapor_Compression_RS.pdf)*

*[http://www.mcquay.com/mcquaybiz/literature/lit\\_ch\\_wc/AppGuide/AG31-007.pdf](http://www.mcquay.com/mcquaybiz/literature/lit_ch_wc/AppGuide/AG31-007.pdf)*

### UNIT III

Vapor Absorption Refrigeration ( VAR ) System – Description and Working of NH<sub>3</sub> – Water System and Li Br –Water ( Two Shell & Four Shell) System -Calculation of Max COP, Principle of Operation of Three Fluid Absorption System.

Steam Jet Refrigeration System: Working Principle and Basic Components-Estimation of Motive Steam Required, Principle and Operation of: (I) Thermo-Electric Refrigerator (II) Vortex Tube OrHilsch Tube.

**Learning Outcome & Suggested Student Activities:**

*After the completion of the chapter, student can know the purpose and function of each of the basic components of the absorption refrigeration system. Student can have knowledge on latest developments of Electrolux, thermo electric vortex tube methods. Following URLs are highly useful to the students*

*<http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20Lecture%2014.pdf>*

*[http://en.wikipedia.org/wiki/Thermoelectric\\_cooling](http://en.wikipedia.org/wiki/Thermoelectric_cooling)*

### UNIT IV

Introduction to Air Conditioning: Psychrometric Properties & Processes – Characterization of Sensible and Latent Heat Loads — Need For Ventilation, Consideration of Infiltrated Air – Heat Load Concepts.

Air Conditioning Systems: Air Cooler (Evaporative Cooling) ,Window, Split, Summer , Winter, Year Round, Central Air Conditioning Systems.

**Learning Outcome & Suggested Student Activities:**

*After the end of the chapter, student can have knowledge on the use of psychrometric terms in Air conditioning. Student can learn the use of psychrometric chart to know psychrometric properties of air. Student can able to understand the terms sensible heat load and latent heat load. This technical information is fundamental to all types of*

domestic, commercial and industrial systems for the calculations of heat loads. Student is advised to conduct experiment on A.C tutor in the laboratory. Following URLs are highly useful to the students

<http://server.fst.uga.edu/kerr/FDST%204060/pdf%20files/7%20Psychrometrics.pdf>

<http://people.eng.unimelb.edu.au/mjbrear/436-432/chapter%208%20-%20psychrometry.pdf>

<http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/R&AC%20Lecture%2031.pdf>

## UNIT V

Air Conditioning Equipment - Humidifiers – Dehumidifiers – Air Filters, Fans and Blowers.

Human Comfort: Requirements of Temperature, Humidity And Concept of Effective Temperature, Comfort Chart.Heat Pump – Heat Sources – Different Heat Pump Circuits.

### **Learning Outcome & Suggested Student Activities:**

After the completion of the chapter, student can understand the components of A/C system and describe the cooling equipment combinations. Student can describe the concept of human comfort chart and the processes by which the body produces and rejects heat. Student can be familiar with the Heat pump circuit analysis. Following URLs are highly useful to the students

Effective temp- <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/R&AC%20Lecture%2029.pdf>

[http://courses.washington.edu/me333afe/Comfort\\_Health.pdf](http://courses.washington.edu/me333afe/Comfort_Health.pdf)

<http://web.me.unr.edu/me372/Spring2001/Heat%20Pumps.pdf>

### **Text Books:**

1. Refrigeration and Air Conditioning ,CP Arora, TMH, 15<sup>th</sup> edition, 2013.
2. A Course in Refrigeration and Air conditioning, S.C.Arora&Domkundwar, Dhanpatrai

### **Reference Books:**

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age, 2<sup>nd</sup> edition, 2013
2. Principles of Refrigeration - Dossat / Pearson Education, 4<sup>th</sup> edition, 2007.
3. Refrigeration and Air Conditioning-P.L.Ballaney, 2<sup>nd</sup> edition, 2012.
4. Basic Refrigeration and Air-Conditioning – P.N.Ananthanarayanan / TMH, 4<sup>th</sup> edition, 2013.

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**NOTE:** Tables/Codes: Thermal Engineering Data Book containing Réfrigérant and Psychrometric property Tables and charts are permitted in Exam

**Suggestions:**

The entire syllabus is covered in the text book –“ A Course in Refrigeration and Air conditioning “ by Domkundwar, Arora, Dhanpatrai Publications ( Highly useful book for GATE exam and other Government /Private sector competitive examinations)

Students can visit the nearby small scale Industries like Ice Plants to understand the principles of production of Ice and to observe the other simple components for practical understanding. Student is also advised to visit domestic refrigerator manufacturing industries/ Centralized and Split A/C system units.

Students are advised to watch the video lectures in the website - <http://nptel.iitm.ac.in>  
The fundamental concepts of Thermodynamics, Psychrometrics etc., are required for better understanding of this subject.

**Web Resources:**

<http://www.refrigerationbasics.com/index.htm> <http://www.howstuffworks.com/ac.htm>

<http://www.ashrae.org>

<http://www.taftan.com/thermodynamics/AIRCOND.HTM>

<http://www.wisegeek.com/how-does-air-conditioning-work.htm>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech IV-I Sem. (ME)

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**15A03705 TOOL DESIGN  
(CBCC- II)**
**Course Objective:**

*To make the students to understand the design of single point cutting tool.*

*To learn about the design of drilling tool, tool wear Machinability index and tool life.*

*To make the students to understand jigs and fixtures, design principle of jigs and fixtures, locating and clamping principles.*

*To learn about the sheet metal operations, Design forming ,drawings ,Bending and drawing dies, forming dies.*

*To make the students to understand plastics commonly used as tooling material.*

**UNIT I**

Tool materials: Ferrous, non ferrous, materials, heat treatment, plastics Classification of moulds used in processing of plastics, Design of injection, blow, and compression moulds.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit, students are able to understand the fundamentals of plastics as tooling materials, processing of plastics for tooling materials, heat treatment of materials, ferrous, nonferrous, non metallic, tooling materials.*

**UNIT II**

Design of single point cutting tools: Single point, cutting tools-various systems of specifications, geometry and their interrelation, theories of formation of chip and their effect.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand single point cutting tool geometry and its design theory of chip formation.*

**UNIT III**

Design of multipoint cutting tools: Drill geometry, Design of Drills, Rake & Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, milling cutters, cutting speeds and feed-machining times-design-form cutters, combination tools, reamers etc.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the drilling tool geometry and its design. Tool life, machinability and tool wear.*

**UNIT IV**

Design of jigs and fixtures: Basic principles of location and clamping, locating, methods and devices, jigs, definitions, types, general consideration in the design of jigs, drills bushing, methods of construction, fixtures-vice fixtures milling, boring, and lathe grinding fixtures.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the design of Jigs and fixtures and advantages and disadvantages of Jigs and fixtures, types of Jigs & Fixtures – Principles of location and clamping. Some examples of jigs and fixtures.*

**UNIT V**

Design of sheet metal blanking and piercing: Fundamentals of die cutting operating, power press- types, General press information, Material handling equipment, cutting action in punch and die operation. Die clearance, and types of Die construction. Die design fundamentals-blanking and piercing die construction, pilots, stripper and pressure pads presswork material, strip layout.

Design of sheet metal bending, forming and drawings die: Bending dies, drawing dies, forming dies, drawing operations, variables that effect metal flow during drawing. Determination of blank size, drawing force, single and double action draw dies.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the press working operations like punching, blanking, bending, drawing and forming, types of power presses, design of die, strip layout*

**Text Books:**

1. *Tool Design, Donaldson, Lecain and Goold, Tata McGraw Hill, 4<sup>th</sup> edition, 2012.*
2. *Principles of Metal cutting, A Bhattacharya, New Central Book Agency, Calcutta*
3. *ASTME Hand book on Tool Design.*

**Reference Books:**

1. *Production Engineering Design (Tool Design) , SurendraKenav and Umesh 'Chandra, Satyaprakashan, New Delhi 1994..*
2. *Design of cutting Tools. Use of Metal Cutting Theory. ASTME publication Michigan USA, 1969. Amitabha Battacharya*

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech IV-I Sem. (ME)**

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**15A03706 MODERN MANUFACTURING METHODS  
(CBCC- II)**
**UNIT I**

Need for Modern Manufacturing Methods: Non-traditional machining methods and rapid prototyping

methods - their relevance for precision and lean manufacturing.

Classification of non-traditional processes - their selection for processing of different materials and the range of applications.

Introduction to rapid prototyping - Classification of rapid prototyping methods - stereolithography, fused deposition methods - materials, principle of prototyping and various applications.

**UNIT II**

Ultrasonic machining – Elements of the process, mechanics of material removal, process parameters, applications and limitations.

Abrasive jet, Water jet and abrasive water jet machining: Basic mechanics of material removal, descriptive of equipment, process variables, applications and limitations.

**UNIT III**

Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, metal removal rate in ECM, Tooling, process variables, applications, economic aspects of ECM.

Chemical Machining: Fundamentals of chemical machining- Principle of material removal- maskants – etchants- process variables, advantages and applications.

**UNIT IV**

Thermal Metal Removal Processes: Basic principle of spark erosion (EDM), Wire cut EDM, and Electric Discharge Grinding processes - Mechanics of machining, process parameters, selection of tool electrode and dielectric fluids, choice of parameters for improved surface finish and machining accuracy -

Applications of different processes and their limitations.

Plasma Machining: Principle of material removal, description of process and equipment, process

variables, scope of applications and the process limitations.



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**UNIT V**

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes - process mechanics, parameters, applications and limitations. Laser Beam Machining: Process description, Mechanism of material removal, process parameters, capabilities and limitations, features of machining, applications and limitations.

**Text Books:**

1. *Advanced machining processes*, VK Jain, Allied publishers.
2. *Manufacturing processes for engineering materials* by Serope Kalpakjian and Steven R Schmid, 5edn, Pearson Pub.

**Reference Books:**

1. *New Technology*, Bhattacharya A, The Institution of Engineers, India 1984
2. *Manufacturing Technology*, Kalpakzian, Pearson
3. *Modern Machining Process*, Pandey P.C. and Shah H.S., TMH.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech IV-I Sem. (ME)

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**15A03707 COMPUTATIONAL FLUID DYNAMICS  
(CBC- III)**
**Course Objective:**

*This course covers topics related to Computational Fluid Dynamics (CFD). CFD is an important tool in engineering analysis and design of fluid systems. In this course Students will develop the equations describing fluid flow and numerical solutions to these equations. Emphasis will be placed on understanding different approaches employed for both time and spatial discretization and how to evaluate these approaches. Students will look at time accurate and steady-state methods, explicit and implicit techniques, laminar and turbulent flow, compressible and incompressible approaches, stability considerations, etc. These techniques will be applied to applications of mixing and heat transfer.*

**UNIT I**

INTRODUCTION: Methods to solve a physical problem , numerical methods , brief comparison between FDM, FEM & FVM, applied numerical methods. Solution of a system of simultaneous linear algebraic equations, Iterative schemes of matrix inversion, direct methods for matrix inversion, direct methods for banded matrices. Finite difference applications in heat conduction and convection, heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer.

**Learning outcome & Suggested Student Activities:**

*This chapter gives the overall view of the various kinds of numerical methods adopted. It also discusses about various solutions for the numerical methods adopted in CFD. The applications of finite difference methods with examples in conduction and convective heat transfer are introduced.*

**UNIT II**

FINITE DIFFERENCES: Discretization, consistency, stability, and fundamentals of fluid flow modeling. Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

**Learning outcome & Suggested Student Activities:**

*This chapter gives how to discretize partial differential equations, including the governing flow equations which is the foundation for the finite difference method. Explicit and implicit approaches represent the fundamental distinction between various numerical techniques.*

**UNIT III**

ERRORS AND STABILITY ANALYSIS: introduction, first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme.

REVIEW OF EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER: Introduction, Conservation of mass Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier stokes equations.

**Learning outcome & Suggested Student Activities:**

*This chapter focuses on numerical errors that are generated and how the numerical calculations become unstable and also entails the conservations of mass, momentum and energy equations to the fluid flow along with Navier stokes equation.*

**UNIT IV**

STEADY FLOW: Dimensions form of momentum and energy equations, navier stokes equation, and conservative body force fields, stream function, vorticity formulation, boundary, layer theory, buoyancy, driven convection and stability.

**Learning outcome & Suggested Student Activities:**

*This unit gives the fundamental principles of fluid mechanics, its governing differential equations and boundary conditions.*

**UNIT V**

SIMPLE CFD TECHNIQUES: Viscous flows conservation form space marching, relocation techniques, viscous flows, conservation from space marching relocation techniques, artificial viscosity, the alternating direction implicit techniques, pressure correction technique, computer graphic techniques used in CFD. Quasi one dimensional flow through a nozzle, turbulence models, standard and high reynolds number models and their applications.

**Learning outcome & Suggested Student Activities:**

*This unit gives the information about some techniques for numerical solutions for flow problems. These equations are applicable to time and space marching solutions especially parabolic hyperbolic and elliptic equations.*

**Text Books:**

1. Computational Fluid Dynamics, J Chung (2010), 2nd edition, Cambridge University Press, India.
2. Computational Fluid Dynamics, John .D. Anderson (2010), 3rd edition, McGraw- Hill International Edition, India.

**Reference Books:**

1. *Computational Fluid Mechanics and Heat Transfer*, Ronnie Anderson, 3rd edition, CRC Press, Special Indian Edition.
2. *Computational aerodynamics and fluid dynamics an introduction*, Jean-Jacques Chattot (2010), 3rd edition, Springer, Germany.
3. *Essential computational fluid Dynamics* – olegzikanov, wiley India.
4. *Introduction to computational fluid dynamics* – pradip, Niyogi S.K. Chakrabary, M.K. Laha – pearson.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech IV-I Sem. (ME)

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**15A03708      AUTOMATION AND ROBOTICS  
(CBCC- III)**

**Course Objective:**

*The subject should enable the students to understand the principles of automation, importance of automated flow lines and its types.*

*To learn the concepts of Robotics, kinematics of robot, principles of robot drives and controls, sensors used in robots and programming methods.*

**UNIT I**

Introduction to Automation: Need, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation.

Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand to know what is automation, types of automation, components of automation, strategies and levels of automation. Student is advised to visit URLs <http://www.nptel.iitm.ac.in/and iitb.ac.in> , <http://www.learnerstv.com/video/Free-video-Lecture-30103-Engineering.htm> for video lectures.*

**UNIT II**

Automated flow lines: Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage.

Assembly line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the types of flow lines, quantitative analysis of flow lines, how the assembly is carried out on automated flow line without interruption and how to balance the line and flexible assembly lines.*

*Student is advised to visit URLs*

*<http://www.nptel.iitm.ac.in/and iitb.ac.in>,*

*<http://www.learnerstv.com/video/Free-video-Lecture-30103-Engineering.htm> for video lectures.*

**UNIT III**

Introduction to Industrial Robotics: Classification of Robot Configurations, functional line diagram, degrees of freedom. Components common types of arms, joints grippers, factors to be considered in the design of grippers.

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading - Process - spot and continuous arc welding & spray painting - Assembly and Inspection.

**Learning outcome & Suggested Student Activities:**

*Student should come to know the various components in the anatomy of robot. By knowing this the student may apply in the design of new robotic structure. Student is advised to visit URLs*

*<http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm>*

**UNIT IV**

Manipulator Kinematics: Homogenous transformations as applicable to rotation and transition - D-H notation, Forward inverse kinematics.

Robot actuators and Feedback components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand the applications of various types of end effectors, and sensor devices. Student should also learn about the homogeneous transformations and its applications in the analysis of a robotic structure and method of developing different types of mechanisms and kinematics of the robot. Student is advised to visit URLs*

*<http://www.nptel.iitm.ac.in> , <http://www.iitb.ac.in> , <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm>*

**UNIT V**

Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton - Euler formations. Trajectory Planning: Trajectory Planning and avoidance of obstacles path planning, skew motion, joint integrated motion - straight line motion.

**Learning outcome & Suggested Student Activities:**

*After completion of this unit students are able to understand robot programming languages which may adopt in different applications of robot. Student also knows the control motion mechanism in all devices of robot and application of robots in manufacturing sector. Student is advised to visit URLs*

*<http://www.nptel.iitm.ac.in> and <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm>*

**Text Books:**

1. *Automation , Production systems and CIM*,M.P. Groover/Pearson Edu.
2. *Industrial Robotics - M.P. Groover, TMH.*

**Reference Books:**

1. *Robotics , Fu K S, McGraw Hill, 4<sup>th</sup> edition, 2010.*
2. *An Introduction to Robot Technology, P. Coiffet and M. Chaironze, Kogam Page Ltd. 1983 London.*
3. *Robotic Engineering , Richard D. Klafter, Prentice Hall*
4. *Robotics, Fundamental Concepts and analysis – AshitaveGhosal,Oxford Press, 1/e, 2006*
5. *Robotics and Control , Mittal R K &Nagrath I J , TMH.*
6. *Introduction to Robotics – John J. Craig,PearsonEdu*

**Web References:**

[http://www.cadcamfunda.com/cam\\_computer\\_aided\\_manufacturing](http://www.cadcamfunda.com/cam_computer_aided_manufacturing)  
<http://wings.buffalo.edu/eng/mae/courses/460-564/Course-Notes/cnc-classnotes.pdf>  
<http://nptel.iitm.ac.in/courses.php?branch=Mechanical>  
<http://academicearth.org/courses/introduction-to-roboticsVideo>  
references:-<http://nptel.iitm.ac.in/video.php?courseId=1052>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech IV-I Sem. (ME)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**15A03709 PRODUCTION AND OPERATIONS MANAGEMENT  
(CBCC- III)**
**Course Objective:**

*To make the students understand the functions of production planning & controls, generating of new products, issues in product design and strategies of aggregate planning. To provide the knowledge on principles of forecasting, forecasting methods, types and its accuracy. To provide the knowledge on facilities location, various types layouts and assembly line balancing. To provide the knowledge on lean management, concepts of JIT, six sigma, quality control, MRP,ERP and LOB. To make the students understand the inventory management and scheduling techniques.*

**UNIT I**

Functions of Production Planning & Controls operations & productivity, productivity measurement, Design of goods and services: selection, generating new products, product development, issues in product design. Strategies for aggregates planning, aggregate planning using O.R. Models, Chase planning, Expediting, controlling aspects.

**Learning Outcome & Suggested Student Activities:**

*At the end of this unit students can get the concepts on Production planning & controls operations and its functions, productivity and productivity measurements, design of goods and services and aggregate planning. Students are advised to visit following URLs*

*[http://www.nptel.iitm.ac.in/courses/IIT-MADRAS/Management\\_Science\\_II/Pdf/3\\_5.pdf](http://www.nptel.iitm.ac.in/courses/IIT-MADRAS/Management_Science_II/Pdf/3_5.pdf). And also well documented note is available in pdf form at the following links.*

*[www.processprotocol.com/extranet/documents/pdf/.../production1.pdf](http://www.processprotocol.com/extranet/documents/pdf/.../production1.pdf)*

*[elearning.dbhosting.net/.../Production%20Planning%20And%20Control](http://elearning.dbhosting.net/.../Production%20Planning%20And%20Control)*

*<http://www.academicearth.org/lectures/product-development-process-observation>*

**UNIT II**

Forecasting – Importance of forecasting – Types of forecasting, their uses – General Principles of forecasting – Forecasting techniques – qualitative methods and quantitative methods – accuracy of forecasting methods. Scheduling Policies – Techniques, flow shop and job shop Scheduling techniques.



**Learning Outcome & Suggested Student Activities:**

Students can understand the importance of forecasting, uses of long term and short term forecasting and application of qualitative and quantitative methods for finding the future demands. Students are advised to refer the text book *Forecasting: Methods and Applications* Spyros G. Makridakis, Steven C. Wheelwright, Rob J Hyndman. For video lectures advised to visit following URLs <http://www.learnerstv.com/video/Free-video-Lecture-2496-Management.htm>; [http://www.slideshare.net/jrdn\\_27/qualitative-and-quantitative-methods-of-research](http://www.slideshare.net/jrdn_27/qualitative-and-quantitative-methods-of-research)

**UNIT III**

Factors affecting facilities location, mathematical models for facilities, location, Types of facilities- layout: product layout, process layout, group technology layout, Assembly line balancing, computerized layout: ALDEP, CRAFT, CORELAP.

**Learning Outcome & Suggested Student Activities:**

At the end of the unit the student will be able to understand where the plant is to be located based on facilities available and what are the important factors affecting the facilities location of a plant, and plant layout. And also able to understand plant layout design to facilitate material flow and processing of a product in the most efficient manner through the shortest possible time. Can compare the rural & urban sites, methods of selection. The following URLs are useful to the students  
<http://www.slideshare.net/satya4/plant-layout-16143741>  
<http://freevideolectures.com/Course/2371/Project-and-Production-Management/32>  
<http://www.tcyonline.com/video-tutorials-computerised-layout-planning/101568>

**UNIT IV**

Lean Management, philosophy and creation of lean enterprise, JIT concepts-Kanban System-Elements of total quality management, Six Sigma Quality Control. MRP, –lot sizing techniques in MRP, introduction to ERP, LOB (Line of Balance).

**Learning Outcome & Suggested Student Activities:**

Students can understand the how philosophy of lean management applied to develop lean enterprise and basic concepts JIT, Six sigma control etc., Students are advised to visit the following URLs <http://www.learnerstv.com/video/Free-video-Lecture-6944-Management.htm>; <http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-852j-integrating-the-lean-enterprise-fall-2005/lecture-notes/>  
<http://freevideolectures.com/Course/2688/Human-Resource-Management/13>

**UNIT V**

Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – various models Simple Problems.

**Learning Outcome & Suggested Student Activities:**

At the end of the unit the student will be able to understand the scheduling policies, flow shop and job shop scheduling techniques and concepts of Inventory, Classification, Functions, it's associated costs etc., and also able to recognize the importance of Inventory control to ensure their availability with minimum capital lock up. The following URLs are useful to the students.

<http://www.technologyevaluation.com/search/for/inventory-management-pdf.html>

<http://freevideolectures.com/Course/3096/Operations-and-Supply-Chain-Management/10>

**Text Books:**

1. *Production and Operations Management*, Ajay K Garg, McGrawHill, 2015
2. *Operation Management* by B. Mahadevan, PearsonEdu.
3. *Operation and O.M* by Adam & Ebert- PHI Pub.,

**Reference Books:**

1. *Operations Management* – S.N. Chary.
2. *Modern Production , Operations Management ,* Baffa&Rakesh Sarin.
3. *Production Control A Quantitative Approach ,* John E. Biegel.
4. *Production Control ,* Moore.
5. *Operations Management ,* Joseph Monks.
6. *Operation Management* by Jay Heizar& Read new Pearson
7. *Elements of Production Planning and Control,* Samuel Eilon.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech IV-I Sem. (ME)**

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**15A03710 CAD/CAM LABORATORY****LIST OF EXPERIMENTS:**

- I. 2D Drafting using Auto CAD or any drafting package
- II. 3D Modeling :
  1. Modeling of Component in 3D – V block
  2. Modeling of Component in 3D – Open Bearing
  3. Modeling of Component in 3D – Angular block
  4. Modeling of Component in 3D – Dovetail Guide
  5. Modeling of Component in 3D – Dovetail Bracket
  6. Modeling of Component in 3D – Tool post

Geometric Modeling may be done Using Auto CAD or Pro-E or CATIA or Solid Works or Iron CAD

## III. Assembly Modeling:

1. Assembly of a screw jack parts
2. Assembly of a knuckle joint
3. Assembly of a Oldham's coupling
4. Assembly of a footstep bearing
5. Assembly of a stuffing box
6. Assembly of a square tool post

## IV. Machining of Simple Components on CNC Lathe and CNC Milling Machine.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech IV-I Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>15A03711</b>	<b>METROLOGY &amp; MEASUREMENTS LABORATORY</b>			

Any 6 experiments from each section

**Section A:**

1. Measurement of bores by internal micrometers and dial bore indicators.
2. Use of gear teeth vernier calipers and checking the chordal addendum and chordal height of spur gear.
3. Alignment test on the lathe and milling machine
4. Study of Tool makers microscope and its application
5. Angle and taper measurements by Bevel protractor, Sine bars, spirit level etc.
6. Thread measurement by Two wire/ Three wire method.
7. Surface roughness measurement by Talysurf instrument.
8. Use of straight edge and spirit level in finding the flatness of surface plate.

**Section B:**

1. Calibration of Pressure Gauges
2. Calibration of transducer or thermocouple for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Study and calibration of capacitive transducer for angular measurement.
5. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
6. Study and calibration of a rotometer for flow measurement.
7. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
8. Study and calibration of McLeod gauge for low pressure.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech IV-II Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>
<b>15A03801</b>	<b>INDUSTRIAL ENGINEERING</b>			
	<b>(MOOCS-II)</b>			

**UNIT I**

Concepts of Management-Administration and Organization – Functions of Management – Schools of Management Thought: Taylor's Scientific Management, Fayol's Principles of Management, Douglas Mc-Gregor's Theory X and Y, Mayo's Hawthorne Experiments, Herzberg's Two factor Theory of Motivation, Maslow's Hierarchy of Human needs – Systems Approach to Management. Organizational Structures- Functional- Divisional- Matrix etc., Basic Concepts Related to Organization – Departmentation and Decentralization and their Merits, Demerits and Suitability

**UNIT II**

Plant Location: Definition, Factors affecting the Plant Location, Comparison of Rural and Urban sites, Selection of Plant Location – Types of Production; Plant Layout: Definition, Objectives, Types of Plant Layout - Materials Handling: Functions- Objectives – Types, Selection Criteria of Material Handling Equipment.

**UNIT III**

Work Study – Definition, Objectives, Method Study – Steps Involved – Various Types of Process Charts –Micro motion and Memo motion Studies. Work Measurement - Definition, Time Study, Steps involved - Equipment, Different Methods of Performance Rating - Allowances, Standard Time Calculation. Work Sampling - Definition, Steps Involved, Standard Time Calculations - Applications.

**UNIT IV**

Inventory Models- Deterministic models- EOQ Models – With and Without Shortages Models; Inventory Models with Price Breaks -Probabilistic Models –Discrete Variable, Continuous Variable. Inventory Control Systems

**UNIT V**

Inspection & Quality Control: Statistical Quality Control- Techniques-Variables and Attributes- Control Charts: X and R Charts; P Charts and C Charts. Acceptance Sampling Plan - Single Sampling and Double Sampling Plans- OC Curves. Introduction to TQM- Quality circles-BIS & ISO Standards-Importance .

**Text Books:**

1. Manufacturing Organization and Management, T.Amrine/ Pearson, 2nd Edition, 2004
2. Industrial Engineering and Management ,O.P.Khanna, DhanpatiRai, 18th edition, 2013.
3. Industrial Engineering and Management, Dr. C.Nadamuni Reddy, New Age International Publishers, 1<sup>st</sup> edition, 2011.

**Reference Books:**

1. *Industrial Engineering and production management, MartindTelsang S.Chand..*
2. *Work Study by ILO(International Labour Organization)*
3. *Management by James AF Stoner, Freeman 6th Ed, Pearson Education, New Delhi,2005*
4. *Production and Operations management, PanneerSelvam, PHI,2004.*
5. *Statistical Quality Control by EL Grantt, McGrawhil*
6. *Motion and time studies by Ralph M Barnes, John Wiley and Sons,2004*

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech IV-II Sem. (ME)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>
<b>15A03802 PRODUCT DESIGN (MOOCS-II)</b>				

**Course Objective:**

*To make the students understand the product development process, requirements setting, conception design,, embodiment design principles, to understand the basics of mechatronics and adaptronics.*

**UNIT I****PRODUCT DEVELOPMENT PROCESS**

General problem solving process - Flow of Work during the process of designing - Activity Planning Timing and scheduling, Planning Project and Product Costs - Effective Organization Structures - Interdisciplinary Cooperation, Leadership and Team behavior.

**UNIT II****TASK CLARIFICATION**

Importance of Task Clarification - Setting up a requirements list - Contents, Format, Identifying the requirements, refining and Extending the requirements, Compiling the requirements list, Examples. Using requirements lists - Updating, Partial requirements lists, Further uses - Practical applications of requirements lists.

**UNIT III****CONCEPTUAL DESIGN**

Steps in Conceptual Design.

Abstracting to identify the essential problems - Aim of Abstraction, Broadening the problem. Formulation, Identifying the essential problems from the requirements list, Establishing functions structures, Overall function, Breaking a function down into sub-functions.

Developing working structures - Searching for working principles, Combining Working Principles, Selecting Working Structures, Practical Application of working structures.

Developing Concepts - Firming up into principle solution variants, Evaluating principle solution variants, Practical Applications of working structures.

Examples of Conceptual Design - One Handed Household Water Mixing Tap, Impulse - Loading Test Rig.

**UNIT IV**

EMBODIMENT DESIGN - Steps of Embodiment Design, Checklist for Embodiment Design Basic rules of Embodiment Design Principles of Embodiment Design - Principles of Force Transformations, Principles of Division of Tasks, Principles of Self-Help, Principles of Stability and Bi-Stability, Principles of Fault-Free Design

Guide for Embodiment Design - General Considerations, Design to allow for expansion, Design to allow for creep and relaxation, Design against Corrosion, Design to minimize wear, Design to Ergonomics, Design for Aesthetics, Design for Production, Design for Assembly, Design for Maintenance, Design for Recycling, Design for Minimum risk, Design to standards.

Evaluation of Embodiment Designs.

**UNIT V**

MECHANICAL CONNECTIONS, MECHATRONICS AND ADAPTRONICS

Mechanical Connections - General functions and General Behavior, Material connections, From Connections, Force connections, Applications.

Mechatronics - General Architecture and Terminology, Goals and Limitations, Development of Mechatronic Solution, Examples.

Adaptronics - Fundamentals and Terminology, Goals and Limitations, Development of Adaptronics Solutions, Examples.

**Text Books:**

1. *Engineering Design: G.Paul; W. Beitzetal, Springer International Education 2010.*
2. *Product Design And Development: Kevin Otto: K. Wood Pearson Education 2016.*

**Reference Books:**

1. *Product Planning Essentials: Kenith B. Kahu, Yes dee Publishing 2011.*
2. *Product Design and Development: K.T. Ulrich TMH Publishers 2011.*



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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech IV-II Sem. (ME)**

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**15A03803 COMPOSITE MATERIALS  
(MOOCS-II)**
**Unit-I**

**Introduction to Composite Materials:** Introduction, Classification: Polymer Matrix Composites. Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber. Reinforced Composites and nature-made composites, and applications

**Reinforcements:** Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and boron carbide. fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosets, Metal matrix and ceramic composites.

**Unit-II**

**Manufacturing methods:** Autoclave curing, tape production, moulding methods, filament winding, hand layup, pultrusion, RTM. Compression moulding, tape winding.

**Macromechanical Analysis of a Lamina:** Introduction ,Definitions: Stress, Strain ,Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, Plane Stress Assumption, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

**Unit-III**

**Micromechanical Analysis of a Lamina:** Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi Empirical Models ,Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion, Coefficients of Moisture Expansion

**UNIT-IV**

**Macromechanical Analysis of Laminates:** Introduction, Laminate Code, Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate , Hygrothermal Effects in a Laminate, Warpage of Laminates

**UNIT-V**

**Failure Analysis and Design of Laminates:** Introduction, Special Cases of Laminates, Failure Criterion for a Laminate.

**Text Books:**

1. Engineering Mechanics of Composite Materials- Isaac and M Daniel, Oxford University Press, 1994.
2. Mechanics of Composite Materials, R. M. Jones, Mc Graw Hill Company, New York, 1975.

**References:**

1. Analysis and performance of fibre Composites, B. D. Agarwal and L. J. Broutman Wiley- Interscience, New York, 1980.
2. Mechanics of Composite Materials, Second Edition (Mechanical Engineering)- Autar K. Kaw, Publisher: CRC
3. Finite Element Analysis of Composite Materials, Ever J. Barbero , CRC Press, 2007.
4. Analysis of Laminated Composite Structures, L. R. Calcote, Van Nostrand Rainfold, New York, 1969.
5. Mechanics of Composite Materials and Structures, Madhujit Mukhopadhyay, University Press, 2009.
6. Composite Materials Science and Engineering, Krishan K. Chawla, Springer, 2009

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**B. Tech IV-II Sem. (ME)**

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**15A03804 POWER PLANT ENGINEERING  
(MOOCS-III)**
**UNIT I**

Introduction To The Sources Of Energy – Resources and Development of Power in India. Layouts of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power Cycles - Comparison and Selection, Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor – Tariff - Related Exercises. Effluents from Power Plants and Impact on Environment – Pollutants and Pollution Standards – Methods of Pollution Control. Inspection And Safety Regulations.

**UNIT II**

Steam Power Plant : Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Steam Power Plant : Combustion Process : Properties of Coal – Overfeed and Under Feed Fuel Beds, Traveling Grate Stokers, Spreader Stokers, Retort Stokers, Pulverized Fuel Burning System And Its Components, Combustion Needs and Draught System, Cyclone Furnace, Design and Construction, Dust Collectors, Cooling Towers And Heat Rejection. Analysis of Pollution from Thermal Power Plants - Pollution Controls.CO2 Recorders

**UNIT III**

Diesel Power Plant: Diesel Power Plant: Introduction – IC Engines, Types, Construction– Plant Layout with Auxiliaries – Fuel Storage Gas Turbine Plant : Introduction – Classification - Construction – Layout With Auxiliaries – Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

**UNIT IV**

Hydro Electric Power Plant: Water Power – Hydrological Cycle / Flow Measurement – Drainage Area Characteristics – Hydrographs – Storage and Pondage – Classification of Dams and Spill Ways.

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Hydro Projects and Plant: Classification – Typical Layouts – Plant Auxiliaries – Plant Operation Pumped Storage Plants. .

## **UNIT V**

Power from Non-Conventional Sources: Utilization of Solar Collectors- Principle Of its Working, Wind Energy – Types of Turbines – HAWT & VAWT-Tidal Energy. MHD power Generation.

Nuclear Power Station: Nuclear Fuel – Nuclear Fission, Chain Reaction, Breeding and Fertile Materials – Nuclear Reactor – Reactor Operation.

Types of Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast

breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding –

Radioactive Waste Disposal.

### **Text Books:**

1. *Power plant Engineering*, P.K. Nag, TMH, 3rd edition, 2013.
2. *A course in power plant Engineering*, Arora and S. Domkundwar.

### **Reference Books:**

1. *A Text Book of Power Plant Engineering*, Rajput, Laxmi Publications, 4th edition, 2012.
2. *Power plant Engineering*, Ramalingam, Scietech Publishers
3. *power plant engineering* P.C. Sharma, S.K. Kataria Publications, 2012.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech IV-II Sem. (ME)</b>	<b>L T P C</b>
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**15A03805 GAS TURBINES AND JET PROPULSION  
(MOOCS- III)**

**UNIT-I**

Gas Turbine Operating Cycles: Simple open cycle gas turbine or air standard Brayton cycle, Actual Brayton cycle, the cycle air flow rate, the cycle work ratio, optimum pressure ratio or maximum cycle thermal efficiency, means of improving the efficiency and the specific out put of simple cycle.

**UNIT-II**

Gas Turbines; gas turbine applications, gas turbine advantages & disadvantages, energy flow & back work, deviation from ideal cycle, gas turbine with regeneration, thermal efficiency of gas turbine with & without regenerator, gas turbine engines, inter-cooling & reheating, turbojet engine, turbofan engine, turboprop engine.

**UNIT-III**

**Jet propulsion:** Historical sketch- reaction principle- essential features of propulsion devices- Thermal jet engines, classification of – energy flow, thrust, thrust power and propulsion efficiency- need for thermal jet engines and applications.

Turboprop and turbojet – thermodynamic cycles, plant layout, essential components, and principles of operation – performance evaluation – thrust augmentation and Thrust reversal – contrasting with piston engine propeller plant.

**UNIT-IV**

Ram jet- Thermo dynamic cycle, plant lay out, essential components – principle of operation – performance evaluation – comparison among atmospheric thermal jet engines- serqujet and pulse jet, elementary treatment.

**Rocket Engines:** Need for, applications- basic principle of operation and parameters of performance – classification, solid and liquid propellant rocket engines, advantages, domains of application – propellants – comparison of propulsion systems.

**UNIT-V**

**Rocket Technology:** Flight mechanics, application thrust profiles, acceleration-staging of rockets, need for – feed systems, injectors and expansion nozzles – rocket transfer and ablative cooling.

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Testing & instrumentation - need for Cryogenics – advanced propulsion systems, elementary treatment of Electrical nuclear and plasma Arc Propulsion.

**TEXT BOOKS:**

1. Gas Turbines , V. Ganesan TMGH
2. Gas turbines , cohen , Rogers & Sarvana Muttoo , Addison Wiley & longman

**REFERENCES BOOK:**

1. Thermodynamics of propulsion, Hill & Paterson.
2. Rocket Propulsion , Sutton.
3. Element of Gas Turbines propulsion , Jack D Matingly, MGH

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech IV-II Sem. (ME)

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**15A03806 ENERGY MANAGEMENT  
(MOOCS-III)**
**UNIT - I****ENGINEERING ECONOMICS:**

Managerial objectives - steps in planning- Capital budgeting- Classification of costs- Interest- Types- Nominal and effective interest rates Discrete and continuous compounding - discounting - Time value of money - Cash flow diagrams - Present worth factor, Capital recovery factor, Equal annual payments - Equivalence between cash flows.

**UNIT - II****DEPRECIATION & COST ANALYSIS:**

Aims-Physical depreciation-Functional depreciation- Methods of depreciation-Straight line method, Declining balance method, Sum of years digits method, Sinking fund method, Service output method- Capital recovery with return-Service life estimation- Morality curves. Break even analysis and break even chart- Minimum cost analysis- Benefit cost analysis- Life cycle cost analysis.

**UNIT - III****PROJECT MANAGEMENT:**

Methods of investment appraisal- Rate of return method, Payback period method, Net present value method (NPV)- Internal Rate of Return method(IRR)- Adoption of the methods in energy conservation campaign- Types of projects- Purpose of project management - Classification – Role and qualities of project manager - Types of budgets - Budget committee – budgeting.

**ENERGY MANAGEMENT PROGRAMS:**

Necessary steps of energy management programmer - Concepts of Energy management - General principles of energy management – Energy management in manufacturing and process industries- Qualities and functions of Energy manager - Language of Energy manager-Checklist for top management.

**UNIT - IV****ENERGY AUDITING:**

A definition- Objectives- Level of responsibility- Control of Energy- Uses of Energy checklists - Energy conservation- Energy index - Cost index - Pie charts-sankey diagrams Load profiles - Types of energy audits- Questionnaire - Energy audit of industries - General energy audit- Detailed energy audit - Energy saving potential.

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**UNIT - V****ENERGY POLICY, SUPPLY, TRADE& PRICES:**

Energy resources in India – level of power generation – transmission & distribution of power. Indian energy policy, Energy trade & its economic impacts – domestic energy production – Energy transformation & distribution & energy self sufficiency. International & National crude oil prices – domestic fuel prices – natural gas, LPG, kerosene and firewood - pricing policy.

**TEXT BOOKS:**

1. Energy Management, Murphy W.R and McKay G, , Elsevier, 2007
2. Albert Thumann, Handbook of Energy Audits, The Fairmont Press Inc., Atlanta Georgia, 1979.

**REFERENCES BOOKS:**

1. Albert Thumann, Plant Engineer and Management guide to Energy Conservation, Van Nost and Reinhold Co., Newyork.
2. Energy Audits, E.E.O.-Book-lets, U.K. 1988.
3. Craig B.Smith, “Energy Management Principles”, Pergamon Press.
4. The role of Energy Manager, E.E.O., U.K.
5. The Energy conservation Design Resource Hand Book-The Royal architectural Institute of Canada.
6. Energy Management Hand Book-Ed. By Wayne C. Turner, John Wiley and sons, 1982.





# **Jawaharlal Nehru Technological University Anantapur**

*(Established by Govt. of A.P., Act. No. 30 of 2008)*

**Ananthapuramu–515 002 (A.P) India**

## **B.Tech. in Mechanical Engineering Course Structure and Syllabi under R19 Regulations**

<b>JNTUA Curriculum</b>
<b>Mechanical Engineering B. Tech Course Structure</b>

<b>S.No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P-C</b>
1	Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counselling	MC	2-0-2-0
3	Orientation to all branches -- career options, tools, etc.	MC	3-0-0-0
4	Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

<b>Semester - I (Theory - 3, Lab - 4)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
1.	19A54101	Algebra and Calculus	BS	3-1-0	4
2.	19A51101T	Engineering Chemistry	BS	3-0-0	3
3.	19A05101T	Problem Solving & Programming	ES	3-1-0	4
4.	19A03102	Engineering Graphics Lab	ES	1-0-4	3
5.	19A03101	Engineering Workshop	LC	0-0-2	1
6.	19A51101P	Engineering Chemistry Lab	BS	0-0-3	1.5
7.	19A05101P	Problem Solving & Programming Lab	ES	0-0-3	1.5
<b>Total</b>					<b>18</b>

<b>Semester - II (Theory - 5, Lab - 5)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
1.	19A02201T	Basic Electrical & Electronics Engineering	ES	3-0-0	3
2.	19A54201	Differential Equations and Vector Calculus	BS	3-1-0	4
3.	19A56102T	Engineering Physics	BS	3-0-0	3
4.	19A05201T	Data Structures	ES	3-0-0	3
5.	19A52101T	Communicative English 1	HS	2-0-0	2
6.	19A52101P	Communicative English 1 Lab	HS	0-0-2	1
7.	19A03201	Mechanical Engineering Workshop	LC	0-0-2	1
8.	19A02201P	Basic Electrical & Electronics Engineering Lab	ES	0-0-3	1.5
9.	19A56102P	Engineering Physics Lab	BS	0-0-3	1.5
10.	19A05201P	Data Structures Lab	ES	0-0-3	1.5
<b>Total</b>					<b>21.5</b>

<b>Semester - III (Theory - 7, Lab – 3,MC-1)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
1.	19A54301	Complex Variables, Transforms and PDE	BS	2-1-0	3
2.	19A05304T	Python Programming	ES	2-1-0	3
3.	19A03301T	Manufacturing Processes	PC	3-0-0	3
4.	19A03302	Engineering Mechanics	PC	3-0-0	3
5.	19A03303T	Material Science and Engineering	PC	3-0-0	3
6.	19A99303T	Design Thinking & Product Innovation	ES	2-0-0	2
7.	19A52301	Universal Human Values	HE	2-0-0	2
8.	19A99303P	Design Thinking & Product Innovation Lab	ES	0-0-3	1.5
9.	19A03301P	Manufacturing Processes Lab	PC	0-0-3	1.5
10.	19A03303P	Material Science and Engineering Lab	PC	0-0-3	1.5
11.	19A99301	Environmental Sciences	MC	3-0-0	0
<b>Total</b>					<b>23.5</b>

<b>Semester - IV (Theory - 6, Lab – 2, MC-1)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
1.	19A54304	Numerical Methods and Probability theory	BS	2-1-0	3
2.	19A03401	Thermodynamics	PC	2-1-0	3
3.	19A03402T	Mechanics of Materials	PC	2-1-0	3
4.	19A01407	Fluid Mechanics and Hydraulic Machinery	PC	2-1-0	3
5.	19A05406T	Internet of Things	ES	2-0-2	3
6.	19A03403	Kinematics of Machinery	PC	2-1-0	3
7.	19A03404	Computer Aided Machine Drawing	PC	0-0-3	1.5
8.	19A03402P	Mechanics of Materials Lab	PC	0-0-3	1.5
9.	19A99302	Biology For Engineers	MC	3-0-0	0
<b>Total</b>					<b>21</b>

<b>Semester - V (Theory - 6, Lab – 3, MC-1)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
1.	19A03501T	Applied Thermodynamics	PC	2-1-0	3
2.	19A03502T	Manufacturing Technology	PC	2-0-0	2
3.	19A03503T	Heat Transfer	PC	2-1-0	3
4.	19A03505	Dynamics of Machinery	PC	2-1-0	3
5.	19A03504a	Professional Elective 1 Automobile Engineering	PE	3-0-0	3
	19A03504b	Manufacturing Methods in Precision Engineering			
	19A03504c	Design of Transmission Systems			
	19A03504d	Power Plant Engineering			
	19A03504e	Ergonomics and Human Factors in Engineering			
6.	19A01506a	Open Elective-I Experimental stress analysis.	PE	3-0-0	3
	19A01506b	Building Technology			
	19A02506a	Electrical Engineering Materials			
	19A04506a	Analog Electronics			
	19A04506b	Digital Electronics			
	19A05506a	Free and Open Sources Systems			
	19A05506b	Computer Graphics and Multimedia Animation			
	19A27506a	Brewing Technology			
	19A27506b	Computer Applications in Food Technology			
	19A54506a	Optimization Techniques			
	19A52506a	Technical Communication and Presentation Skills			
19A51506a	Chemistry of Energy Materials				
7.	19A03501P	Applied Thermodynamics Lab	PC	0-0-3	1.5
8.	19A03502P	Manufacturing Technology Lab	PC	0-0-3	1.5
9.	19A03403P	Fluid Mechanics & Hydraulic Machinery Lab	PC	0-0-2	1
10.	19A03507	Socially Relevant Projects (15 Hrs/Sem)	PR	0-0-0.5	0.5
11.	19A99501	Mandatory Course: Constitution of India	MC	3-0-0	0
				<b>Total</b>	<b>21.5</b>

<b>Semester - VI (Theory - 6, Lab – 2, MC-1)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
<b>1.</b>	19A03601	Design of Machine Elements	PC	2-1-0	3
<b>2.</b>	19A03602T	Introduction to CAD/CAM	PC	3-0-0	3
<b>3.</b>	19A52601T	English Language Skills	BS	3-0-0	3
<b>4.</b>	19A03603a	Professional Elective-II (MOOC)	PE	3-0-0	3
	19A03603b	Introduction to Turbo machinery			
	19A03603c	Fundamentals of Additive Manufacturing			
	19A03603d	Introduction to Composites			
	19A03603e	Computational Fluid Dynamics			
<b>5.</b>	19A01604a	Open Elective-II	OE	3-0-0	3
	19A01604b	Industrial waste and wastewater management.			
	19A02604a	Building Services & Maintenance			
	19A02604b	Industrial Automation			
	19A04604a	System Reliability Concepts			
	19A04604b	Basics of VLSI			
	19A05604a	Principles of Communication Systems			
	19A05604b	Fundamentals of VR/AR/MR			
	19A27604a	Data Science			
	19A27604b	Food Toxicology			
	19A54604a	Food Plant Equipment Design			
	19A52604a	Wavelet Transforms & its applications			
	19A51604a	Soft Skills			
	19A51604a	Chemistry of Polymers and Its Applications			
<b>6.</b>	19A52602a	Humanities Elective-I	HS	3-0-0	3
	19A52602b	Entrepreneurship & Incubation			
	19A52602c	Managerial Economics and Financial Analysis			
	19A52602d	Business Ethics and Corporate Governance			
	19A52602e	Enterprise Resource Planning			
<b>7.</b>	19A03503P	Supply Chain Management	PC	0-0-3	1.5
<b>8.</b>	19A52601P	Heat Transfer Lab	BS	0-0-3	1.5
<b>9.</b>	19A03605	English Language Skills Lab	PR	----	0.5
<b>10.</b>	19A99601	Socially Relevant Projects (15 Hrs/Sem)	MC	3-0-0	0
<b>11.</b>	19A03606	Research Methodology		-	0
				<b>Total</b>	<b>21.5</b>

<b>Semester – VII (Theory - 5, Lab -2)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
<b>1.</b>	19A03701	Operations Research	PC	2-1-0	3
<b>2.</b>	19A03702T	Metrology & Measurements	PC	2-0-0	2
<b>3</b>	19A03703a	Professional Elective-III Automotive Transmission Systems	PE	3-0-0	3
	19A03703b	Simulation and Modelling of Manufacturing Systems			
	19A03703c	Mechanical Behaviour of Materials			
	19A03703d	Solar and Wind Energy			
<b>4.</b>	19A01704a	Open Elective-III Air pollution and control.	PE	3-0-0	3
	19A01704b	Basics of civil Engineering			
	19A02704a	Renewable Energy Systems			
	19A02704b	Electric Vehicle Engineering			
	19A04704a	Introduction to Microcontrollers & Applications			
	19A04704b	Principles of Digital Signal Processing			
	19A05704a	Fundamentals of Game Development			
	19A05704b	Cyber Security			
	19A27704a	Corporate Governance in Food Industries			
	19A27704b	Process Technology for Convenience & RTE Foods			
	19A54704a	Numerical Methods for Engineers (ECE , CSE, IT &CE )			
19A51704a	Chemistry of Nanomaterials and Applications				
<b>5</b>	19A52701a	Humanities Elective-II Organizational Behavior	HS	3-0-0	3
	19A52701b	Management Science			
	19A52701c	Business Environment			
	19A52701d	Strategic Management			
	19A52701e	E-Business			
<b>6.</b>	19A03702P	Metrology & Measurements Lab	PC	0-0-3	1.5
<b>7.</b>	19A03602P	CAD / CAM Lab	PC	0-0-3	1.5
<b>8.</b>	19A05406P	IOT Lab	PC	0-0-2	1
<b>9.</b>	19A03705	Industrial Training / Skill Development / Research Project	PR	- - -	2
<b>Total</b>					<b>20</b>

<b>Semester – VIII (Theory - 2)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
<b>1.</b>	19A03801a	Professional Elective-IV Autotronics	PE	3-0-0	3
	19A03801b	Mechanical Vibrations			
	19A03801c	Refrigeration and Air conditioning			
	19A03801d	Total Quality Management (TQM)			
<b>2.</b>	19A01802a	Open Elective-IV Disaster Management.	OE	3-0-0	3
	19A01802b	Global Warming and climate changes			
	19A02802a	IoT Applications in Electrical Engineering			
	19A02802b	Smart Electric Grid			
	19A04802a	Introduction to Image Processing			
	19A04802b	Principles of Cellular and Mobile Communications			
	19A04802c	Industrial Electronics			
	19A04802d	Electronic Instrumentation			
	19A05802a	Block Chain Technology and Applications			
	19A05802b	MEAN Stack Technology			
	19A27802a	Food Plants Utilities & Services			
	19A27802b	Nutraceuticals & Functional Foods			
	19A54802a	Mathematical Modeling & Simulation			
	19A51802a	Green Chemistry and Catalysis for Sustainable Environment			
	<b>3.</b>	19A03803			
				<b>Total</b>	<b>13</b>



### Honours Degree in Mechanical Engineering

S.No.	Course No.	Course Name	L	T	P	Credits
1.	19A03H01	Alternate fuels and Emissions Control in Automotives	3	1	0	4
2.	19A03H02	Robotics and Applications in Manufacturing	3	1	0	4
3.	19A03H03	Product Marketing	3	1	0	4
4.	19A03H04	Additive Manufacturing	3	1	0	4
5.	19A03H05	Mechanics of Composite Materials	3	1	0	4
<b>Total</b>						<b>20</b>

### Minor Degree in Mechanical Engineering

S.No.	Course No.	Course Name	L	T	P	Credits
1.	19A03401	Thermodynamics	2	1	0	3
2.	19A03301T	Manufacturing Processes	2	1	0	3
3.	19A03303T	Material Science and Engineering	3	0	0	3
4.	19A03504a	Automobile Engineering	3	0	0	3
5.	19A03601	Design of Machine Element	2	1	0	3
6.	19A03M01	Minor Discipline Project	-	-	-	5
<b>Total</b>						<b>20</b>

**(19A54101) ALGEBRA & CALCULUS**  
(Common to all branches of Engineering)

**Course Objectives:**

- This course will illuminate the students in the concepts of calculus and linear algebra.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

**Bridge Course:** Limits, continuity, Types of matrices

**Unit 1: Matrices**

**10 hrs**

Rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous equations linear equations. Eigen values and Eigen vectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalisation of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- solving systems of linear equations, using technology to facilitate row reduction determine the rank, eigenvalues and eigenvectors, diagonal form and different factorizations of a matrix; (L3)
- identify special properties of a matrix, such as positive definite, etc., and use this information to facilitate the calculation of matrix characteristics; (L3)

**Unit 2: Mean Value Theorems**

**6 hrs**

Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof);

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Translate the given function as series of Taylor's and Maclaurin's with remainders (L3)
- analyze the behaviour of functions by using mean value theorems (L3)

**Unit 3: Multivariable calculus**

**8 hrs**

Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Find partial derivatives numerically and symbolically and use them to analyze and interpret the way a function varies. (L3)
- Acquire the Knowledge maxima and minima of functions of several variable (L1)
- Utilize Jacobian of a coordinate transformation to deal with the problems in change of variables (L3)

#### **Unit 4:Multiple Integrals**

**10hrs**

Double integrals, change of order of integration, double integration in polar coordinates, areas enclosed by plane curves. Evaluation of triple integrals, change of variables between Cartesian, cylindrical and spherical polar co-ordinates.

#### **Learning Outcomes:**

- At the end of this unit, the student will be able to
- Evaluate double integrals of functions of several variables in two dimensions using Cartesian and polar coordinates (L5)
- Apply double integration techniques in evaluating areas bounded by region (L4)
- Evaluate multiple integrals in Cartesian, cylindrical and spherical geometries (L5)

#### **Unit 5:Special Functions**

**6 hrs**

Beta and Gamma functions and their properties, relation between beta and gamma functions, evaluation of definite integrals using beta and gamma functions.

#### **Learning Outcomes:**

At the end of this unit, the student will be able to

- understand beta and gamma functions and its relations (L2)
- Conclude the use of special function in evaluating definite integrals (L4)

#### **Text Books:**

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

#### **Reference Books:**

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 201.
4. Micheael Greenberg, Advanced Engineering Mathematics, 9<sup>th</sup> edition, Pearson edn
5. Dean G. Duffy, Advanced engineering mathematics with MATLAB, CRC Press
6. Peter O'neil, Advanced Engineering Mathematics, Cengage Learning.
7. R.L. Garg Nishu Gupta, Engineering Mathematics Volumes-I &II, Pearson Education
8. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education
9. H. k Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand.
10. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

**Course Outcomes:**

At the end of the course, the student will be able to

- develop the use of matrix algebra techniques that is needed by engineers for practical applications (L6)
- Utilize mean value theorems to real life problems (L3)
- familiarize with functions of several variables which is useful in optimization (L3)
- Students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional coordinate systems (L5)
- Students will become familiar with 3- dimensional coordinate systems and also learn the utilization of special functions

**(19A51101T) ENGINEERING CHEMISTRY**  
**(MECH and CIVIL)**

**Course Objectives:**

- To familiarize engineering chemistry and its applications
- To impart the concept of soft and hard waters, softening methods of hard water
- To train the students on the principles and applications of electrochemistry, polymers, surface chemistry, and cement

**Unit 1: Water Technology**

**(8 hrs)**

Introduction –Soft Water and hardness of water, Estimation of hardness of water by EDTA Method - Boiler troubles - scale and sludge, Industrial water treatment – specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, zeolite and ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electrodialysis.

**Learning outcomes:**

The student will be able to

- **list** the differences between temporary and permanent hardness of water (L1)
- **explain** the principles of reverse osmosis and electrodialysis. (L2)
- **compare** quality of drinking water with BIS and WHO standards. (L2)
- **illustrate** problems associated with hard water - scale and sludge. (L2)
- **explain** the working principles of different Industrial water treatment processes (L2)

**Unit 2: Electrochemistry and Applications:**

**(10 hrs)**

Electrodes – concepts, electrochemical cell, Nernst equation, cell potential calculations.

Primary cells –**Leclanche cell, Li Battery**

Secondary cells – lead acid, and lithium ion batteries- working of the batteries including cell reactions.

Fuel cells- Basic Principles and Working Principles of hydrogen-oxygen, methanol fuel cells

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, **Factors affecting the corrosion,** cathodic and anodic protection, electroplating and electroless plating (Nickel and Copper).

**Learning Outcomes:**

*At the end of this unit, the students will be able to*

- **apply** Nernst equation for calculating electrode and cell potentials (L3)
- **apply** Pilling Bedworth rule for corrosion and corrosion prevention (L3)
- **demonstrate** the corrosion prevention methods and factors affecting corrosion (L2)
- **compare** different batteries and their applications (L2)

### **Unit 3: Polymers and Fuel Chemistry: (12 hrs)**

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth and coordination polymerization,

Thermoplastics and Thermo-setting plastics:- **Preparation, properties and applications of PVC and Bakelite**

Elastomers – **Preparation, properties and applications of Buna S, Buna N, Thiokol**

Fuels – Types of fuels, calorific value, numerical problems based on calorific value; Analysis of coal, **Liquid Fuels** refining of petroleum, fuels for IC engines, knocking and anti-knock agents, Octane and Cetane values, cracking of oils; alternative fuels- propane, methanol and ethanol, bio fuels.

#### **Learning Outcomes:**

*At the end of this unit, the students will be able to*

- **explain** different types of polymers and their applications (L2)
- **Solve the numerical problems based on Calorific value(L3)**
- **select** suitable fuels for IC engines (L3)
- **explain** calorific values, octane number, refining of petroleum and cracking of oils (L2)

### **UNIT-4 Advanced Engineering Materials**

**(8 hrs)**

- Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications
- Refractories- Classification, Properties, Factors affecting the refractory materials and Applications
- Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils and Applications
- Building materials- Portland Cement, constituents, phases and reactivity of clinker, Setting and Hardening of cement.

#### **Learning Outcomes:**

*At the end of this unit, the students will be able to*

- explain the constituents of Composites and its classification (L2)
- Identify the factors affecting the refractory material(L3)
- Illustrate the functions and properties of lubricants (L2)
- demonstrate the phases and reactivity of concrete formation (L2)
- identify the constituents of Portland cement (L3)
- enumerate the reactions at setting and hardening of the cement (L3)

### **Unit 5: Surface Chemistry and Applications:**

**(10 hrs)**

Introduction to surface chemistry, colloids, micelle formation, synthesis of colloids (any two methods with examples), chemical and electrochemical methods (not more than two methods) of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, characterization of surface by physicochemical methods (SEM, TEM, X-ray diffraction), solid-gas interface, solid-liquid interface, adsorption isotherm, BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors.

### **Learning Outcomes:**

*At the end of this unit, the students will be able to*

- **summarize** the applications of SEM, TEM and X-ray diffraction in surface characterization (L2)
- **explain** the synthesis of colloids with examples (L2)
- **outline** the preparation of nanomaterials and metal oxides (L2)
- **identify** the application of colloids and nanomaterials in medicine, sensors and catalysis (L2)

### **Text Books:**

1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

### **Reference Books:**

1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
2. D.J. Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heinemann, 1992.
3. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.

### **Course Outcomes:**

At the end of the course, the students will be able to

- **demonstrate** the corrosion prevention methods and factors affecting corrosion (L2)
- **explain** the preparation, properties, and applications of thermoplastics & thermosetting, elastomers & conducting polymers. (L2)
- **explain** calorific values, octane number, refining of petroleum and cracking of oils (L2)
- **explain the setting and hardening of cement and concrete phase (L2)**
- **summarize** the application of SEM, TEM and X-ray diffraction in surface characterization (L2)

**(19A05101T) PROBLEM SOLVING AND PROGRAMMING**  
**(Common to All Branches of Engineering)**

**Course Objectives:**

1. Introduce the internal parts of a computer, and peripherals.
2. Introduce the Concept of Algorithm and use it to solve computational problems
3. Identify the computational and non-computational problems
4. Teach the syntax and semantics of a C Programming language
5. Demonstrate the use of Control structures of C Programming language
6. Illustrate the methodology for solving Computational problems

**Unit 1:**

**Computer Fundamentals: What is a Computer, Evolution of Computers, Generations of Computers, Classification of Computers, Anatomy of a Computer, Memory revisited, Introduction to Operating systems, Operational overview of a CPU.**

**Introduction to Programming, Algorithms and Flowcharts:** Programs and Programming, Programming languages, Compiler, Interpreter, Loader, Linker, Program execution, Fourth generation languages, Fifth generation languages, Classification of Programming languages, Structured programming concept, Algorithms, Pseudo-code, Flowcharts, Strategy for designing algorithms, Tracing an algorithm to depict logic, Specification for converting algorithms into programs.

**Unit Outcomes:**

Student should be able to

1. Identify the different peripherals, ports and connecting cables in a PC (L2)
2. Illustrate the working of a Computer (L3)
3. Select the components of a Computer in the market and assemble a computer (L4)
4. Solve complex problems using language independent notations (L3)

**Unit 2:**

**Introduction to computer problem solving:** Introduction, the problem-solving aspect, top-down design, implementation of algorithms, the efficiency of algorithms, the analysis of algorithms.

**Fundamental algorithms:** Exchanging the values of two variables, counting, summation of a set of numbers, factorial computation, sine function computation, generation of the Fibonacci sequence, reversing the digits of an integer.

**Learning Outcomes:** Student should be able to

1. Solve Computational problems (L3)
2. Apply Algorithmic approach to solving problems (L3)
3. Analyze the algorithms (L4)



### Unit 3:

**Types, Operators, and Expressions:** Variable names, data types and sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence and order of evaluation.

**Input and output:** standard input and output, formatted output-Printf, formatted input-Scanf.

**Control Flow:** Statements and blocks, if-else, else-if, switch, Loops-while and for, Loops-Do-while, break and continue, Goto and labels.

**Functions and Program Structure:** Basics of functions, functions returning non-integers, external variables, scope variables, header variables, register variables, block structure, initialization, recursion, the C processor.

**Learning Outcomes:** Student should be able to

1. Recognize the programming elements of C Programming language (L1)
2. Select the control structure for solving the problem (L4)
3. Apply modular approach for solving the problem (L3)

### Unit 4:

**Factoring methods:** Finding the square root of a number, the smallest divisor of a number, the greatest common divisor of two integers, generating prime numbers.

**Pointers and arrays:** Pointers and addresses, pointers and function arguments, pointers and arrays, address arithmetic, character pointers and functions, pointer array; pointers to pointers, Multi-dimensional arrays, initialization of arrays, pointer vs. multi-dimensional arrays, command line arguments, pointers to functions, complicated declarations.

**Array Techniques:** Array order reversal, finding the maximum number in a set, removal of duplicates from an order array, finding the  $k^{\text{th}}$  smallest element

**Learning Outcomes:** Student should be able to

1. Solve mathematical problems using C Programming language (L3)
2. Structure the individual data elements to simplify the solutions (L6)
3. Facilitate efficient memory utilization (L6)

### Unit 5:

**Sorting and Searching:** Sorting by selection, sorting by exchange, sorting by insertion, sorting by partitioning, binary search.

**Structures:** Basics of structures, structures and functions, arrays of structures, pointers to structures, self-referential structures, table lookup, typedef, unions, bit-fields.

**Some other Features:** Variable-length argument lists, formatted input-Scanf, file access, Error handling-stderr and exit, Line Input and Output, Miscellaneous Functions.

**Learning Outcomes:** Student should be able to

1. Select sorting algorithm based on the type of the data (L4)

2. Organize heterogeneous data (L6)
3. Design a sorting algorithm (L6)

**Text Books:**

1. Pradip Dey, and Manas Ghosh, “Programming in C”, 2018, Oxford University Press.
2. R.G. Dromey, “How to Solve it by Computer”. 2014, Pearson.
3. Brian W. Kernighan, and Dennis M. Ritchie, “The C Programming Language”, 2<sup>nd</sup> Edition, Pearson.

**Reference Books:**

1. RS Bichkar “Programming with C”, 2012, Universities Press.
2. Pelin Aksoy, and Laura Denardis, “Information Technology in Theory”, 2017, Cengage Learning.
3. Byron Gottfried and Jitender Kumar Chhabra, “Programming with C”, 4<sup>th</sup> Edition, 2019, McGraw Hill Education.

**Course Outcomes:**

1. Construct his own computer using parts (L6).
2. Recognize the importance of programming language independent constructs (L2)
3. Solve computational problems (L3)
4. Select the features of C language appropriate for solving a problem (L4)
5. Design computer programs for real world problems (L6)
6. Organize the data which is more appropriated for solving a problem (L6)

**(19A03102) ENGINEERING GRAPHICS LAB**  
**(Common to All Branches of Engineering)**

**Course Objectives:**

- Bring awareness that Engineering Drawing is the Language of Engineers.
- Familiarize how industry communicates technical information.
- Teach the practices for accuracy and clarity in presenting the technical information.
- Develop the engineering imagination essential for successful design.
- Instruct the utility of drafting & modeling packages in orthographic and isometric drawings.
- Train the usage of 2D and 3D modeling.
- Instruct graphical representation of machine components.

**Part A: Manual Drawing: (7 Classes)**

**Introduction to Engineering graphics:** Principles of Engineering Graphics and their significance-Conventions in drawing-lettering - BIS conventions.

- a) Conic sections including the rectangular hyperbola- general method only,
- b) Cycloid, epicycloids and hypocycloid
- c) Involute

**(2L + 6P hrs)**

**Projection of points, lines and planes:** Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line. Projections of regular plane surfaces.  
**(2L + 6P hrs)**

**Projections of solids:** Projections of regular solids inclined to one or both planes by rotational or auxiliary views method. **(1L + 3P hrs)**

**Sections of solids:** Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone. True shapes of the sections. **(1L + 3P hrs)**

**Development of surfaces:** Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts. **(1L + 6P hrs)**

**Part B: Computer Aided Drafting: (6 Classes)**

**Introduction to AutoCAD:** Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions. **(1L + 3P hrs)**

Dimensioning principles and conventional representations.

**Orthographic Projections:** Systems of projections, conventions and application to orthographic projections. (3L + 9P hrs)

**Isometric Projections:** Principles of isometric projection- Isometric scale; Isometric views: lines, planes, simple solids. (2L + 6P hrs)

**Text Books:**

1. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, Chennai, 2012.
2. Venugopal, Engineering Drawing and Graphics, 3/e, New Age Publishers, 2000

**Reference Books:**

1. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2009
2. N.D.Bhatt, Engineering Drawing, 53/e, Charotar Publishers, 2016.
3. Shah and Rana, Engineering Drawing, 2/e, Pearson Education, 2009
4. K.C.John, Engineering Graphics, 2/e, PHI, 2013
5. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2008.

**Course Outcomes:**

After completing the course, the student will be able to

- draw various curves applied in engineering. (L2)
- show projections of solids and sections graphically. (L2)
- draw the development of surfaces of solids. (L3)
- use computers as a drafting tool. (L2)
- draw isometric and orthographic drawings using CAD packages. (L3)

**Note:**

1. Manual (part A) and Computer Aided Drafting (part B) classes can be held in alternative weeks for optimal utilization of computer facilities.
2. External examinations to be conducted both manual and computer mode with equal weight of marks.

**Additional Sources**

1. Youtube: <http://sewor.carleton.ca/gkardos/88403/drawings.html> conic sections-online, red woods.edu

**(19A03101) ENGINEERING WORKSHOP**  
**(Common to all branches)**

**Course Objective:**

To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills

**Wood Working:**

Familiarity with different types of woods and tools used in wood working and make following joints

- a) Half – Lap joint
- b) Mortise and Tenon joint
- c) Corner Dovetail joint or Bridle joint

**Sheet Metal Working:**

Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets

- a) Tapered tray
- b) Conical funnel
- c) Elbow pipe
- d) Brazing

**Fitting:**

Familiarity with different types of tools used in fitting and do the following fitting exercises

- a) V-fit
- b) Dovetail fit
- c) Semi-circular fit
- d) Bicycle tire puncture and change of two wheeler tyre

**Electrical Wiring:**

Familiarities with different types of basic electrical circuits and make the following connections

- a) Parallel and series
- b) Two way switch
- c) Godown lighting
- d) Tube light
- e) Three phase motor
- f) Soldering of wires

**Course Outcomes:**

After completion of this lab the student will be able to

1. Apply wood working skills in real world applications. (13)
2. Build different parts with metal sheets in real world applications. (13)
3. Apply fitting operations in various applications. (13)
4. Apply different types of basic electric circuit connections. (13)
5. Demonstrate soldering and brazing. (12)

**(19A51101P) ENGINEERING CHEMISTRY LAB**  
**(MECH and CIVIL)**

**Course Objectives:**

- To Verify the fundamental concepts with experiments

**List of Experiments:**

1. Determination of Hardness of a groundwater sample.
2. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base
3. Determination of cell constant and conductance of solutions
4. Potentiometry - determination of redox potentials and emfs
5. Determination of Strength of an acid in Pb-Acid battery
6. Preparation of a polymer
7. Determination of percentage of Iron in Cement sample by colorimetry
8. Estimation of Calcium in port land Cement
9. Preparation of nanomaterials
10. Adsorption of acetic acid by charcoal
11. Determination of percentage Moisture content in a coal sample
12. Determination of Viscosity of lubricating oil by Red Viscometer 1 &2
13. Determination of Calorific value of gases by Junker's gas Calorimeter

**Course Outcomes:**

At the end of the course, the students will be able to

- **determine** the cell constant and conductance of solutions (L3)
- **prepare** advanced polymer materials (L2)
- **determine** the physical properties like surface tension, adsorption and viscosity (L3)
- **estimate** the Iron and Calcium in cement (L3)
- **calculate** the hardness of water (L4)

**(19A05101P) PROBLEM SOLVING AND PROGRAMMING LAB**  
**(Common to All Branches of Engineering)**

**Laboratory Experiments #**

1. Assemble and disassemble parts of a Computer
2. Design a C program which reverses the number
3. Design a C program which finds the second maximum number among the given list of numbers.
4. Construct a program which finds the kth smallest number among the given list of numbers.
5. Design an algorithm and implement using C language the following exchanges  
$$a \leftarrow b \leftarrow c \leftarrow d$$
6. Develop a C Program which counts the number of positive and negative numbers separately and also compute the sum of them.
7. Implement the C program which computes the sum of the first n terms of the series  
$$\text{Sum} = 1 - 3 + 5 - 7 + 9$$
8. Design a C program which determines the numbers whose factorial values are between 5000 and 32565.
9. Design an algorithm and implement using a C program which finds the sum of the infinite series  
$$1 - x^2/2! + x^4/4! - x^6/6! + \dots$$
10. Design a C program to print the sequence of numbers in which each number is the sum of the three most recent predecessors. Assume first three numbers as 0, 1, and 1.
11. Implement a C program which converts a hexadecimal, octal and binary number to decimal number and vice versa.
12. Develop an algorithm which computes the all the factors between 1 to 100 for a given number and implement it using C.
13. Construct an algorithm which computes the sum of the factorials of numbers between m and n.
14. Design a C program which reverses the elements of the array.
15. Given a list of n numbers, Design an algorithm which prints the number of stars equivalent to the value of the number. The stars for each number should be printed horizontally.
16. Implement the sorting algorithms a. Insertion sort b. Exchange sort c. Selection sort d.. Partitioning sort.

17. Illustrate the use of auto, static, register and external variables.
18. Design algorithm and implement the operations creation, insertion, deletion, traversing on a singly linked list.
19. Develop a C program which takes two numbers as command line arguments and finds all the common factors of those two numbers.
20. Design a C program which sorts the strings using array of pointers.

# The above list is not exhaustive. Instructors may add some experiments to the above list. Moreover, 50% of the experiments are to be changed every academic year. Instructors can choose the experiments, provided those experiments are not repetitions.

**Course outcomes:** Student should be able to

1. Construct a Computer given its parts (L6)
2. Select the right control structure for solving the problem (L6)
3. Analyze different sorting algorithms (L4)
4. Design solutions for computational problems (L6)
5. Develop C programs which utilize the memory efficiently using programming constructs like pointers.

**References:**

1. B. Govindarajulu, "IBM PC and Clones Hardware Trouble shooting and Maintenance", Tata McGraw-Hill, 2<sup>nd</sup> edition, 2002.
2. R.G. Dromey, "How to Solve it by Computer". 2014, Pearson.



**(19A02201T) BASIC ELECTRICAL & ELECTRONICS ENGINEERING**

**Part A: Basic Electrical Engineering**  
**(Civil, Mechanical, CSE, CSSE, IT and Food Technology)**

**Course Objectives:**

1. To introduce basics of electric circuits.
2. To teach DC and AC electrical circuit analysis.
3. To explain working principles of transformers and electrical machines.
4. To impart knowledge on low voltage electrical installations

**Unit 1 DC & AC Circuits:**

Electrical circuit elements (R - L and C) - Kirchoff laws - Series and parallel connection of resistances with DC excitation. Superposition Theorem - Representation of sinusoidal waveforms - peak and rms values - phasor representation - real power - reactive power - apparent power - power factor - Analysis of single-phase ac circuits consisting of RL - RC - RLC series circuits.

**Unit Outcomes: Able to**

- Recall Kirchoff laws (L1)
- Analyze simple electric circuits with DC excitation (L4)
- Apply network theorems to simple circuits (L3)
- Analyze single phase AC circuits consisting of series RL - RC - RLC combinations (L4)

**Unit 2 DC & AC Machines:**

Principle and operation of DC Generator - EMF equations - OCC characteristics of DC generator – principle and operation of DC Motor – Performance Characteristics of DC Motor - Speed control of DC Motor – Principle and operation of Single Phase Transformer - OC and SC test on transformer - principle and operation of Induction Motor [ Elementary treatment only ]

**Unit Outcomes: Able to**

- Explain principle and operation of DC Generator & Motor.
- Perform speed control of DC Motor (L2)
- Explain operation of transformer and induction motor. (L2)
- Explain construction & working of induction motor - DC motor

**Unit 3 Basics of Power Systems:**

Layout & operation of Hydro, Thermal, Nuclear Stations - Solar & wind generating stations – Typical AC Power Supply scheme – Elements of Transmission line – Types of Distribution systems: Primary & Secondary distribution systems.

**Unit Outcomes: Able to**

- Understand working operation of various generating stations (L2)
- Explain the types of Distribution systems

**Text Books:**

1. D. P. Kothari and I. J. Nagrath - "Basic Electrical Engineering" - Tata McGraw Hill - 2010.
2. V.K. Mehta & Rohit Mehta, "Principles of Power System" – S.Chand – 2018.

**References:**

1. L. S. Bobrow - "Fundamentals of Electrical Engineering" - Oxford University Press - 2011.
2. E. Hughes - "Electrical and Electronics Technology" - Pearson - 2010.
3. C.L. Wadhwa – "Generation Distribution and Utilization of Electrical Energy", 3rd Edition, New Age International Publications.

**Course Outcomes:**

- Apply concepts of KVL/KCL in solving DC circuits (L3)
- Choose correct rating of a transformer for a specific application (L5)
- Illustrate working principles of induction motor - DC Motor (L3)
- Identify type of electrical machine based on their operation.(L1)
- Describe working principles of protection devices used in electrical circuits. (L2)

**Part B: Basic Electronics Engineering****Course Objectives:**

- To provide comprehensive idea about working principle, operation and applications of PN junction & zener diodes, BJT, FET, MOSFET and operational amplifier
- To introduce fundamentals of digital electronics
- To educate on principles of various communication systems
- To teach efficacy of electronic principles which are pervasive in engineering applications

**Unit I Analog Electronics**

Overview of Semiconductors, PN junction diode, Zener diode, Applications of diode as switch and rectifier, Zener diode as regulator, special purpose diodes: schottky diode, tunnel diode, varactor diode, photodiode, phototransistor and LED.

BJT construction, operation, configuration and characteristics, JFET and MOSFET construction, operation, characteristics (CS configuration), applications

Operational Amplifiers: Introduction, block diagram, basic op-amp circuits: Inverting, Non Inverting, summer, subtractor, voltage follower.

**Unit Outcomes:**

- Describe operation and characteristics of diodes and transistors (L2)
- Make use of diodes and transistors in simple, typical circuit applications (L3)
- Understand operation of basic op-amp circuits (L2)

**Unit II Digital Electronics**

Introduction, Switching and Logic Levels, Digital Waveform, characteristics of digital ICs, logic gates, number systems, combinational circuits - adders, multiplexers, decoders; introduction to sequential circuits, flip flops, shift register, binary counter.

**Unit Outcomes:**

- Explain different logic gates using truth table (L2)
- Distinguish combinational and sequential circuits (L2)
- Analyze various combinational circuits such as adders, multiplexers and decoders (L4)
- Understand functionality of flip-flops, shift registers and counters (L2)

**Unit III                      Communication Systems**

Introduction, Elements of Communication Systems, EM spectrum, basics of electronic communication, Amplitude and Frequency modulation, Pulse modulation, Communication receivers, Examples of communication systems: Microwave & Satellite, Fibre optic, Television, mobile communication (block diagram approach).

**Unit Outcomes:**

- Describe basic elements of a communication system (L2)
- Explain need for modulation and different modulation techniques (L2)
- Understand functioning of various communication systems (L2)

**Text Books:**

1. D.P. Kothari, I.J.Nagrath, Basic Electronics, 2<sup>nd</sup> edition, McGraw Hill Education(India)Private Limited
2. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, 2<sup>nd</sup> edition, Pearson India Private Limited.

**Reference Books:**

1. R. Muthusubramanian, S. Salivahanan, “Basic Electrical and Electronics Engineering”, Tata McGraw-Hill Education, Reprint 2012.
2. David Bell, Electronic Devices and Circuits: Oxford University Press, 5th EDn., 2008.

**(19A54201) DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS**  
**(Civil, Mechanical, EEE, ECE and EIE)**

**Course Objectives:**

- 1) To enlighten the learners in the concept of differential equations and multivariable calculus.
- 2) To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.

**UNIT 1: Linear differential equations of higher order**

**8hrs**

Definitions, complete solution, operator D, rules for finding complimentary function, inverse operator, rules for finding particular integral, method of variation of parameters.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- identify the essential characteristics of linear differential equations with constant coefficients (L3)
- solve the linear differential equations with constant coefficients by appropriate method (L3)

**UNIT 2: Equations reducible to Linear Differential Equations**

**8hrs**

Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients, Applications to L-C-R Circuit problems and Mass spring system.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- classify and interpret the solutions of linear differential equations (L3)
- formulate and solve the higher order differential equation by analyzing physical situations (L3)

**UNIT 3: Partial Differential Equations**

**8 hrs**

First order partial differential equations, solutions of first order linear and non-linear PDEs. Solutions to homogenous and non-homogenous higher order linear partial differential equations.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- apply a range of techniques to find solutions of standard PDEs (L3)
- outline the basic properties of standard PDEs (L2)

**UNIT4: Vector differentiation**

**8hrs**

Scalar and vector point functions, vector operator del, del applies to scalar point functions- Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- apply del to Scalar and vector point functions (L3)
- illustrate the physical interpretation of Gradient, Divergence and Curl (L3)

**UNIT 5: Vector integration****8hrs**

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- find the work done in moving a particle along the path over a force field (L4)
- evaluate the rates of fluid flow along and across curves (L4)
- apply Green's, Stokes and Divergence theorem in evaluation of double and triple integrals (L3)

**Text Books:**

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

**Reference Books:**

1. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2011.
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B.Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
4. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
5. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011.
6. Micheael Greenberg, Advanced Engineering Mathematics, 9<sup>th</sup> edition, Pearson edn
7. Dean G. Duffy, Advanced engineering mathematics with MATLAB, CRC Press
8. Peter O'neil, Advanced Engineering Mathematics, Cengage Learning.
9. R.L. Garg Nishu Gupta, Engineering Mathematics Volumes-I &II, Pearson Education
10. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education.
11. H. k Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand.
12. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

**Course Outcomes:**

At the end of the course, the student will be able to

- solve the differential equations related to various engineering fields (L6)
- Identify solution methods for partial differential equations that model physical processes (L3)
- interpret the physical meaning of different operators such as gradient, curl and divergence (L5)

- estimate the work done against a field, circulation and flux using vector calculus (L6)

(19A56102T) ENGINEERING PHYSICS  
(Civil, Mechanical and Food Technology)

**Course Objectives:**

- To impart knowledge in basic concepts of mechanics.
- To familiarize the basic concepts of acoustics and ultrasonics with their Engineering applications.
- To explain the significant concepts of dielectric and magnetic materials this leads to potential applications in the emerging micro devices.
- To impart knowledge in basic concepts of optical fibers and LASERs along with its Engineering applications.
- Familiarize types of sensors for various engineering applications

**Unit-1: MECHANICS**

**(10 hrs)**

Basic laws of vectors and scalars-rotational frames-conservative forces-  $F = -\text{grad } V$ , torque and angular momentum - Newton's laws in inertial and linear accelerating non-inertial frames of reference-rotating frame of reference with constant angular velocity-qualitative explanation of Foucault's pendulum-rigid body-angular velocity vector -center of mass- gravitation and Kepler's Law (Qualitative).

**Learning Outcomes:**

*The students will be able to*

- **Identify** forces and moments in mechanical systems using scalar and vector techniques (L3)
- **interpret** the equation of motion of a rigid rotating body (torque on a rigid body) (L3)
- **extend** Newton's second law for inertial and non-inertial frame of reference (L2)
- **explain** consideration of Earth's rotation in designing and launching missiles (L2)

**Unit-2: ACOUSTICS AND ULTRASONICS**

**(9 hrs)**

Acoustics Introduction – Reverberation – Reverberation time– Sabine's formula- derivation using growth and decay method – Absorption coefficient and its determination –factors affecting acoustics of buildings and their remedies.

Ultrasonics – Introduction, Properties and Production by magnetostriction& piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Medical applications.

**Learning Outcomes:**

*The students will be able to*

- **explain** how sound is propagated in buildings (L2)
- **analyze** acoustic properties of typically used materials in buildings (L4)

- **recognize** sound level disruptors and their use in architectural acoustics (L2)
- **identify** the use of ultrasonics in different fields (L3)

### **Unit-3 : Dielectric and Magnetic Materials (8hrs)**

Introduction--Dielectric polarization-Dielectric polarizability, Susceptibility and Dielectric constant- Types of polarizations: Electronic, Ionic, Orientation Polarizations (Qualitative) - Frequency dependence of polarization-Lorentz (internal) field-Claussius -Mosotti equation- Applications of Dielectrics.

Introduction-Magnetic dipole moment-Magnetization-Magnetic susceptibility and permeability-Origin of permanent magnetic moment -Classification of Magnetic materials-Domain Concepts of ferromagnetism-Hysteresis-soft and hard magnetic materials-Magnetic device applications.

#### **Unit Outcomes:**

*The students will be able to*

- **explain** the concept of dielectric constant and polarization in dielectric materials (L2)
- **summarize** Gauss's law in the presence of dielectrics (L2)
- **interpret** dielectric loss, Lorentz field and Claussius- Mosotti relation (L2)
- **classify** the magnetic materials based on susceptibility and their temperature dependence (L2)
- **explain** the applications of dielectric and magnetic materials (L2)

### **Unit – IV: Lasers and Fiber Optics (10hrs)**

Introduction - Characteristics of Laser - Spontaneous and Stimulated emission of radiation - Einstein's coefficients - Population inversion - Pumping Mechanisms - He-Ne laser, Nd-YAG laser - Semiconductor laser - Applications of laser.

Introduction to Optical Fibers-Total Internal Reflection-Construction of optical fibers, Critical angle of propagation-Acceptance angle-Numerical Aperture-Classification of fibers based on Refractive index profile& modes –Propagation of electromagnetic wave through optical fiber-importance of V number- Block Diagram of Fiber optic Communication system -Medical Applications.

#### **Unit Outcomes:**

*The students will be able to*

- **Understand** the basic concepts of LASER light Sources (L2)
- **Apply** the concepts to learn the types of lasers (L3)
- **Identifies** the Engineering applications of lasers (L2)
- **explain** the working principle of optical fibers (L2)
- **classify** optical fibers based on refractive index profile and mode of propagation (L2)
- **identify** the applications of optical fibers in medical, communication and other fields (L2)

### **Unit – V: Sensors (8 hrs)**

Sensors:(qualitative description only): Different types of sensors and applications; Strain and Pressure sensors- Piezoelectric, magnetostrictive sensors, Fibre optic methods of pressure sensing; Temperature sensors - bimetallic strip, pyroelectric detectors, Hall-effect sensor, smoke and fire detectors.



**Learning Outcomes:**

The students will be able to

- **identify** different types of sensors and applications (L3)
- **explain** physics behind the working principles of sensors (L2)
- **select** sensors for different type of applications (L3)

**Text Books :**

1. M.N.Avadhanulu, P.G.Kshirsagar & TVS Arun Murthy” A Text book of Engineering Physics”-S.Chand Publications, 11<sup>th</sup> Edition 2019
2. Shatendra Sharma, Jyotsna Sharma, “ Engineering Physics”, Pearson Education, 2018

**Reference Books:**

1. M K Varma “Introduction to Mechanics”-Universities Press-2015.
2. D.K. Bhattacharya and A. Bhaskaran, “Engineering Physics”- Oxford Publications-2015
3. Ian R Sinclair, Sensor and Transducers, 3rd eds, 2001, Elsevier (Newnes)

**Course Outcomes:**

After completing this course students will be able to

- Explain physics applied to solve engineering problems (L2)
- Apply the principles of acoustics in designing of buildings (L3)
- Explains the applications of ultrasonics in various engineering fields (L2)
- Apply electromagnetic wave propagation in different Optical Fibers (L2)
- Apply the lasers concepts in various applications (L3)
- Explains the concepts of dielectric and magnetic materials (L2)
- Identify the sensors for various engineering applications (L3)

**(19A05201T) DATA STRUCTURES**  
**(Common to All Branches of Engineering)**

**Course Objectives:**

1. To teach the representation of solution to the problem using algorithm
2. To explain the approach to algorithm analysis
3. To introduce different data structures for solving the problems
4. To demonstrate modeling of the given problem as a graph
5. To elucidate the existing hashing techniques

**Unit – 1: Introduction**

Algorithm Specification, Performance analysis, Performance Measurement. Arrays: Arrays, Dynamically Allocated Arrays. Structures and Unions. Sorting: Motivation, Quick sort, How fast can we sort, Merge sort, Heap sort

**Learning Outcomes :**

Student should be able to

1. Analyze the given algorithm to find the time and space complexities.(L4)
2. Select appropriate sorting algorithm (L4)
3. Design a sorting algorithm (L6)

**Unit – 2: Stack, Queue and Linked lists**

Stacks, Stacks using Dynamic Arrays, Queues, Circular Queues Using Dynamic Arrays, Evaluation of Expressions, Multiple Stacks and Queues. Linked lists: Singly Linked Lists and Chains, Representing Chains in C, Linked Stacks and Queues, Additional List Operations, Doubly Linked Lists.

**Learning outcomes:** Student should be able to

1. Evaluate expressions (L5)
2. Develop the applications using stacks and queues (L3)
3. Construct the linked lists for various applications (L6)

**Unit – 3 :Trees**

Introduction, Binary Trees, Binary Tree Traversals, Additional Binary Tree Operations, Binary Search Trees, Counting Binary Trees, Optimal Binary search Trees, AVL Trees. B-Trees: B-Trees, B + Trees.

**Learning outcomes**

1. Explain the concept of a tree (L2)
2. Compare different tree structures (L4)
3. Apply trees for indexing (L3)

## **Unit – 4 : Graphs and Hashing**

The Graph Abstract Data Type, Elementary Graph Operations, Minimum Cost Spanning Trees, Shortest Paths and Transitive Closure

Hashing: Introduction to Hash Table, Static Hashing, Dynamic Hashing.

### **Learning outcomes:**

Student should be able to

1. Recognize the importance of Graphs in solving real world problems (L2)
2. Apply various graph traversal methods to applications (L3)
3. Design a minimum cost solution for a problem using spanning trees (L6)
4. Select the appropriate hashing technique for a given application (L5)
5. Design a hashing technique (L6)

## **Unit – 5: Files and Advanced sorting**

File Organization: Sequential File Organization, Direct File Organization, Indexed Sequential File Organization.

Advanced sorting: Sorting on Several keys, List and Table sorts, Summary of Internal sorting, External sorting.

### **Learning outcomes:** Student should be able to

1. Organize data in the form of Files (L6)
2. Apply sorting on large amount of data (L3)

### **Text Books:**

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson Freed “Fundamentals of Data Structures in C”, 2<sup>nd</sup> Edition, University Press, 2007.
2. Alan L. Tharp, “File Organization and Processing”, Wiley and Sons, 1988.

### **Reference Books:**

1. D. Samanta, “Classic Data Structures”, 2<sup>nd</sup> Edition, Prentice-Hall of India, Pvt. Ltd., India, 2012.
2. Peter Bras, “Advanced Data Structures”, Cambridge University Press, 2016
3. Richard F. Gilberg, Behrouz A. Forouzan, “Data Structures A Pseudo code Approach with C”, Second Edition, Cengage Learning 2005.

### **Course Outcomes:**

Students should be able to

1. Select Appropriate Data Structure for solving a real world problem (L4)
2. Select appropriate file organization technique depending on the processing to be done (L4)
3. Construct Indexes for Databases (L6)
4. Analyse the Algorithms (L4)
5. Develop Algorithm for Sorting large files of data (L3)

(19A52101T) COMMUNICATIVE ENGLISH I  
(Common to All Branches of Engineering)

### Introduction

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

### Course Objectives

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

### Unit 1

**Listening:** Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions. **Speaking:** Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others. **Reading:** Skimming to get the main idea of a text; scanning to look for specific pieces of information. **Reading for Writing:** Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph. **Grammar and Vocabulary:** Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countables and uncountables; singular and plural; basic sentence structures; simple question form - wh-questions; word order in sentences.

### Learning Outcomes

At the end of the module, the learners will be able to

- understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- ask and answer general questions on familiar topics and introduce oneself/others
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- form sentences using proper grammatical structures and correct word forms

## Unit 2

**Listening:** Answering a series of questions about main idea and supporting ideas after listening to audio texts. **Speaking:** Discussion in pairs/ small groups on specific topics followed by short structured talks. **Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together. **Writing:** Paragraph writing (specific topics) using suitable cohesive devices; mechanics of writing - punctuation, capital letters. **Grammar and Vocabulary:** Cohesive devices - linkers, sign posts and transition signals; use of articles and zero article; prepositions.

### Learning Outcomes

At the end of the module, the learners will be able to

- comprehend short talks on general topics
- participate in informal discussions and speak clearly on a specific topic using suitable discourse markers
- understand the use of cohesive devices for better reading comprehension
- write well structured paragraphs on specific topics
- identify basic errors of grammar/ usage and make necessary corrections in short texts

## Unit 3

**Listening:** Listening for global comprehension and summarizing what is listened to. **Speaking:** Discussing specific topics in pairs or small groups and reporting what is discussed. **Reading:** Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension. **Writing:** Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. **Grammar and Vocabulary:** Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

### Learning Outcomes

At the end of the module, the learners will be able to

- comprehend short talks and summarize the content with clarity and precision
- participate in informal discussions and report what is discussed
- infer meanings of unfamiliar words using contextual clues
- write summaries based on global comprehension of reading/listening texts
- use correct tense forms, appropriate structures and a range of reporting verbs in speech and writing

## Unit4

**Listening:** Making predictions while listening to conversations/ transactional dialogues without video; listening with video. **Speaking:** Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. **Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data. **Writing:** Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. **Grammar and Vocabulary:** Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

### Learning Outcomes

At the end of the module, the learners will be able to

- infer and predict about content of spoken discourse
- understand verbal and non-verbal features of communication and hold formal/informal conversations
- interpret graphic elements used in academic texts
- produce a coherent paragraph interpreting a figure/graph/chart/table
- use language appropriate for description and interpretation of graphical elements

## Unit 5

**Listening:** Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension. **Speaking:** Formal oral presentations on topics from academic contexts - without the use of PPT slides. **Reading:** Reading for comprehension. **Writing:** Writing structured essays on specific topics using suitable claims and evidences **Grammar and Vocabulary:** Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

### Learning Outcomes

At the end of the module, the learners will be able to

- take notes while listening to a talk/lecture and make use of them to answer questions
- make formal oral presentations using effective strategies
- comprehend, discuss and respond to academic texts orally and in writing
- produce a well-organized essay with adequate support and detail
- edit short texts by correcting common errors

### Text Book

- **English all round: Communication Skills for Undergraduate Learners** Vol. I, Orient BlackSwan Publishers, First Edition 2019.

### Reference Books

- Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.
- Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking*. Heinley ELT; 2nd Edition, 2018.
- Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.

## Sample Web Resources

Grammar/Listening/Writing

[1-language.com](http://1-language.com)

<http://www.5minuteenglish.com/>

<https://www.englishpractice.com/>

Grammar/Vocabulary

[English Language Learning Online](http://www.bbc.co.uk/learningenglish/)

<http://www.bbc.co.uk/learningenglish/>

<http://www.better-english.com/>

<http://www.nonstopenglish.com/>

<https://www.vocabulary.com/>

[BBC Vocabulary Games](#)

[Free Rice Vocabulary Game](#)

Reading

<https://www.usingenglish.com/comprehension/>

<https://www.englishclub.com/reading/short-stories.htm>

<https://www.english-online.at/>

Listening

<https://learningenglish.voanews.com/z/3613>

<http://www.englishmedialab.com/listening.html>

Speaking

<https://www.talkenglish.com/>

[BBC Learning English – Pronunciation tips](#)

[Merriam-Webster – Perfect pronunciation Exercises](#)

All Skills

<https://www.englishclub.com/>

<http://www.world-english.org/>

<http://learnenglish.britishcouncil.org/>

Online Dictionaries

[Cambridge dictionary online](#)

[MacMillan dictionary](#)

[Oxford learner's dictionaries](#)

## Course Outcomes:

At the end of the course, the learners will be able to

- Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English

- Apply grammatical structures to formulate sentences and correct word forms
- Analyze discourse markers to speak clearly on a specific topic in informal discussions
- Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.
- Create a coherent paragraph interpreting a figure/graph/chart/table



(19A52101P) COMMUNICATIVE ENGLISH I LAB  
(Common to All Branches of Engineering)

### Introduction

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

### Course Objectives

- To expose the students to variety of self instructional, learner friendly modes of language learning
- To help the students cultivate the habit of reading passages from the computer monitor. Thus providing them with the required facility to face computer based competitive exams like GRE, TOEFL, and GMAT etc.
- To enable them to learn better pronunciation through stress, intonation and rhythm
- To train them to use language effectively to face interviews, group discussions, public speaking
- To initiate them into greater use of the computer in resume preparation, report writing, format making etc

### Course Outcomes

- CO1: To remember and understand the different aspects of the English language proficiency with emphasis on LSRW skills
- CO2: To apply communication skills through various language learning activities
- CO3: To analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
- CO4: To evaluate and exhibit acceptable etiquette essential in social and professional settings
- CO5: To create awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.

### Unit 1

1. Phonetics for listening comprehension of various accents
2. Reading comprehension

### 3. Describing objects/places/persons

#### **Learning Outcomes**

At the end of the module, the learners will be able to

- understand different accents spoken by native speakers of English
- employ suitable strategies for skimming and scanning on monitor to get the general idea of a text and locate specific information
- learn different professional registers and specific vocabulary to describe different persons, places and objects

#### **Unit 2**

1. JAM
2. Small talks on general topics
3. Debates

#### **Learning Outcomes**

At the end of the module, the learners will be able to

- produce a structured talk extemporarily
- comprehend and produce short talks on general topics
- participate in debates and speak clearly on a specific topic using suitable discourse markers

#### **Unit 3**

1. Situational dialogues – Greeting and Introduction
2. Summarizing and Note making
3. Vocabulary Building

#### **Learning Outcomes**

At the end of the module, the learners will be able to

- Learn different ways of greeting and introducing oneself/others
- summarize the content with clarity and precision and take notes while listening to a talk/lecture and make use of them to answer questions
- replenish vocabulary with one word substitutes, homonyms, homophones, homographs to reduce errors in speech and writing

#### **Unit4**

1. Asking for Information and Giving Directions
2. Information Transfer
3. Non-verbal Communication – Dumb Charade

#### **Learning Outcomes**

At the end of the module, the learners will be able to

- Learn different ways of asking information and giving directions
- Able to transfer information effectively
- understand non-verbal features of communication

#### **Unit 5**

1. Oral Presentations

2. Précis Writing and Paraphrasing
3. Reading Comprehension and spotting errors

### Learning Outcomes

At the end of the module, the learners will be able to

- make formal oral presentations using effective strategies
- learn different techniques of précis writing and paraphrasing strategies
- comprehend while reading different texts and edit short texts by correcting common errors

### Reference Books

- English in Action, 1st Edition, 2019, Maruthi Publications.
- Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.
- Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking*. Heinley ELT; 2nd Edition, 2018.
- Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.

### Sample Web Resources

Grammar/Listening/Writing

[1-language.com](http://1-language.com)

<http://www.5minuteenglish.com/>

<https://www.englishpractice.com/>

Grammar/Vocabulary

[English Language Learning Online](http://www.bbc.co.uk/learningenglish/)

<http://www.bbc.co.uk/learningenglish/>

<http://www.better-english.com/>

<http://www.nonstopenglish.com/>

<https://www.vocabulary.com/>

[BBC Vocabulary Games](#)

[Free Rice Vocabulary Game](#)

Reading

<https://www.usingenglish.com/comprehension/>

<https://www.englishclub.com/reading/short-stories.htm>

<https://www.english-online.at/>

Listening

<https://learningenglish.voanews.com/z/3613>

<http://www.englishmedialab.com/listening.html>

Speaking

<https://www.talkenglish.com/>

[BBC Learning English – Pronunciation tips](#)

[Merriam-Webster – Perfect pronunciation Exercises](#)

## All Skills

<https://www.englishclub.com/>

<http://www.world-english.org/>

<http://learnenglish.britishcouncil.org/>

## Online Dictionaries

[Cambridge dictionary online](#)

[MacMillan dictionary](#)

[Oxford learner's dictionaries](#)

**(19A03201) MECHANICAL ENGINEERING WORKSHOP**

**Course Objectives:**

1. Familiarize moulding and casting skills.
2. Train on different types welding joints.
3. Develop assemble or disassembly skills.
4. Make plastic components.
5. Familiarize with use power tools.
6. Demonstrate assembly of computer and installation of software

**Foundry Practice: (2 Sessions)**

- i. a) Determination of average grain size for sand sample using sieve shaker  
b) Preparation of a green sand mould using single piece pattern
- ii. Preparation of a green sand mould using split piece pattern with core and demonstration of casting.

**Welding Practice: (2 Sessions)**

- i. Lap joint, butt joint and T joint using arc welding.
- ii. a) Lap joint using resistance spot welding  
b) Lap and butt joints using gas welding

**Assembling/Disassembling Practice: (3 Sessions)**

- i. Bicycle
- ii. Clutch and carburetor
- iii. Two wheeler engine parts
- iv. Desktop Computer and installation of Operating system Software

**Manufacture of a Plastic Component (2 Sessions)**

- i. Use of injection moulding machine
- ii. FRP composite using hand layup method
- iii. Joining of plastic components

**Manufacturing any two domestic utility products with any material by above methods (2 Sessions) Use of Power Tools (2 Sessions)**

Drilling, Cutting, Planing, Finishing, Etc., on wood or metals

**Text Books:**

1. K. Venkata Reddy Workshop Manual 6<sup>th</sup> Ed., B.S. Publishers, 2013.
2. B.L. Juneja Workshop practice 1<sup>st</sup> Ed., Cengage, 2015.

**Course Outcomes:**

After completion of this lab student will be able to

- make moulds for sand casting. (L3)
- develop different weld joints. (L3)
- assemble or disassemble of machine components. (L3)
- make plastic components. (L3)
- use power tools for different applications. (L3)
- Assemble computer and installation of software (L3)

**(19A02201P) BASIC ELECTRICAL & ELECTRONICS ENGINEERING LAB**  
**(Civil, Mechanical, CSE, CSSE, IT and Food Technology)**

**Part A: Electrical Engineering Lab**

**Course Objectives:**

1. To Verify Kirchoff's laws
2. To verify Superposition theorem.
3. To learn performance characteristics of DC Machines.
4. To perform open circuit & Short Circuit test on 1- Phase Transformer.
5. To Study the I – V Characteristics of Solar PV Cell

**List of experiments: -**

1. Verification of Kirchhoff laws.
2. Verification of Superposition Theorem.
3. Open circuit characteristics of a DC Shunt Generator.
4. Speed control of DC Shunt Motor.
5. OC & SC test of 1 – Phase Transformer.
6. Brake test on 3 - Phase Induction Motor.
7. I – V Characteristics of Solar PV cell
8. Brake test on DC Shunt Motor.

**Course Outcomes: Able to**

1. Verify Kirchoff's Laws & Superposition theorem.
2. Perform testing on AC and DC Machines.
3. Study I – V Characteristics of PV Cell

**Part B: Electronics Engineering Lab**

**Course outcomes:**

- Describe construction, working and characteristics of diodes, transistors and operational amplifiers (L2)
- Demonstrate how electronic devices are used for applications such as rectification, switching and amplification (L2)
- Build different building blocks in digital electronics using logic gates (L3)
- Explain functionality of flip-flops, shift registers and counters for data processing applications (L2)
- Explain functioning of various communication systems (L2)

**List of Experiments:**

1. Draw and study the characteristics of Semi-conductor diode and Zener Diode
2. Draw and study the input and output characteristics of Transistor in Common Emitter configuration
3. Draw and study the static and transfer characteristics of FET in Common Source Configuration

4. Construct half wave and full wave rectifier circuits. Find ripple factor and plot their output waveforms with and without filters
5. Study the application of Op-amp as an Inverting amplifier, Non-inverting amplifier, Voltage follower, Summer and Subtractor
6. Realization of logic gates, AND, OR, NOT, NAND, NOR, XOR
7. Realization of Adders, Multiplexers and Decoders using logic gates.
8. Realization of flip-flops using logic gates.
9. Conduct an experiment on AM & FM modulation & demodulation, Plot the corresponding modulated and demodulated signals



**(19A56102P) ENGINEERING PHYSICS LAB**  
**(Civil, Mechanical and Food Technology)**

**Course Objectives:**

- Understand the role of Optical fiber parameters in engineering applications.
- Recognize the significance of laser by studying its characteristics and its application in finding the particle size.
- Illustrates the magnetic and dielectric materials applications.
- Identifies the various sensor applications.

**Note: - In the following list of experiments, out of 15 experiments any 12 experiments must be performed in a semester.**

**List of Physics Experiments:**

1. Determination of wavelength of LASER light using diffraction grating.  
Experimental outcomes:  
operates various instrument (L2)  
estimate the wavelength of laser source (L2)  
Identifies the formation of grating spectrum due diffraction. (L2)
2. Determination of particle size using LASER.  
Experimental outcomes:
  - operates various instrument (L2)
  - estimate the Particles size using laser (L2)
  - Identifies the application of laser (L2)
3. Determination of spring constant of springs using Coupled Oscillator  
Experimental outcomes:  
operates various instrument. (L2)  
estimate the spring constant (L2)  
Identifies the principle of coupled oscillations. (L2)
4. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.  
operates various instruments and connect them as per the circuit. (L2)  
estimate the charge carrier concentration and mobility in a semiconductor. (L2)  
Illustrates the applications of hall effect. (L3)  
plots the voltage with current and voltage with magnetic field (L3)
5. Determination of Dielectric constant of dielectric material using charging and discharging of capacitor.  
Experimental outcomes:  
operates various instruments and connect them as per the circuit. (L2)  
estimate the dielectric constant of the given substance. (L2)  
Identifies the significance of dielectric constant in various devices. (L2)
6. Magnetic field along the axis of a circular coil carrying current.  
Experimental outcomes:  
operates various instruments and connect them as per the circuit. (L2)

- estimate the magnetic field along the axis of a circular coil carrying current. (L2)  
plots the intensity of the magnetic field of circular coil carrying current with distance (L3)
7. Rigidity modulus of material of a wire-dynamic method (Torsional pendulum)  
Experimental outcomes:  
operates various instruments. (L2)  
estimate the rigidity modulus of a given wire (L2)  
plots length of the pendulum ( $l$ ) with time period  $T^2$  (L3)
8. Determination of hysteresis loss by tracing B-H Curve of ferromagnetic material.  
Experimental outcomes:  
operates various instruments and connect them as per the circuit. (L2)  
estimate the hysteresis loss, coercivity and retentivity of the ferromagnetic material.. (L2)  
classifies the soft and hard magnetic material based on B-H curve. (L2)  
plots the magnetic field  $H$  and flux density  $B$  (L3)
9. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle  
Experimental outcomes:  
operates various instruments and connect them as per the circuit. (L2)  
estimate the numerical aperture and acceptance angle of a given optical fiber. (L2)  
Identifies the significance of numerical aperture and acceptance angle of a optical fiber in various engineering applications. (L2)
10. Measurement of magnetic susceptibility by Gouy's method  
Experimental outcomes:  
operates various instruments and connect them as per the circuit. (L2)  
estimate the magnetic susceptibility of the given material. (L2)  
Identifies the significance of magnetic susceptibility in various engineering applications. (L2)
11. Determination of ultrasonic velocity in liquid (Acoustic grating)  
Experimental outcomes:  
operates various instruments. (L2)  
estimate the velocity of ultrasonic waves in liquids. (L2)  
Illustrates the basic applications of ultrasonics. (L3)
12. Determination of pressure variation using Strain Gauge sensor.  
Experimental outcomes:  
operates various instruments. (L2)  
estimate the pressure variation using strain gauge sensor. (L2)  
Illustrates the applications of strain gauge sensors. (L3)
13. Determination of temperature change using Strain Gauge sensor.  
Experimental outcomes:  
operates various instruments. (L2)  
estimate the temperature variation using strain gauge sensor. (L2)  
Illustrates the applications of strain gauge sensors. (L3)
14. Determination of pressure variations using optical fiber sensors.  
Experimental outcomes:  
operates various instruments. (L2)

estimate the pressure variation using Optical fiber sensor. (L2)  
Illustrates the applications of Optical fiber sensors. (L3)

15. Determination of temperature changes using optical fiber sensors.

Experimental outcomes:

operates various instruments. (L2)

estimate the temperature variation using Optical fiber sensor. (L2)

Illustrates the applications of Optical fiber sensors. (L3)

### Course Outcomes:

*The students will be able to*

- **Operate** various optical instruments (L2)
- **Estimate** wavelength of laser and particles size using laser (L2)
- **estimate** the susceptibility and related magnetic parameters of magnetic materials (L2)
- **plot** the intensity of the magnetic field of circular coil carrying current with distance (L3)
- **evaluate** the acceptance angle of an optical fiber and numerical aperture (L3)
- **determine** magnetic susceptibility of the material and its losses by B-H curve (L3)
- **identify** the type of semiconductor i.e., n-type or p-type using hall effect (L3)
- **Apply** the concepts of sensors for various applications (L2)

### Reference Books:

1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017
2. <http://vlab.amrita.edu/index.php> -Virtual Labs, Amrita University

**(19A05201P) DATA STRUCTURES LAB**  
**(Common to All Branches of Engineering)**

**Course Objectives:**

1. To introduce to the different data structures
2. To elucidate how the data structure selection influences the algorithm complexity
3. To explain the different operations that can be performed on different data structures
4. To introduce to the different search and sorting algorithms.

**Laboratory Experiments**

1. String operations using array of pointers
2. Searching Algorithms (With the Number of Key Comparisons) Sequential, Binary and Fibonacci Search Algorithms.
3. Sorting Algorithms: Insertion Sort, Selection Sort, Shell Sort, Bubble Sort, Quick Sort, Heap Sort, Merge Sort, and Radix Sort. Using the system clock, compute the time taken for sorting of elements. The time for other operations like I/O etc should not be considered while computing time.
4. Implementation of Singly Linked List, Doubly Linked List, Circular Linked List
5. Stack implementation using arrays
6. Stack implementation using linked lists
7. Queue implementation using arrays. Implement different forms of queue. While implementing you should be able to store elements equal to the size of the queue. No positions should be left blank.
8. Queue implementation using linked lists
9. Creation of binary search tree, performing operations insertion, deletion, and traversal.
10. Breadth first search
11. Depth first search
12. Travelling sales man problem
13. File operations
14. Indexing of a file
15. Reversing the links (not just displaying) of a linked list.
16. Consider a linked list consisting of name of a person and gender as a node. Arrange the linked list using 'Ladies first' principle. You may create new linked lists if necessary.
17. An expression can be represented in three ways: infix, prefix and postfix. All the forms are necessary in different contexts. Write modules to convert from one form to another form.
18. A table can be defined as a collection of rows and columns. Each row and column may have a label. Different values are stored in the cells of the table.

The values can be of different data types. Numerical operations like summation, average etc can be performed on rows/columns which contain numerical data. Such operations are to be prevented on data which is not numeric. User may like to insert row/columns in the already existing table. User may like to remove row/column. Create table datatype and support different operations on it.

**Course Outcomes:**

At the end of the course students should be able to

1. Select the data structure appropriate for solving the problem (L5)
2. Implement searching and sorting algorithms (L3)
3. Design new data types (L6)
4. Illustrate the working of stack and queue (L4)
5. Organize the data in the form of files (L6)

**(19A54301) COMPLEX VARIABLES, TRANSFORMS & PARTIAL DIFFERENTIAL EQUATIONS**

(Common to MECH & CIVIL)

**Course Objective:**

This course aims at providing the student to acquire the knowledge on the calculus of functions of complex variables. The aim is to analyze the solutions of partial differential equations.

**Unit-I: Complex Variable – Differentiation:**

Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations, analytic functions (exponential, trigonometric, logarithm), harmonic functions, finding harmonic conjugate-construction of analytic function by Milne Thomson method-Conformal mappings-standard and special transformations ( $\sin z$ ,  $e^z$ ,  $\cos z$ ,  $z^2$ ) Mobius transformations (bilinear) and their properties.

**Unit Outcomes:**

Students will be able to

- Understand functions of Complex variable and its properties.
- Find derivatives of complex functions.
- Understand the analyticity of complex functions .
- Understand the conformal mappings of complex functions.

**Unit-II: Complex Variable – Integration:**

Line integral-Contour integration, Cauchy's integral theorem, Cauchy Integral formula, Liouville's theorem (without proof) and Maximum-Modulus theorem (without proof); power series expansions: Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals (around unit circle, semi circle with  $f(z)$  not having poles on real axis).

**Unit Outcomes:**

Students will be able to

- Understand the integration of complex functions.
- Apply Cauchy's integral theorem and Cauchy's integral formula.
- Understand singularities of complex functions.
- Evaluate improper integrals of complex functions using Residue theorem.

**Unit-III: Laplace Transforms**

Definition-Laplace transform of standard functions-existence of Laplace Transform – Inverse transform – First shifting Theorem, Transforms of derivatives and integrals – Unit step function – Second shifting theorem – Dirac’s delta function – Convolution theorem – Laplace transform of Periodic function. Differentiation and integration of transform – solving Initial value problems to ordinary differential equations with constant coefficients using Laplace transforms.

### **Unit Outcomes:**

Students will be able to

- Understand the concept of Laplace transforms and find the Laplace transforms of elementary functions.
- Find the Laplace transforms of general functions using its properties.
- Understand Laplace transforms of special functions(Unit step function, Unit Impulse & Periodic).
- Apply Laplace transforms to solve Differential Equations.

### **Unit-IV: Fourier series**

Determination of Fourier coefficients (Euler’s) – Dirichlet conditions for the existence of Fourier series – functions having discontinuity-Fourier series of Even and odd functions – Fourier series in an arbitrary interval – Half-range Fourier sine and cosine expansions- typical wave forms - Parseval’s formula- Complex form of Fourier series.

### **Unit Outcomes:**

Students will be able to

- Understand finding Fourier series expression of the given function.
- Determine Fourier coefficients (Euler’s) and identify existence of fourier series of the given function.
- Expand the given function in Fourier series given in Half range interval.
- Apply Fourier series to establish Identities among Euler coefficients.
- Find Fourier series of wave forms.

### **Unit-V: Partial Differential Equations & Applications**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of first order PDEs by Lagrange’s method- Solution of non linear PDEs (Standard forms)-Solution of second order PDEs by Method of separation of variables – Solutions of one dimensional wave equation, one dimensional heat equation under initial and boundary conditions.

### **Unit Outcomes:**

At the end of this unit, the students will be able to

- Form Partial Differential Equations.

- Solve Partial Differential Equations of first order.
- Understand the method of separation of variables.
- Solve applications of Partial Differential Equations.

**Course Outcomes:**

After the completion of course, students will be able to

- Understand the analyticity of complex functions and conformal mappings.
- Apply Cauchy's integral formula and Cauchy's integral theorem to evaluate improper integrals along contours.
- Understand the usage of Laplace Transforms.
- Evaluate the Fourier series expansion of periodic functions.
- Formulate/solve/classify the solutions of Partial differential equations and also find the solution of one dimensional wave equation and heat equation.

**Text Books:**

1. B.S.Grewal , "Higher Engineering Mathematics", Khanna publishers.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India

**Reference Books:**

1. B.V.Ramana, "Higher Engineering Mathematics", Mc Graw Hill publishers.
2. Alan Jeffrey, "Advanced Engineering Mathematics", Elsevier.



**(19A05304T) PYTHON PROGRAMMING**

**Course Objectives:**

- To learn the fundamentals of Python
- To elucidate problem-solving using a Python programming language
- To introduce a function-oriented programming paradigm through python
- To get training in the development of solutions using modular concepts
- To introduce the programming constructs of python

**Unit – I**

**Introduction:** What is a program, Running python, Arithmetic operators, Value and Types.

**Variables, Assignments and Statements:** Assignment statements, Script mode, Order of operations, string operations, comments.

**Functions:** Function calls, Math functions, Composition, Adding new Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters are local, Stack diagrams, Fruitful Functions and Void Functions, Why Functions.

**Unit Outcomes:**

Student should be able to

- List the basic constructs of Python.
- Solve the problems by applying modularity principle.

**Unit – II**

**Case study:** The turtle module, Simple Repetition, Encapsulation, Generalization, Interface design, Refactoring, docstring.

**Conditionals and Recursion:** floor division and modulus, Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, Recursion, Infinite Recursion, Keyboard input.

**Fruitful Functions:** Return values, Incremental development, Composition, Boolean functions, More recursion, Leap of Faith, Checking types,

**Unit Outcomes:**

Student should be able to

- Apply the conditional execution of the program.
- Apply the principle of recursion to solve the problems.

**Unit – III**

**Iteration:** Reassignment, Updating variables, The while statement, Break, Square roots, Algorithms.

**Strings:** A string is a sequence, len, Traversal with a for loop, String slices, Strings are immutable, Searching, Looping and Counting, String methods, The in operator, String comparison.

**Case Study:** Reading word lists, Search, Looping with indices.

**Lists:** List is a sequence, Lists are mutable, Traversing a list, List operations, List slices, List methods, Map filter and reduce, Deleting elements, Lists and Strings, Objects and values, Aliasing, List arguments.

### **Unit Outcomes:**

Student should be able to

- Use the data structure list.
- Design programs for manipulating strings.

### **Unit – IV**

**Dictionaries:** A dictionary is a mapping, Dictionary as a collection of counters, Looping and dictionaries, Reverse Lookup, Dictionaries and lists, Memos, Global Variables.

**Tuples:** Tuples are immutable, Tuple Assignment, Tuple as Return values, Variable-length argument tuples, Lists and tuples, Dictionaries and tuples, Sequences of sequences.

**Files:** Persistence, Reading and writing, Format operator, Filename and paths, Catching exceptions, Databases, Pickling, Pipes, Writing modules.

**Classes and Objects:** Programmer-defined types, Attributes, Instances as Return values, Objects are mutable, Copying.

Classes and Functions:

### **Unit Outcomes:**

Student should be able to

- Apply object orientation concepts.
- Use data structure dictionaries.
- Organize data in the form of files.

### **Unit – V**

**Classes and Functions:** Time, Pure functions, Modifiers, Prototyping versus Planning

**Classes and Methods:** Object oriented features, Printing objects, The init method, The \_\_str\_\_ method, Operator overloading, Type-based Dispatch, Polymorphism, Interface and Implementation

**Inheritance:** Card objects, Class attributes, Comparing cards, decks, Printing the Deck, Add Remove shuffle and sort, Inheritance, Class diagrams, Data encapsulation.

**The Goodies:** Conditional expressions, List comprehensions, Generator expressions, any and all, Sets, Counters, defaultdict, Named tuples, Gathering keyword Args,

### **Unit Outcomes:**

Student should be able to

- Plan programs using object orientation approach.
- Illustrate the principle of inheritance.

**Course Outcomes:**

Student should be able to

1. Apply the features of Python language in various real applications.
2. Select appropriate data structure of Python for solving a problem.
3. Design object oriented programs using Python for solving real-world problems.
4. Apply modularity to programs.

**Text books:**

1. Allen B. Downey, “Think Python”, 2<sup>nd</sup> edition, SPD/O’Reilly, 2016.

**Reference Books:**

1. Martin C.Brown, “The Complete Reference: Python”, McGraw-Hill, 2018.
2. Kenneth A. Lambert, B.L. Juneja, “Fundamentals of Python”, Cengage, 2015.
3. R. Nageswara Rao, “Core Python Programming”, 2<sup>nd</sup> edition, Dreamtech Press, 2019

19A03301T MANUFACTURING PROCESSES

Course Objectives:

- Working principle of different metal casting processes and gating system.
- Nature of plastic deformation, cold and hot working process, working of a rolling mill and types, extrusion processes.
- Principles of forging, tools and dies, working of forging processes.
- Classification of the welding processes, working of different types of welding processes and welding defects
- Classification, applications and manufacturing methods of plastics, ceramics and powder metallurgy.
- Learning Characteristics of Unconventional Machining Processes

UNIT I

8 hrs

**Introduction :** Importance and selection of manufacturing processes.

**Casting Processes:** Introduction to casting process, process steps; pattern: types, materials and allowance; Cores: Types of cores, core prints, principles and design of gating system; Solidification of casting: Concept, solidification of pure metal and alloy; Special casting processes: Shell casting, investment casting, die casting, centrifugal casting, casting defects and remedies.

Unit Outcomes:

At the end of this unit, the student will be able to

- Selection of suitable manufacturing process for a given product. (L3)
- Understand the steps involved in metal casting, pattern making. (L2)
- Apply the knowledge of designing gating systems, risers. (L3)
- Compare the working of various metal casting processes. (L4)
- Identify the various casting defects. (L3)

UNIT II

8hrs

**Metal Forming:** Introduction, nature of plastic deformation, hot and cold working of metals, mechanics of metal forming; Rolling: Principle, types of rolling mill and products, roll passes, forces in rolling and power requirements; Extrusion: Basic extrusion process and its characteristics, hot extrusion and cold extrusion, wire drawing, tube drawing.

**Forging:** Principles of forging, tools and dies. Types: Smith forging, drop forging, forging hammers, rotary forging and forging defects. Sheet metal forming: Mechanics of sheet metal working, blanking, piercing, bending, stamping.

## Unit Outcomes:

At the end of this unit, the student will be able to

- Compare cold working and hot working processes. (L4)
- Explain the working of rolling mills. (L2)
- Evaluate the forces and power in rolling and extrusion processes. (L5)
- Summarize the working of various extrusion processes. (L2)
- Identify the principles of forging, tools and dies. (L3)
- Summarize the various operations of Sheet metal forming. (L2)

## UNIT III

8hrs

**Metal Joining Processes:** Classification of welding processes, types of welds and welded joints and V-I characteristics, arc welding, weld bead geometry, submerged arc welding, gas tungsten arc welding, gas metal arc welding. applications, advantages and disadvantages of the above processes, other fabrication processes. Heat affected zones in welding; soldering and brazing: Types and their applications, Welding defects: causes and remedies.

## Unit Outcomes:

At the end of this unit, the student will be able to

- Classify the working of various welding processes. (L2)
- Compare V-I characteristics of different welding processes. (L4)
- Summarize the applications, advantages of various welding processes. (L2)
- Identify the defects in welding. (L3)

## UNIT IV : Plastic Processing, Ceramics and Powder Metallurgy:

8hrs

**Plastics:** Types, properties and their applications, processing of plastics, extrusion of plastics, transfer molding and compression molding, injection molding, thermoforming, rotational molding and blow molding

**Ceramics:** Classification of ceramic materials, properties and their application, ceramic powder preparation; Processing of ceramic parts: Pressing, casting, sintering; Secondary processing of ceramics: Coatings, finishing.

**Powder Metallurgy:** Principle, manufacture of powders, steps involved.

## Unit Outcomes:

At the end of this unit, the student will be able to

- Learn the methods of manufacturing plastics parts. (L2)
- Explain the steps in making ceramics parts. (L2)
- Explain the steps in manufacturing of powder metallurgy parts. (L2)
- Demonstrate the application of plastic, ceramics and power metallurgy. (L2)

## UNIT V

10hrs

**Unconventional Machining Processes:** Electrical discharge machining (EDM), principle and processes parameters, electro-chemical machining (ECM) Laser beam machining (LBM), plasma arc machining (PAM) and electron beam machining  
Principles and process parameters of Abrasive jet machining (AJM), water jet machining, ultrasonic machining

**Unit Outcomes:**

At the end of this unit, the student will be able to

- Identify different unconventional machining processes. (L3)
- Evaluate process parameters of EDM, ECM, LBM, PAM and AJM.(L5)
- Apply various unconventional machining processes. (L3)

**Course Outcomes:**

At the end of the course, the student will be able to

- Demonstrate different metal casting processes and gating systems. (L2)
- Classify working of various welding processes. (L2)
- Evaluate the forces and power requirements in rolling process. (L5)
- Apply the principles of various forging operations. (L3)
- Outline the manufacturing methods of plastics, ceramics and powder metallurgy. (L1)
- Identify different unconventional processes and their applications. (L3)

**Text Books:**

1. Rao P.N., “Manufacturing Technology – Volume I”, 5<sup>th</sup> edition, McGraw-Hill Education, 2018.
2. Kalpakjain S and Schmid S.R., “Manufacturing Engineering and Technology”, 7<sup>th</sup> edition, Pearson, 2018.

**Reference Books:**

1. Millek P. Groover, “Fundamentals of Modern Manufacturing”: “Materials, Processes and Systems”, 4<sup>th</sup> edition, John Wiley and Sons Inc, 2010.
2. Sharma P.C., “A Text book of Production Technology”, 8<sup>th</sup> edition, S Chand Publishing, 2014.

**(19A03302) ENGINEERING MECHANICS**

**Course Objectives:**

- Explain the effect of force and moment in different engineering applications.
- Teach centre of gravity and moment of inertia of solids and surfaces.
- Familiarize frictional forces in mechanical applications.
- Analysis of rigid bodies under dynamic conditions.

**UNIT I**

**12 hours**

Introduction to Engineering Mechanics: Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and concurrent coplanar forces, resultant of coplanar force systems couple, moment of a force Varignon's theorem, concept of free body diagrams, concept of equilibrium of coplanar force systems.

Friction: Laws of friction, types of friction, equilibrium of force systems involving frictional forces, wedge friction. Free body diagrams involving frictional forces.

**Unit Outcomes:**

At the end of this unit, the student will be able to

- Resolve the forces in mechanical systems (L2)
- Identify the moments and forces (L3)
- Draw free body diagram (L3)

**UNIT II**

**10 hours**

Analysis of Structures: Introduction to plane trusses, analysis of plane trusses by method of joints and method of sections.

Virtual Work: Equilibrium of ideal systems, work done by a force, work done by a couple, principle of virtual work.

**Unit Outcomes:**

At the end of this unit, the student will be able to

- Identify different types of trusses. (12)
- Analyze the plane trusses by method of joints and the method of sections. (14)
- Demonstrate equilibrium of ideal system. (12)
- Estimate the work done by a force and work done by a couple. (13)

**UNIT III**

**10 hours**

Properties of Surfaces and Volumes: Centroid and center of gravity, derivation of centroids from first moment of area, centroids of composite sections, center of gravity of common volumes - cylinder, cone, sphere, theorem of Pappus-Guldinus.

Moment of Inertia: Area moment of inertia of plane and composite shapes, parallel axis theorem, perpendicular axis theorem, polar moment of inertia, mass moment of inertia of common volumes - thin plates, thin rod, cylinder, cone, sphere, rectangular prism, radius of gyration.

### **Unit Outcomes:**

At the end of this unit, the student will be able to

- Identify the centre of gravity of composite sections. (L3)
- Determine the centre of gravity of common solids. (L3)
- Determine moment of inertia for composite volumes. (L3)

## **UNIT IV**

**10 hours**

**Kinematics:** Equations of motion for rigid bodies, constant and variable acceleration, rectilinear and curvilinear motion, motion under gravity - projectile motion, use of rectangular coordinates, tangential and normal coordinates, radius of curvature, rotation of a rigid body about a fixed axis, introduction to plane motion.

### **Unit Outcomes:**

At the end of this unit, the student will be able to

- Write equations of motion for rigid bodies. (L3)
- Find velocity and acceleration in rectilinear and curvilinear motions (L4)
- Trace the path of projectile. (L3)

## **UNIT V**

**10 hours**

**Kinetics:** Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy.

**Ideal Systems:** Principle of conservation of energy, concept of power, conservation of linear and angular momentum, principle of momentum and impulse, impact - types of impact.

### **Unit Outcomes:**

At the end of this unit, the student will be able to

- Apply D'Alembert's principle in rectilinear translation. (L3)
- Relate principle of work and energy in dynamic systems. (L3)
- Make use of principle of momentum and impulse to dynamic bodies. (L4)



**Course Outcomes:**

Upon successful completion of the course, the students will be able to

- Resolve forces and couples in mechanical systems. (L3)
- Identify the frictional forces and its influence on equilibrium. (L3)
- Find the centre of gravity and moment of inertia for various geometric shapes (L3)
- Develop equations for different motions. (L4)
- Determine the displacement, velocity and acceleration relations in dynamic systems (L4)
- Relate the impulse and momentum (L4)

**Text books:**

1. S S Bhavikatti, "Engineering Mechanics", 4<sup>th</sup> edition, New Age International, 2008.
2. S Timoshenko, DH Young, JV Rao, Sukumar Pati, "Engineering Mechanics (in SI units)", 5<sup>th</sup> edition, McGraw Hill, 2013.

**Reference Books:**

1. Basudeb Bhattacharya., "Engineering Mechanics", 2<sup>nd</sup> edition, Oxford University Press (India), 2015.
2. Irving Shames, G K M Rao, "Engineering Mechanics: Statics and Dynam-ics", 4<sup>th</sup> edition, Pearson, 2009.
3. K L Kumar, Veenu Kumar, "Engineering Mechanics", 4<sup>th</sup> edition, Tata McGraw Hill, 2010.

**(19A03303T) MATERIAL SCIENCE AND ENGINEERING**

**Course Objectives**

- To teach the principles of physical metallurgy, i.e. crystallography of metals, constitution of alloys, phase diagrams.
- Expose commercially important metals and alloys (both ferrous and non ferrous) with engineering constraints.
- Explain the methods to change the properties of materials through heat treatment processes
- Familiarize properties and applications of ceramics, polymers and composite materials.
- Demonstrate the fundamental properties of nano-materials and their applications.

**UNIT I**

**10 Hours**

**Structure of Metals:** Crystal Structures: Unit cells, Metallic crystal structures, Imperfection in solids: Point, Line, interstitial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

**Constitution of Alloys:** Necessity of Alloying, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-Iron-carbide diagram and microstructural aspects of ferrite, cementite, austenite, ledeburite, and cast iron.

**Unit Outcomes:**

At the end of this unit the student will be able to

- Explain the importance of material science in engineering.(L2)
- Recall the definitions and terminology of crystallography. (L1)
- Distinguish metals and alloys. (L4)
- Make use of the principles of construction of binary phase diagrams. (L3)
- Identify various invariant reactions in binary phase diagrams. (L3)
- Explain the concept of metallography in studying the microstructures of metals and alloys. (L2)

**UNIT II**

**8 Hours**

Steels:

Plain carbon steels, use and limitations of plain carbon steels. AISI& BIS classification of steels. Classification of alloy steels. Micro structure, properties and applications of alloy steels-stainless steels and tool steels.

Cast irons:

Micro structure, properties and applications of white cast iron, malleable cast iron, grey cast iron, nodular cast iron and alloy cast irons.

### **Unit Outcomes:**

At the end of this unit the student will be able to

- Classify various types of steels, their properties and applications. (L2)
- Identify various types of cast irons, their properties and applications. (L3)
- Compare steels and cast irons and their limitations in applications. (L3)

## **UNIT III**

**8 Hours**

**Heat Treatment of Steels:** Annealing, tempering, normalizing and spheroidizing, isothermal transformation diagrams for Fe-Fe<sub>3</sub>C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, and vacuum and plasma hardening

### **Unit Outcomes:**

At the end of this unit the student will be able to

- Understand the importance of steel and iron - iron carbide phase diagram. (L2)
- Explain the influence of heat treatment in modification of properties of steels. (L2)
- Develop a heat treatment cycle based on properties required. (L3)
- Explain the principles of surface hardening methods. (L2)

## **UNIT IV**

**8 Hours**

**Non-ferrous Metals and Alloys:** Micro structure, properties and applications of copper and its alloys, aluminium and its alloys. Study of Al-Cu phase diagram, precipitation hardening. Micro structure, properties and applications of titanium and its alloys.

### **Unit Outcomes:**

At the end of this unit the student will be able to

- Explain the importance of non-ferrous metals and alloys in engineering applications. (L2)
- Demonstrate various properties and applications of non-ferrous alloys. (L4)
- Differentiate between hardening of ferrous and non-ferrous alloys. (L4)

## **UNIT V**

**8 Hours**

**Ceramics, Polymers and Composites:** Structure, properties and applications of ceramics, polymers and composites. Introduction to super alloys and nanomaterials.

### **Unit Outcomes:**

At the end of this unit the student will be able to

- Explain the properties of ceramics and their applications. (L2)
- Summarize the properties of polymers and composites and their use. (L2)
- Interpret the properties of nano materials and their applications. (L2)
- Identify the difference between the micro and nano scale materials and their uses. (L3)

### **Course Outcomes:**

After completing the course, the student will be able to

- Explain the principles of binary phases. (L2)
- Select steels and cast irons for a given application. (L3)
- Apply heat treatment to different applications. (L3)
- Utilize nonferrous metals and alloys in engineering. (L3)
- Choose composites for various applications. (L3)
- Assess the properties of nano-scale materials and their applications. (L2)

### **Text Book(s)**

1. V.Raghavan, “Material Science and Engineering”, 5<sup>th</sup> edition, Prentice Hall of India, 2004.
2. R.Balasubramaniam, Callister’s “Material Science and Engineering”, 2<sup>nd</sup> edition, Wiley India, 2014.

### **References**

1. Y. Lakhtin, “Engineering Physical Metallurgy”, University Press of the Pacific, 2000.
2. S.H.Avner, “Introduction to Physical Metallurgy”, 2<sup>nd</sup> edition, Tata McGraw- Hill, 1997.
3. L.H.Van Vlack, “Elements of Material Science and Engineering”, 6<sup>th</sup> edition, Pearson Education, 2008.
4. George E.Dieter, “Mechanical Metallurgy”, 3<sup>rd</sup> edition, McGraw-Hill, 2013.

**(19A99303T) DESIGN THINKING AND PRODUCT INNOVATION**

Design is a realization of a concept or idea into a configuration, drawing or a product. Design thinking is cognitive and practical processes by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end user. This course introduces the design thinking in product innovation.

**Course Objectives:**

- To bring awareness on innovative design and new product development.
- To explain the basics of design thinking.
- To familiarize the role of reverse engineering in product development.
- To train how to identify the needs of society and convert into demand.
- To introduce product planning and product development process.

**UNIT I**

Science to Engineering: Job of engineers, engineering units and measurement, elements of engineering analysis, forces and motion, energy, kinematics and motion, conversion of linear motion to rotary and vice versa, motion transmission.

Physics to Engineering: Application of Newton laws, Pascal's law, Bouncy, Bernoulli's theorem, Ohm's law, electrical induction in engineering products.

**Unit Outcomes:**

After completion of this Unit, the student will be able to

- Relate the principles of science to engineering (L2)
- Explain simple mechanics motion and force transmission (L2)
- Identify the laws of physics applied to engineering products (L3)

**UNIT II**

Historical Development: Invention wheel, early mechanics in design, mechanical advantages, industrial revolution, steam and petrol for mobility. Innovations in Electrical and Electronics: Electrical energy generation, electrical bulb, electrical equipment, electronics and automation, computing for early days to present, innovations in communications.

**Unit Outcomes:**

After completion of this Unit, the student will be able to

- Identify innovation in early mechanical designs (L2)
- Explain development of electrical equipment (L2)

- list out the developments in computing machines (L4)
- summarize innovations in communication systems (L2)

### **UNIT III**

Systematic approach to product development: Design Thinking, Innovation, Empathize Design Thinking as a systematic approach to Innovation, brainstorming, visual thinking, design challenges, innovation, art of Innovation, strategies for idea generation, creativity, teams for innovation. Solution finding methods: Conventional, intuitive, discursive, methods for combining solution, decision making for new design.

#### **Unit Outcomes:**

After completion of this Unit, the student will be able to

- Explain the steps in the design process (L2)
- Apply systematic approach in design (L3)
- Develop strategies for new product development (L3)

### **UNIT IV**

Reverse engineering in product development: Reversing engineering methods, identifying the bad features in a product, reduction in size and weight, usage of new materials, 3D printing, study of introducing electrical and electronic controls to the old products, importance of ergonomics in product development, environmental considerations in design, safety considerations in design.

#### **Unit Outcomes:**

After completion of this Unit, the student will be able to

- Understand reverse engineering methods in product development (L2)
- Use new materials to improve the product (L2)
- Apply electronic controls to improve the product acceptability (L3)
- Summarize the safety and environmental factors in new product design (L2)
- Understand 3D printing in manufacturing (L2)

### **UNIT V**

Study of Product Development- Agriculture, development of machines for separation of corn seeds, peeling of groundnut shells, husk removing from paddy. Electrical: Design of burglar alarm, speedometer, water level indicator, smart gates, smart lights. Design of electrical vehicles, unmanned vehicles, design principles in drones.

#### **Unit Outcomes:**

After completion of this Unit, the student will be able to

- Identify the needs for new product development in agriculture (L3)
- Develop simple electrical gadgets (L3)
- Explain the principles in design electrical vehicles and drones (L2)

### **Course Outcomes**

After completion of this course, the student will be able to

- summarize the importance of basic sciences in product development (L2)
- explain the historical developments in mechanical, electrical, communications and computational engineering (L3)
- apply systematic approach to innovative designs (L3)
- identify new materials and manufacturing methods in design (L3)

### **Text Book(s)**

1. Philip Kosky, Robert T. Balmer, William D. Keat, George Wise, “Exploring Engineering: An Introduction to Engineering and Design”, 4<sup>th</sup> edition, Elsevier, 2016.
2. David Ralzman, “History of Modern Design”, 2<sup>nd</sup> edition, Laurence King Publishing Ltd., 2010
3. An AVA Book, “Design Thinking”, AVA Publishing, 2010.

### **Reference Books:**

1. G. Pahl, W.Beitz, J. Feldhusen, KH Grote, “Engineering Design: A Systematic Approach”, 3<sup>rd</sup> edition, Springer, 2007.
2. Tom Kelley, Jonathan Littman, “Ten Faces in Innovation”, Currency Books, 2006.

**(19A52301) UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY**  
(Common to all)

**Introduction:**

This course discusses the role of human values in one's family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course names as "H-102 Universal Human Values 2 : "Understanding Harmony" is designed which may be covered in their III or IV Semester.

In the Induction Program, students would get an initial exposure to human values through Universal Human Values-I. This exposure is to be augmented by this compulsory full semester foundation course.

**Course Objective:**

The objective of the course is four fold:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

**COURSE TOPICS:**

The course has 28 lectures and 14 practice sessions in 5 modules:

**Unit 1:**

**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario



- Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

## **Unit 2:**

### **Understanding Harmony in the Human Being - Harmony in Myself!**

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

## **Unit 3:**

### **Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship**

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
- Understanding the meaning of Trust; Difference between intention and competence
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

#### **Unit 4:**

##### **Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**

- Understanding the harmony in the Nature
- Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
- Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
- Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.

#### **Unit 5:**

##### **Implications of the above Holistic Understanding of Harmony on Professional Ethics**

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
- Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

#### **Text Book**

1. R R Gaur, R Asthana, G P Bagaria, “A Foundation Course in Human Values and Professional Ethics”, 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, “Teachers’ Manual for A Foundation Course in Human Values and Professional Ethics”, 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

## Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantik, 1999.
2. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
5. E. F. Schumacher. "Small is Beautiful"
6. Slow is Beautiful –Cecile Andrews
7. J C Kumarappa "Economy of Permanence"
8. Pandit Sunderlal "Bharat Mein Angreji Raj"
9. Dharampal, "Rediscovering India"
10. Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland(English)
13. Gandhi - Romain Rolland (English)

## MODE OF CONDUCT (L-T-P-C 2-1-0-2)

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than "extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practicals are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

## OUTCOME OF THE COURSE:

By the end of the course,

- Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
- They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
- They would have better critical ability.

- They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
- It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

**(19A99303P) DESIGN THINKING AND PRODUCT INNOVATION LAB**

**Course Objectives:**

- To develop products/models by 3D printing.
- To design measuring devices for temperature, pressure, humidity, water level, smart lighting.
- To design pneumatic and hydraulic circuits.

**List of Experiments**

1. 3D Printing
  - a. To develop a CAD model and simulate in CAE environment.
  - b. To develop tooling and make a physical prototype (Two Exercises).
2. To design a device for measurement of Temperature/ pressure.
3. To design a device for measurement of Humidity.
4. To design a device for Water Level Indicator.
5. To design a Smart Lighting system.
6. To design Automatic Car Wiper/ safety issues in Automobiles.
7. Design of simple pneumatic and hydraulic circuits using basic components.
8. Design of pneumatic circuit for speed control of double acting cylinders.
9. Design a hydraulic circuit by using Flow Control Valves for simple application.
10. Design and Simulation of a Hydraulic Shaper.
11. Design and Simulation of a Hydro Electric Circuit for simple application.

**Course Outcomes:**

The student is able to

- To develop 3D models using 3D printing
- To design the system with measuring devices
- Design hydraulic / pneumatic circuits

**(19A03301P) MANUFACTURING PROCESSES LAB**

**Course Objectives:**

- Acquire practical knowledge on Metal Casting, Welding, Press Working and unconventional machining Processes.

**1. METAL CASTING**

- Gating Design and pouring time and solidification time calculations.
- Sand Properties Testing – Exercise for Strength and Permeability.
- Molding, Melting and Casting for ferrous/ non ferrous materials.

**2. WELDING**

- TIG Welding.
- MIG Welding.
- Friction stir welding
- Any other Special Welding Processes.

**3. MECHANICAL PRESS WORKING**

- Press Tool: Blanking and Piercing operation with Simple, Compound and Combination dies.
- Closed die forging, Deep Drawing and Extrusion operations.

**4. UN CONVENTIONAL MANUFACTUNRING PROCESSES**

- Electro Discharge Machining(EDM)/ Wire cut EDM
- Plasma arc cutting / Abrasive jet machining (AJM)
- Additive manufacturing with reverse engineering

**Course Outcomes:**

At the end of the lab, the student will be able to

- Fabricate different types of components using various manufacturing techniques. (L6)
- Adapt unconventional manufacturing methods. (L6)

**(19A03303P) MATERIAL SCIENCE & ENGINEERING LAB**

**Course Objectives:**

- To understand microstructure and hardness of engineering materials.
- To explain grain boundaries and grain sizes of different engineering materials.

**List of Experiments:**

1. Study of microstructure of pure metals – Iron, copper and aluminum.
2. Study of microstructure of low carbon steel, mild steel and high carbon steel.
3. Study of microstructure of cast irons.
4. Study of microstructure of non-ferrous alloys – aluminum, copper, titanium, nickel and their alloys.
5. Study hardenability of steels by Jominy End Quench Test.
6. Study of microstructure of heat treated steels.
7. Find hardness of various untreated and treated steels.
8. Study of microstructure of ceramics, polymeric materials.
9. Study of microstructure of super alloy and nano-materials.
10. Find the hardness of ceramics, super alloys, nano-materials and polymeric materials (one sample on each)

**Course Outcomes:**

The student is able to

- Identify various microstructures of ferrous and non-ferrous metals and alloys. (L3)
- Visualize grains and grain boundaries. (L3)
- Importance of hardening of steels. (L2)
- Evaluate hardness of treated and untreated steels. (L4)

**Course Objectives:**

- To make the students to get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life
- To save earth from the inventions by the engineers.

**UNIT – I**

**Multidisciplinary Nature Of Environmental Studies:** – Definition, Scope and Importance – Need for Public Awareness.

**Natural Resources :** Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

**Unit Outcomes**

- To know the importance of public awareness
- To know about the various resources

**UNIT – II**

**Ecosystems:** Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

- a. Forest ecosystem.
- b. Grassland ecosystem
- c. Desert ecosystem
- d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**Biodiversity And Its Conservation :** Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and



local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

### **Course Outcomes:**

- To know about various eco systems and their characteristics
- To know about the biodiversity and its conservation

### **UNIT – III**

**Environmental Pollution:** Definition, Cause, effects and control measures of :

- a. Air Pollution.
- b. Water pollution
- c. Soil pollution
- d. Marine pollution
- e. Noise pollution
- f. Thermal pollution
- g. Nuclear hazards

**Solid Waste Management :** Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

### **Course Outcomes:**

- To know about the various sources of pollution.
- To know about the various sources of solid waste and preventive measures.
- To know about the different types of disasters and their managerial measures.

### **UNIT – IV**

**Social Issues And The Environment:** From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

## Course Outcomes:

- To know about the social issues related to environment and their protection acts.
- To know about the various sources of conservation of natural resources.
- To know about the wild life protection and forest conservation acts.

## UNIT – V

**Human Population And The Environment:** Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

**Field Work:** Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc..

### Unit Outcomes:

- To know about the population explosion and family welfare programmes.
- To identify the natural assets and related case studies.

## Course Outcomes:

At the end of the course, the student will be able to

- Grasp multidisciplinary nature of environmental studies and various renewable and nonrenewable resources.
- Understand flow and bio-geo- chemical cycles and ecological pyramids.
- Understand various causes of pollution and solid waste management and related preventive measures.
- About the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation.
- Casus of population explosion, value education and welfare programmes.

## TEXT BOOKS:

1. Text book of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, “Environmental Studies”, Pearson education
3. S.Azeem Unnisa, “Environmental Studies” Academic Publishing Company
4. K.Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd.

## **REFERENCES:**

1. Deeksha Dave and E.Sai Baba Reddy, "Textbook of Environmental Science", Cengage Publications.
2. M.Anji Reddy, "Text book of Environmental Sciences and Technology", BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice hall of India Private limited
5. G.R.Chatwal, "A Text Book of Environmental Studies" Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science, Prentice hall of India Private limited.

**(19A54304) NUMERICAL METHODS AND PROBABILITY THEORY**

(Common to EEE, MECH)

**Course Objective:**

This course aims at providing the student with the knowledge on

- Various numerical methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations.
- The theory of Probability and random variables.

**Unit-I: Solution of Algebraic & Transcendental Equations:**

Introduction-Bisection method-Iterative method-Regula falsi method-Newton Raphson method  
System of Algebraic equations: Gauss Jordan method-Gauss Siedal method.

**Unit Outcomes:**

Students will be able to

- Calculate the roots of equation using Bisection method and Iterative method.
- Calculate the roots of equation using Regula falsi method and Newton Raphson method.
- Solve the system of algebraic equations using Gauss Jordan method and Gauss Siedal method.

**Unit-II: Interpolation**

Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae. Gauss forward and backward formula, Stirling's formula, Bessel's formula.

**Unit Outcomes:**

Students will be able to

- Understand the concept of interpolation.
- Derive interpolating polynomial using Newton's forward and backward formulae.
- Derive interpolating polynomial using Lagrange's formulae.
- Derive interpolating polynomial using Gauss forward and backward formulae.

**Unit-III: Numerical Integration & Solution of Initial value problems to Ordinary differential equations**

Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method-Runge-Kutta Methods.

### **Unit Outcomes:**

Students will be able to

- Solve integral equations using Simson's  $1/3$  and Simson's  $3/8$  rule.
- Solve integral equations using Trapezoidal rule.
- Solve initial value problems to ordinary differential equations using Taylor's method.
- Solve initial value problems to ordinary differential equations using Euler's method and Runge Kutta methods.

### **Unit-IV: Probability theory:**

Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation.

### **Unit Outcomes:**

Students will be able to

- Understand the concept of Probability.
- Solve problems on probability using addition law and multiplication law.
- Understand Random variables and probability mass and density functions.
- Understand stastical constants of random variables.

### **Unit-V: Random variables & Distributions:**

Probability distribution - Binomial, Poisson approximation to the binomial distribution and normal distribution-their properties-Uniform distribution-exponential distribution

### **Unit Outcomes:**

Students will be able to

- Understand Probability distribution function.
- Solve problems on Binomial distribution.
- Solve problems on Poisson distribution.
- Solve problems on Normal distribution.

### **Course Outcomes:**

After the completion of course, students will be able to

- Apply numerical methods to solve algebraic and transcendental equations
- Derive interpolating polynomials using interpolation formulae
- Solve differential and integral equations numerically
- Apply Probability theory to find the chances of happening of events.
- Understand various probability distributions and calculate their statistical constants.

**Text Books:**

1. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers.
2. Ronald E. Walpole "Probability and Statistics for Engineers and Scientists", ,PNIE.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India

**Reference Books:**

1. B.V.Ramana, "Higher Engineering Mathematics", Mc Graw Hill publishers.
2. Alan Jeffrey, "Advanced Engineering Mathematics", Elsevier.

(19A03401) THERMODYNAMICS

**Course Objectives**

- Familiarize concepts of heat, work, energy and governing rules for conversion of one form to other.
- Explain relationships between properties of matter and basic laws of thermodynamics.
- Teach the concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
- Introduce the concept of available energy for maximum work conversion.
- Familiarize steam properties to understand working of steam power plants.
- Provide fundamental concepts of air standard cycles used in steam power plants, IC engines and gas turbines

**UNIT I**

**10 hours**

**Introduction: Basic Concepts:** Macroscopic and microscopic viewpoints, definitions of thermodynamic terms, quasi – static process, point and path function, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics.

**First law of Thermodynamics:** Joule’s experiment - first law of thermodynamics, corollaries-perpetual motion machines of first kind, first law applied to non-flow and flow process-limitations of first law of thermodynamics.

**Unit Outcomes**

At the end of this Unit, the student will be able to

- Understand thermodynamic systems, properties and their importance in solving engineering problems. (L3)
- Make energy balance for closed systems and open systems. (L4)
- Solve simple thermodynamics problems. (L3)

**UNIT II**

**8 hours**

**Second Law of Thermodynamics:** Kelvin - Planck statement and Clausius statement and their equivalence, corollaries - perpetual motion machines of second kind - reversibility and irreversibility, cause of irreversibility - Carnot cycle, heat engine, heat pump and refrigerator, Carnot theorem, Carnot efficiency.

**Unit Outcomes**

At the end of this Unit, the student will be able to

- Apply second law of thermodynamics in design of heat engine, refrigerator and heat pump. (L3)
- Explain the efficiency of thermodynamic systems.(L2)
- Enumerate the causes for poor performance of thermodynamic systems. (L3)

### UNIT III

**8 hours**

**Entropy:** Clausius inequality - Concept of Entropy- entropy equation for different processes and systems

**Availability and Irreversibility:** Definition of exergy and anergy, expressions for availability and irreversibility. Availability in steady flow, non-flow processes and irreversibility.

#### Unit outcomes

At the end of this Unit, the student will be able to

- Apply entropy concepts to estimate the performance of systems. (L3)
- Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process. (L4)

### UNIT IV

**8 hours**

**Properties of Steam and use of Steam Tables:** Pure Substances, P-V-T surfaces, T-s and h-s diagram, Mollier chart, dryness fraction, property tables, analysis of steam undergoing various thermodynamic processes using Mollier chart– steam calorimetry.

#### Unit Outcomes

At the end of this Unit, the student will be able to

- Apply properties of steam to design steam systems. (L3)
- Examine steam systems using conservation equations. (L4)
- Evaluate the dryness fraction and performance of steam systems. (L4)

### UNIT V

**8 hours**

**Thermodynamic Relations:** Maxwell relations, TdS equations, difference in heat capacities, ratio of heat capacities, Energy equation, Joule Thompson coefficient, Clausius-Clapeyron equation.

**Air Standard Cycles:** Otto, Diesel and dual cycles, P-V and T -S diagrams - description and efficiencies, mean effective pressures. Comparison of Otto, Diesel and dual cycles

#### Unit Outcomes

At the end of this Unit, the student will be able to

- Explain the importance of T-ds equations. (L3)
- Relate specific heats, internal energy, enthalpy and Joule-Thomson coefficient in standard form. (L3)



- Examine the importance of compression ratio. (L4)
- Explain the cycles on which internal combustion engines work. (L3)

### **Course Outcomes**

After completing the course, the student will be able to

- Explain the importance of thermodynamic properties related to conversion of heat energy into work. (L3)
- Apply the laws of thermodynamics to boilers, heat pumps, refrigerators, heat engines, compressors and nozzles. (L3)
- Utilize steam properties to design steam based components. (L4)
- Compare thermodynamic relations and air standard cycles. (L4)

### **Text Book(s)**

1. P.K.Nag, "Engineering Thermodynamics:", 5<sup>th</sup> edition, Tata McGraw Hill, 2013.
2. Yunus A. Cengel, Michael A. Boles, "Thermodynamics", 7<sup>th</sup> edition, Tata McGraw Hill, 2011.

### **References**

1. J.B.Jones and G.A.Hawkins, "Introduction to Thermodynamics", 2<sup>nd</sup> edition, John Wiley & Sons, 2012.
2. Moran, Michael J. and Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", 3<sup>rd</sup> edition, Wiley, 2015
3. R.K. Rajput, S.Chand& Co., "Thermal Engineering", 6<sup>th</sup> edition, Laxmi publications, 2010.

(19A03402T) MECHANICS OF MATERIALS

**Course Objectives:**

- Introduce the concepts of different stresses, strains and their relationships.
- Discuss the principal stresses and components of stress on different planes under different loads.
- Explain maximum shear force and bending moment of different beams under different loading conditions.
- Demonstrate bending stress and shear stress distribution of various cross section of beams and to predict the maximum slope deflection of beams.
- Impart strain energy due to axial, bending, and torsion loading, and to solve statically indeterminate problems using Castigliano's theorem.
- Focus on the stresses and deformations of the springs.
- Familiarize the Euler's concept of buckling in columns & struts.

**UNIT I**

10 Hrs.

**Stresses and Strains:** Types of stresses and strains, stress-strain relations, stress-strain diagram for ductile and other materials, axial loaded bars of uniform and varying cross section, compound bars, relation between three elastic moduli, thermal stresses.

**Principal stresses and strains:** Biaxial state of stress with and without shear - Mohr's Circle and analytical methods.

**Unit outcomes:**

After completing this unit, the student will be able to

- Determine stresses and deformations due to axial loads in simple members. (L3)
- Analyse stresses compound bars due to temperature raise. (L4)
- Correlate the elastic constants of materials.(L3)
- Construct the Mohr's circle for calculating principal stresses.(L3)
- Analyse principal stresses in biaxial state of loading. (L4)

**UNIT II**

10 Hrs.

**Analysis of Beams:** Types of beams and loads, shear force and bending moment diagram for cantilever, simply supported and overhanging beams for different types of loadings, point of contra flexure, relation between shearing force and bending moment.

**Bending Stresses:** Flexural equation, bending stress distribution and efficiency of various cross sections of beams. **Shear Stresses:** Shear stress distribution for different cross sections of beams.

### **Unit outcomes:**

After completing this unit, the student will be able to

- Draw shear force and bending moment diagrams in beams subject to bending loading.(L3)
- Determine bending stresses in beams under different loading. (L4)
- Evaluate the maximum shear force and bending moment and their location in beams. (L4)
- Demonstrate the shear stress and bending moment distribution in different cross sections of beams.(L4)

### **UNIT III**

8 Hrs.

**Deflection of Beams:** Differential equations of the deflection curve, Slope and deflection: using double integration method, Macaulay's method and Moment area method for simply supported, cantilever and overhanging beams.

**Energy Methods:** Strain energy, resilience. Deflection under single and several loads, Castigliano's theorem.

### **Unit outcomes:**

After completing this unit, the student will be able to

- Compute the slope and deflection in beam under different loading.(L3)
- Distinguish various approaches for calculating slope and deflection. (L4)
- Explain the difference between strain energy, resilience, elastic strain energy and modulus of toughness. (L2)
- Apply the Castigliano's theorem for beams. (L3)

### **UNIT IV**

8 Hrs.

**Torsion of Circular Shafts:** Theory of pure torsion, transmission of power in solid and hollow circular shafts, comparison of strengths of solid and hollow shafts, shafts in series and parallel, combined bending and torsion.

**Springs:** Deflection of closed and open coil helical springs under axial force and axial couple, Leaf springs.

### **Unit outcomes:**

After completing this unit, the student will be able to

- Analyse circular shafts subjected to twisting couple. (L4)
- Determine stresses in shafts subjected to combined loads.(L4)
- Determine angle of twist in shafts. (L4)
- Determine stresses and deformations in helical and leaf springs. (L5)

### **UNIT V**

8 Hrs.

**Buckling of Columns:** Analysis of columns to evaluate buckling loads with different boundary conditions, Euler's formula and its limitations, Rankine's formula, columns under eccentric load, columns under initial curvature.

**Thin Cylinders:** hoop and stresses, longitudinal, cylindrical and spherical shells subjected to internal pressure calculation of volumetric strain.

### **Unit outcomes:**

After completing this unit, the student will be able to

- Determine buckling load in compressive members. (L4)
- Apply concepts of elastic stability of columns. (L3)
- Assess hoop and longitudinal stresses in thin cylinders. (L3)
- Calculate volumetric strain. (L3)

### **Course Outcomes:**

After successful completion of this course student will be able to

- Apply the concepts of stress and strain to machine members. (L3)
- Determine, shear forces, and bending moments in beams. (L4)
- Find the slope and deflection in beams.(L4)
- Estimate the stress in machine members such as shafts and springs.(L4)
- Apply Castigliano's theorem to determine displacements in beams. (L3)
- Analyse columns for buckling loads.(L4)
- Estimate the stresses in thin cylinders due to internal pressure.(L3)

### **Text Books:**

1. F.P. Beer, E.R. Johnston, Jr&John.T. DeWolf, "Mechanics of Materials", 7<sup>th</sup> edition, Tata McGraw-Hill, 2016.
2. SS Rattan, Strength of materials, 3<sup>rd</sup> edition, Tata McGraw-Hill, 2016.

### **References:**

1. Timoshenko, "Strength of Materials Part-I& II", 3<sup>rd</sup> edition, CBS Publishers, 2004.
2. Popov, "Mechanics of Solids", 2<sup>nd</sup> edition, New Pearson Education, 2015.

(19A01407) FLUID MECHANICS AND HYDRAULIC MACHINERY

**Course Objectives:**

- To Introduce concepts of fluid statics and kinematics
- To impart the knowledge on minor losses in pipes
- To impart knowledge on power developed by hydraulic energy and hydro electric installations.
- To impart the knowledge on design of turbines
- To impart the knowledge on design of centrifugal pumps.

**UNIT - I**

**FLUID STATICS** : Dimensions and units: physical properties of fluids – specific gravity, porosity surface tension – vapor pressure and their influence on fluid motion – atmospheric gauge and vacuum pressure – measurement of pressure – Piezometer, U-tube differential manometers.

**FLUID KINEMATICS** : stream line, path line and streak lines and steam tube, classification of flows-steady & unsteady, uniform, non uniform, laminar, turbulent, rotational, and irrotational flows-equation of continuity for one dimensional flow.

**Fluid dynamics:** surface and body forces – Euler’s and Bernoulli’s equations for flowing stream line, momentum equation and its application on force on pipe bend.

**Unit Outcomes:**

- To introduce the concepts stream line, path line, streak line etc.,
- To familiarize the concepts of rotational and irrotational flows

**UNIT – II**

**CONDUIT FLOW: Reynold’s** experiment – Darcy Weisbach equation – Minor losses in pipes – pipes in series and pipes in parallel – total energy line-hydraulic gradient line. Measurement of flow: pitot tube, venturimeter, and orifice meter, Flow nozzle, Turbine current meter.

**Unit Outcomes:**

- To introduce the concepts of pipes in series and parallel
- To familiarize the discharge measurements by using pitot tube, venturimeter etc.,

**UNIT – III**

**TURBO MACHINERY** : hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done efficiency, flow over radial vanes.

**HYDROELECTRIC POWER STATIONS**: Elements of hydro electric power station-types-concept of pumped storage plants-storage requirements.

**Unit Outcomes:**

- To impart the knowledge on effect of impact of jets on different types of vanes.
- To familiarize with the elements of hydroelectric installations.

**UNIT – IV**

**HYDRAULIC TURBINES**: Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies hydraulic design-draft tube- theory- functions and efficiency.

**PERFORMANCE OF HYDRAULIC TURBINES** : Unit and specific quantities, characteristics governing of turbines, selection of type of turbine, cavitation, surge tank, hammer.

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**Unit Outcomes:**

- To impart the knowledge on working principles of hydraulic turbines along with their efficiencies
- To evaluate the performance of different types of turbines.

**UNIT – V**

**CENTRIFUGAL PUMPS** : Classification, working, work done – manometric head – loss efficiencies – specific speed – pumps in series and parallel – performance characteristic curves, NPSH.

**Unit Outcomes:**

- To impart the knowledge on working principles of different pumps.
- To evaluate the performance of different types of pumps

**Course Outcomes:**

At the end of the course, the student will be able to

- Understand characteristics of laminar and turbulent flows.
- Understand the energy losses in different types of pipes.
- Identify the performance of different types of turbines
- Identify the performance of centrifugal pumps.

**TEXT BOOKS :**

1. “Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH”. Standard book house
2. Dr.R.K.Bansal, “Fluid Mechanics” Lakshmi Publications Pvt.Ltd.
3. D.Rama Durgaiah, “Fluid Mechanics and Machinery” New Age International.

**REFERENCE BOOKS :**

1. D.S. Kumar, “Fluid Mechanics and Fluid Power Engineering”, Kotaria & Sons
2. Banga & Sharma, “Hydraulic Machines”, Khanna Publishers.
3. James W.Dally, “Instrumentation for Engineering Measurements”, Wiley Riley, John Wiley & Sons Inc. 2004

**(19A05406T) INTERNET OF THINGS**

**Course Objectives:**

- Introduce the fundamental concepts of IoT and physical computing
- Expose the student to a variety of embedded boards and IoT Platforms
- Create a basic understanding of the communication protocols in IoT communications.
- Familiarize the student with application program interfaces for IoT.
- Enable students to create simple IoT applications.

**UNIT I**

**Overview of IoT:**

**The Internet of Things:** An Overview, The Flavor of the Internet of Things, The “Internet” of “Things”, The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things?

**Design Principles for Connected Devices:** Calm and Ambient Technology, Privacy, Web Thinking for Connected Devices, Affordances.

**Prototyping:** Sketching, Familiarity, Costs Vs Ease of Prototyping, Prototypes and Production, Open source Vs Close source, Tapping into the community.

**Unit Outcomes:**

After completing this Unit, students will be able to

- Explain IoT architecture. [L2]
- Interpret the design principles that govern connected devices [L2]
- Summarize the roles of various organizations for IoT [L2]
- Understand the significance of Prototyping [L2]

**UNIT II**

**Embedded Devices:**

Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, Mobile phones and tablets, Plug Computing: Always-on Internet of Things

**Unit Outcomes:**

After completing this Unit, students will be able to

- Explain the basics of microcontrollers [L2]
- Outline the architecture of Arduino [L2]
- Develop simple applications using Arduino [L3]



- Outline the architecture of Raspberry Pi [L2]
- Develop simple applications using Raspberry Pi [L3]
- Select a platform for a particular embedded computing application [L3]

### UNIT III

#### **Communication in the IoT:**

Internet Communications: An Overview, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols

#### **Prototyping Online Components:**

Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols Protocol

#### **Unit Outcomes:**

After completing this Unit, students will be able to

- Interpret different protocols and compare them [L2]
- Select which protocol can be used for a specific application [L3]
- Utilize the Internet communication protocols for IoT applications [L3]
- Select IoT APIs for an application [L3]
- Design and develop a solution for a given application using APIs [L6]
- Test for errors in the application [L4]

### UNIT IV

**Business Models:** A short history of business models, The business model canvas, Who is the business model for, Models, Funding an Internet of Things startup, Lean Startups.

**Manufacturing:** What are you producing, Designing kits, Designing printed circuit boards.

#### **Unit Outcomes:**

After completing this Unit, students will be able to

- Plan the business model [L6]
- Predict the market value [L5]
- Assemble the product [L6]

### UNIT V

**Manufacturing continued:** Manufacturing printed circuit boards, Mass-producing the case and other fixtures, Certification, Costs, Scaling up software.

**Ethics:** Characterizing the Internet of Things, Privacy, Control, Environment, Solutions.

#### **Unit Outcomes:**

After completing this Unit, students will be able to

- Employ the manufacturing techniques [L4]
- Adapt the Ethics [L6]

**Course outcomes:**

At the end of the course, students will be able to

- Choose the sensors and actuators for an IoT application (L1)
- Select protocols for a specific IoT application (L2)
- Utilize the cloud platform and APIs for IoT applications (L3)
- Experiment with embedded boards for creating IoT prototypes (L3)
- Design a solution for a given IoT application (L6)
- Establish a startup [L4]

**Text Book:**

1. Adrian McEwen, Hakim Cassimally – “Designing the Internet of Things”, Wiley Publications, 2012

**Reference Books:**

1. Arshdeep Bahga, Vijay Madisetti – “Internet of Things”: A Hands-On Approach, Universities Press, 2014.
2. Pethuru Raj, Anupama C. Raman, “The Internet of Things, Enabling technologies and use cases” –CRC Press.

**Reference sites:**

1. <https://www.arduino.cc/>
2. <https://www.raspberrypi.org/>

(19A03403) KINETICS OF MACHINERY

**Course Objectives:**

The Objectives of this course are to

- Introduce various basic mechanisms and applications
- Explain different exact and approximate straight line motion mechanisms
- Explain the concept of instantaneous centre
- Familiarize the concept of velocity and acceleration
- Describe cams and followers and their motions.
- Introduce the gears, gear trains and their applications.

**UNIT – I**

**MECHANISMS AND MACHINES:** Elements or Links – Classification – Rigid Link, flexible and fluid link. Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained. Mechanisms and machines – classification of mechanisms and machines – kinematic chain – inversion of mechanisms – inversions of quadric cycle chain – single and double slider crank chain. Mobility of mechanisms.

**Unit Outcomes:**

At the end of this unit, the student will be able to

- Contrast the difference between machine and structure
- Identify the different types of kinematic pairs and kinematic chains
- Identify the inversions of four bar mechanism

**UNIT-II**

**Straight Line Motion Mechanisms-** Exact and approximate, copied and generated types – Peaucellier, Hart and Scott Russel, Grasshopper, Watt, Tchebicheff and Robert Mechanisms. Pantograph.

**Steering Mechanisms:** Conditions for correct steering – Davis Steering gear, Ackermanns steering gear. Hooke's Joint (Universal coupling) -Single and double Hooke's joint — applications – Simple problems.

**Unit Outcomes:**

At the end of this unit, the student will be able to

- Identify the difference between exact and approximate mechanism
- Explain the working principles of different mechanisms

- Understand the functions of steering gear mechanisms
- Understand the difference between Davis and Ackerman's steering gear mechanism

## UNIT – III

### KINEMATICS

**Velocity and Acceleration Diagrams-** Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method – Slider crank mechanism, four bar mechanism. Acceleration diagrams for simple mechanisms, Coriolis acceleration, determination of Coriolis component of acceleration. Klein's construction: Analysis of slider crank mechanism for displacement, velocity and acceleration of slider using analytical method

**Instantaneous Centre Method:** Instantaneous centre of rotation, centrode and axode – relative motion between two bodies – Three centres in-line theorem – Locating instantaneous centers for simple mechanisms and determination of angular velocity of points and links.

#### Unit Outcomes:

At the end of this unit, the student will be able to

- Draw the velocity and accelerations for different configurations.
- Find the velocity and accelerations of different points on and away from different links
- Understand the concept of instantaneous centers
- Find the velocity of different points on the links and angular velocities of different links using instantaneous centers method

## UNIT – IV

**GEARS:** Higher pairs, toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Forms of tooth- cycloidal and involute profiles. Velocity of sliding – phenomena of interference – Methods to avoid interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact. Introduction to Helical, Bevel and Worm gearing.

**GEAR TRAINS:** Introduction –Types of gears – Simple, Compound, Reverted and Epicyclic gear trains, Train value – Methods of finding train value or velocity ratio – Tabular column method for Epicyclic gear trains. Torque in epicyclic gear trains. Differential gear of an automobile, Simple problems.

#### Unit Outcomes:

At the end of this unit, the student will be able to

- Understand the phenomenon of interference
- Find the relative merits and demerits of different tooth profiles
- Understand principle of operation of different gears trains for different purpose
- Find velocity ratio and torques for different gear trains

## UNIT – V

**CAMS:** Definitions of cam and follower – uses – Types of followers and cams – Terminology. Types of follower motion - Uniform velocity, Simple harmonic motion, Cycloidal and uniform acceleration–and retardation Maximum velocity and maximum acceleration during outward and return strokes. Drawing of cam profiles.

**ANALYSIS OF MOTION OF FOLLOWERS:** Tangent cam with roller follower – circular arc (Convex) cam with flat faced and roller follower.

### **Unit Outcomes:**

At the end of this unit, the student will be able to

- Understand the cam terminology
- Draw the cam profile for different types of follower motion
- Find the velocity and acceleration of the follower for different types of follower motions

### **Course outcomes:**

At the end of the course student will able to:

- An understanding of concepts of different of mechanism with lower pairs and higher pairs.
- Gain the knowledge of different types of straight line motion mechanism and steering gear mechanisms.
- Obtain an in depth knowledge of finding displacement, velocity and acceleration of different points on different mechanisms using different methods( relative velocity, Instantaneous methods).
- Acquire the knowledge on different gear profiles and calculating the different parameters of gears.
- Gain the knowledge in designing of gear trains for the required purpose.
- Design and analyze different cam profile for different types of followers.

### **TEXT BOOKS :**

- S.S. Rattan, “Theory of Machines”, Tata McGraw Hill Publishers.
- 2. J.E. Shiegley, “The Theory of Machines”, McGraw Hill .

### **REFERENCES :**

1. R.S. Khurmi & J.K. Gupta, “Theory of Machines”, S. Chand Pub.
2. R.K.Bansal and J S Brar, “Theory of Machines”, Laxmi Publications.
3. Thomas Bevan, “Theory of Machines”, CBS.
4. J.S. Rao and R.V. Dukupati, “Mechanism and Machine Theory”, New Age
5. R.L Norton , “Kinematics and dynamics of machinery”, Tata McGraw Hill Publishers

**(19A03404) COMPUTER AIDED MACHINE DRAWING**

**Course Objectives:**

- Introduce conventional representations of material and machine components.
- Train to use software for 2D and 3D modeling.
- Familiarize with thread profiles, riveted, welded and key joints.
- Teach solid modeling of machine parts and their sections.
- Explain creation of 2D assembly drawings from 3D assemblies.
- Familiarize with limits, fits and tolerances in mating components.

**The following contents are to be done by any 2D software package Conventional representation of materials and components:**

**Detachable joints:** Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint with washer and locknut, stud joint, screw joint and foundation bolts.

**Riveted joints:** Drawing of rivet, lap joint, butt joint with single strap, single riveted, double riveted double strap joints.

**Welded joints:** Lap joint and T joint with fillet, butt joint with conventions.

**Keys:** Taper key, sunk taper key, round key, saddle key, feather key, woodruff key.

Shaft coupling, bushed pin-type flange coupling, universal coupling, Oldhams' coupling.

**The following contents to be done by any 3D software package**

Sectional views Creating solid models of complex machine parts and create sectional views.

**Assembly drawings: (Any four of the following using solid model software)**

Lathe tool post, tool head of shaping machine, tail stock, machine vice, gate valve, carburettor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling,

**Manufacturing drawing:**

Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

**Course Outcomes:**

After completion of this lab student will be able to

- Demonstrate the conventional representations of materials and machine components.
- Model riveted, welded and key joints using CAD system.
- Create solid models and sectional views of machine components.
- Generate solid models of machine parts and assemble them.
- Translate 3D assemblies into 2D drawings.
- Create manufacturing drawing with dimensional and geometric tolerances.

**Text Books:**

1. K.L.Narayana, P.Kannaiah, “A text book on Engineering Drawing”, SciTech Publications, 2014
2. “Software tools/packages”, Auto CAD, Solid works or equivalent.

**Reference Books:**

1. Cecil Jensen, Jay Helsel and Donald D.Voisinet, “Computer Aided Engineering Drawing”, Tata Mcgraw-Hill, NY, 2000.
2. James Barclay, Brain Griffiths, “Engineering Drawing for Manufacture”, Kogan Page Science, 2003.
3. N.D.Bhatt, “Machine Drawing”, Charotar, 50<sup>th</sup> edition, 2014.
4. K.L.Narayana, “Production Drawing”, NewAge International Publishers, 3<sup>rd</sup> edition, 2014

**(19A03402P) MECHANICS OF MATERIALS LABORATORY**

**Course Objectives:**

- To conduct uni-axial tension test on Steel, Aluminium, Copper and Brass.
- To perform compression test on spring and wood.
- To determine elastic constants of materials using flexural and torsion tests.
- To find hardness of given metals.

**List of Experiments:**

1. Study the stress – strain relations of (a) Mild Steel b) Cast iron and (c) Tor Steel by conducting tension/compression test on U.T.M.
2. Study the stress – strain relation of (a) Copper and (b) Aluminium (c) other materials by conducting tension /compression test.
3. Find the compressive and shear strength of wood and shear strength of GI sheet by conducting relevant tests.
4. Find the Brinnell’s and Vicker’s hardness numbers of (a) Steel (b) Brass (c) Aluminium (d) Copper.
5. Determine the Modulus of rigidity (a) Solid shaft (b) Hollow shaft made of steel and aluminium.
6. Find the spring index and modulus of rigidity of the material of a spring by conducting compression and tensile tests.
7. Determine the Young’s modulus of the material by conducting deflection test on a simply supported, propped cantilever and continuous beams.
8. Find impact strength of a given material by conducting a) Charpy test and b) Izod test
9. Determine buckling load in a compressive member made with steel and aluminium.
10. Determine the deflection in leaf spring with a single leaf and multiple leaves.

**Course Outcomes:**

On completion of this lab student will be able to

- Understand the stress-strain behaviour of different materials.
- Identify the difference between compression and tension testing.
- Evaluate the hardness of different materials.
- Correlate the elastic constants of the materials.
- Explain the relation between elastic constants and hardness of materials.



(19A99302) BIOLOGY FOR ENGINEERS

**Course Objectives:**

To provide basic understanding about life and life Process. Animal and plant systems. To understand what biomolecules are, their structures and functions. Application of certain biomolecules in Industry.

- Brief introduction about human physiology and bioengineering.
- To understand hereditary units, i.e. DNA (genes) and RNA and their synthesis in living organism.
- How biology Principles can be applied in our daily life using different technologies.
- Brief introduction to the production of transgenic microbes, Plants and animals.

**Unit I: Introduction to Basic Biology**

Cell as Basic unit of life, cell theory, Cell shapes, Cell structure, Cell cycle. Chromosomes. Prokaryotic and eukaryotic Cell. Plant Cell, Animal Cell, Plant tissues and Animal tissues, Brief introduction to five kingdoms of classification.

**Unit Outcomes:**

After completing this unit, the student will be able to

- Summarize the basis of life. (L1)
- Understand the difference between lower organisms (prokaryotes) from higher organisms (eukaryotes). (L2)
- Understand how organisms are classified. (L3)

**Unit II: Introduction to Biomolecules**

Carbohydrates, lipids, proteins, Vitamins and minerals, Nucleic acids (DNA and RNA) and their types. Enzymes, Enzyme application in Industry. Large scale production of enzymes by Fermentation.

**Unit Outcomes:**

After completing this unit, the student will be able to

- Understand what are biomolecules? their role in living cells, their structure, function and how they are produced. (L1)
- Interpret the relationship between the structure and function of nucleic acids. (L2)
- Summarize the applications of enzymes in industry. (L3)
- Understand what is fermentation and its applications of fermentation in industry. (L4)

### **Unit III: Human Physiology**

Nutrition: Nutrients or food substances. Digestive system, Respiratory system, (aerobic and anaerobic Respiration). Respiratory organs, respiratory cycle. Excretory system.

#### **Unit Outcomes:**

After completing this unit, the student will be able to

- Understand what nutrients are (L1)
- Understand the mechanism and process of important human functions (L2 & L3)

### **Unit IV: Introduction to Molecular Biology and recombinant DNA Technology**

Prokaryotic gene and Eukaryotic gene structure. DNA replication, Transcription and Translation. rDNA technology. Introduction to gene cloning.

#### **Unit Outcomes:**

After completing this unit, the student will be able to

- Understand and explain about gene structure and replication in prokaryotes and Eukaryotes (L1)
- How genetic material is replicated and also understands how RNA and proteins are synthesized. (L2)
- Understand about recombinant DNA technology and its application in different fields.(L3)
- Explain what is cloning. (L4)

### **Unit V: Application of Biology**

Brief introduction to industrial Production of Enzymes, Pharmaceutical and therapeutic Proteins, Vaccines and antibodies. Basics of biosensors, biochips, Bio fuels, and Bio Engineering. Basics of Production of Transgenic plants and animals.

#### **Unit Outcomes:**

After completing this unit, the student will be able to Understand.

- How biology is applied for production of useful products for mankind.(L1)
- What are biosensors, biochips etc. (L2)
- Understand transgenic plants and animals and their production (L3)

#### **Course Outcomes:**

After studying the course, the student will be able to:

- Explain about cells and their structure and function. Different types of cells and basics for classification of living Organisms.
- Explain about biomolecules, their structure and function and their role in the living organisms. How biomolecules are useful in Industry.

- Briefly about human physiology.
- Explain about genetic material, DNA, genes and RNA how they replicate, pass and preserve vital information in living Organisms.
- Know about application of biological Principles in different technologies for the production of medicines and Pharmaceutical molecules through transgenic microbes, plants and animals.

**Text books:**

1. P.K.Gupta, Cell and Molecular Biology, 5<sup>th</sup> Edition, Rastogi Publications -
2. U. Satyanarayana. Biotechnology, Books & Allied Ltd 2017

**Reference Books:**

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A Global Approach”, Pearson Education Ltd, 2018.
2. T Johnson, Biology for Engineers, CRC press, 2011
3. J.M. Walker and E.B. Gingold, Molecular Biology and Biotechnology 2<sup>nd</sup> ed.. Panima Publications. PP 434.
4. David Hames, Instant Notes in Biochemistry –2016
5. Phil Tunner, A. Mctennan, A. Bates & M. White, Instant Notes – Molecular Biology – - 2014.

(19A03501T) APPLIED THERMODYNAMICS

**Course Objectives**

- To familiarize the Working Principles of IC engines.
- To teach combustion process in SI and CI engines.
- To introduce different types of compressors.
- To familiarize concepts of thermodynamic cycles used in steam power plants and gas turbines
- To impart knowledge on the working of nozzles, turbines, refrigeration and air conditioning.

**UNIT I**

**10 hours**

**IC Engines:** Working and classification of IC engines, comparison of two stroke and four stroke engines, comparison of SI and CI Engines.

**Testing and Performance of IC Engines:** Methods of testing IC Engines, performance analysis of IC Engines.

**Combustion in IC Engines:** SI engine: stages of combustion, normal combustion, abnormal combustion, variables effecting delay period and knocking, pre-ignition. CI engine: stages of combustion, normal combustion, abnormal combustion, variables effecting delay period and knocking. Fuel requirements and fuel rating.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Understand working of IC engines on the basis of thermodynamic cycles. (L2)
- Estimate engine performance. (L5)
- Identify the effects of abnormal combustion in IC engines. (L3)

**UNIT II**

**8 hours**

Air compressors

Reciprocating Compressor: Single stage reciprocating compressors, work required, effect of clearance in compressors, volumetric efficiency, multi stage compressor, effect of inter cooling in multi stage compressors, compressor performance.

Rotary Compressor: Working principle of a rolling piston type compressor (fixed vane type), multi vane type compressors, characteristics of rotary vane type compressor, working principle of centrifugal compression and axial flow compressors, velocity triangles.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Classify different types of air compressors. (L2)
- Compare the performance of different types of air compressors (L2)

### UNIT III

8 hours

**Vapour Power Cycles:** Vapour power cycle, simple Rankine cycle, mean temp of heat addition thermodynamic variables effecting efficiency and output of Rankine cycle

**Gas power Cycle:** Simple gas turbine plant, Brayton cycle, closed cycle and open cycle for gas turbines, condition for maximum pressure ratio and optimum pressure ratio, actual cycle. Methods to improve performance: regeneration, intercooling and reheating. Introduction to jet propulsion: working principle of ramjet, turbojet, turbofan, turboprop and pulse jet engines,

#### Learning Outcomes:

After completion of this unit, students will be able to

- Explain concepts of vapour power cycle used in steam power plant. (12)
- Evaluate the cycles used in gas turbines. (15)
- Outline the jet propulsion system (12)

### UNIT IV

8 hours

**Nozzles:** Type of nozzles - air and steam nozzles. Compressible flow through nozzle- condition for maximum discharge - nozzle efficiency.

**Steam Turbines:** Classification of steam turbines -impulse turbine and reaction turbine - compounding in turbines - velocity diagrams in impulse and reaction turbines, efficiency, degree of reaction - governing of turbines

#### Learning Outcomes:

After completion of this unit, students will be able to

- Compare the performance of nozzles, used in turbines. (12)
- Classify steam turbines and applications. (14)
- Analyse the performance of steam turbines under different operating conditions. (15)

### UNIT V

8 hours

**Refrigeration:** Bell-Coleman cycle - vapour compression cycle, effect of vapour condition on COP of VCR, -vapour absorption cycle, properties of common refrigerants

**Principles of Psychrometry and Air Conditioning:** Psychrometric terms, psychrometric processes and air conditioning systems.

#### Learning Outcomes:

After completion of this unit, students will be able to

- Outline the operation of refrigerators. (L2)
- Identify different refrigerants and applications.(L3)
- Use properties of moist air in calculations for air-conditioning system. (L3)

### **Course Outcomes**

After completing this course, the students can

- Explain working of IC engines with combustion process. (L2)
- Select compressors for different applications. (L1)
- Use T-s diagram in vapour power and gas power cycles. (L3)
- Explain the basic principles of steam turbines. (L2)
- Select appropriate refrigerant for different applications. (L1)

### **Text Book(s)**

1. Ganesan V, “Internal Combustion Engines”, Tata McGraw Hill, 2017.
2. M.L.Mathur and F.S.Mehta, “Thermal Engineering”, Jain brothers,2014

### **References:**

1. Mahesh V Rathore, “Thermal Engineering”, Tata McGraw Hill 2017
2. Yahya, S. M., Turbines, “Compressors and Fans”, 4<sup>th</sup> edition, Tata McGraw Hill, 2010.
3. Nag P.K, “Engineering Thermodynamics”, 4<sup>th</sup> edition, Tata McGraw-Hill, 2008.
4. Onkar Singh, “Thermal Turbomachines”, 3<sup>rd</sup> edition, Wiley India, 2014.
5. P.L.Ballaney, “Thermal Engineering”, 2<sup>nd</sup> edition, Khanna, 2005.

(19A03502T) MANUFACTURING TECHNOLOGY

**Course Objectives:**

- Explain parameters in the metal cutting operation.
- Relate tool wear and tool life and the variables that control them.
- Calculate machining times for different machining processes.
- Teach various metal cutting processes. (lathe, drilling, boring shaping, slotting, milling and grinding).
- Familiarise the principles of jigs and fixtures and types of clamping and work holding devices.

**UNIT I:**

**Material Removal Processes:**

**8hrs**

**Metal Cutting:** Single and multi-point cutting, orthogonal cutting, various force components, chip formation, tool wear and tool life, surface finish and integrity, machinability, cutting tools and materials, cutting fluids, coatings.

**Learning Outcomes:**

At the end of the this unit, the student will be able to

- Describe cutting processes and variables. (12)
- Classify various types of chips, cutting tool materials and cutting fluids. (14)
- Calculate cutting force, speed and feed finding techniques during machining. (15)

**UNIT II:**

**Machining processes for round shapes:**

**12hrs**

**Lathe and Lathe Operations:** Principles of working, specifications, types of lathes, operations performed, work holders and tool holders. Taper turning, thread turning attachments for lathes. machining time calculations. Turret and capstan lathes - Principle of working, collect chucks, other work holders - tool holding devices.

**Drilling and Drilling Machines:** Principles of working, specifications, types, and operations performed - tool holding devices - nomenclature of twist drill.

**Boring and Boring Machines-** Principles of working, specifications, types, and operations performed - tool holding devices - nomenclature of boring tools

**Reaming and Reamers:** Principles of working, specifications, types, and operations performed - tool holding devices - nomenclature of reamers.

**Taping and Taps:** Principles of working, specifications, types, and operations performed - tool holding devices - nomenclature of taps.

## **Learning Outcomes:**

At the end of this unit, the student will be able to

- List the specifications for various types of lathes. (11)
- Determine cutting speeds for different machining operations. (15)
- Identify parts of drilling, boring, reaming machines. (13)

## **UNIT III:**

### **Machine processes for other shapes:**

**8hrs**

**Milling operations and Milling machines** - Principles of working, specifications, classifications of milling machines, machining operations, types and geometry of milling cutters, methods of indexing, and accessories to milling machines, machining time calculations.

**Shaping, Slotting and planing machines** - Principles of working - principal parts, specification, classification, operations performed, machining time calculations

## **Learning Outcomes:**

At the end of this unit, the student will be able to

- Recognize the parts of milling, shaping, slotting and planing machine. (13)
- Compare tool geometry for milling, shaping, slotting and planing operations. (13)
- Calculate machining times. (15)

## **UNIT IV:**

### **Abrasive Machining:**

**6hrs**

Grinding and grinding machines: Grinding process, types of grinding machines, grinding process parameters, honing, lapping, other finishing processes.

## **Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the basic principles of abrasive processes. (12)
- Classify different types of grinding machines and their applications. (14)
- Assess the grinding process and variables that effect the operation. (15)
- Estimate the time and power required for the grinding operation. (15)
- Explain various types of abrasive processes such as honing and lapping for final finishing operation. (12)

## **UNIT V**

**8hrs**

**Jigs and Fixtures** Principles of design of Jigs and fixtures and uses, 3-2-1 principle of location and clamping, classification of Jigs & Fixtures, types of clamping and work holding devices, typical examples of jigs and fixtures.



## **Learning Outcomes:**

At the end of this unit, the student will be able to

- Classify various types of jigs and fixtures. (14)
- Identify various types of work and tool holding devices. (13)
- Explain the design principles of jigs and fixtures. (12)
- Design a jig and fixture for a given application. (16)

## **Course Outcomes:**

At the end of the course, the student will be able to

- Choose cutting processes and variables. (13)
- Relate tool wear and tool life. (11)
- Calculate the machining parameters for different machining processes. (15)
- Identify methods to generate different types of surfaces. (13)
- Explain work-holding requirements. (12)
- Design jigs and fixtures. (16)

## **Text books:**

1. P.N. Rao, "Manufacturing Technology: Metal Cutting and Machine Tools", (Volume 2), 3<sup>rd</sup> edition, Tata McGraw-Hill Education, 2013
2. R.K. Jain and S.C. Gupta, "Production Technology", 17<sup>th</sup> edition, Khanna Publishers, 2012.

## **Reference books:**

1. Kalpakzian S and Schmid SR, "Manufacturing Engineering and Technology", 7<sup>th</sup> edition, Pearson, 2018.
2. Milton C.Shaw , "Metal Cutting Principles", 2<sup>nd</sup> edition, Oxford, 2012
3. Hindustan Machine Tools, "Production Technology", TMH, 2001
4. V.K.Jain, Advanced Machining Process,12<sup>th</sup> edition, Allied Publications, 2010
5. AB. Chattopadhyay, "Machining and Machine Tools", 2<sup>nd</sup> edition, Wiley, 2017
6. Halmi A Yousuf & Hassan, "Machine Technology: Machine Tools and Operations", CRC Press Taylor and Francis Group, 2008

(19A03503T) HEAT TRANSFER

**Course Objectives**

- To impart the basic laws of conduction, convection and radiation heat transfer and their applications
- To familiarize the convective heat transfer concepts
- To explain basics of radiation heat transfer
- To make conversant with the heat transfer analysis related to thermal systems like heat exchangers, evaporator, and condenser.
- To understand the phenomenon of boiling and condensation to familiarize the mass transfer process

**UNIT I**

**10 hours**

**Introduction:** Basic modes of heat transfer- rate equations- generalized heat conduction equation - steady state heat conduction solution for plain and composite slabs - cylinders - critical thickness of insulation- heat conduction through fins of uniform cross section- fin effectiveness and efficiency.

**Unsteady State Heat Transfer Conduction-** Transient heat conduction- lumped system analysis and use of Heisler charts.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Identify the phenomenon related to different modes of heat transfer (L1)
- Compare different types of conduction heat transfer (L2)
- Apply concept of thermal resistance and its importance in practical problems (L3)

**UNIT II**

**9 hours**

**Convection:** Basic concepts of convection–heat transfer coefficients - types of convection – forced convection and free convection.

Forced convection in external flow–concepts of hydrodynamic and thermal boundary layers- use of empirical correlations for flow over plates and cylinders. Fluid friction – heat transfer analogy, approximate solution to laminar boundary layer equation for external flow. Internal flow – Use of empirical relations for convective heat transfer in horizontal pipe flow.

**Free Convection** -development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for convective heat transfer on plates and cylinders in horizontal and vertical orientation

### **Learning Outcomes:**

After completion of this unit, students will be able to

- Apply the convective heat transfer principles (L3)
- Use analogy between fluid friction and heat transfer (L3)
- To estimate the convection heat to differentiate between forced and free convection engineering problems. (L2)

### **UNIT III**

**7 hours**

**Radiation:** Radiation heat transfer – thermal radiation – laws of radiation - Black and Gray bodies – shape factor-radiation exchange between surfaces - Radiation shields - Greenhouse effect.

### **Learning Outcomes:**

After completion of this unit, students will be able to

- Apply the principles of radiation heat transfer (L3)
- Calculate the radiation heat transfer between two bodies (L2)
- Design a radiation shield for given conditions (L3)
- Examine the effect of greenhouse gases on atmosphere (L4)

### **UNIT IV**

**7 hours**

**Heat Exchangers:** Types of heat exchangers- parallel flow- counter flow- cross flow heat exchangers- overall heat transfer coefficient- LMTD and NTU methods- fouling in heat exchangers.

### **Learning Outcomes:**

After completion of this unit, students will be able to

- Understand the working of different types of heat exchangers (L2)
- Calculate the heat transfer in heat exchangers (L2)
- Design a heat exchanger for a given application (L3)

### **UNIT V**

**7 hours**

**Boiling and Condensation:** Different regimes of boiling- nucleate, transition and film boiling – condensation - filmwise and dropwise condensation.

**Mass Transfer:** Conservation laws and constitutive equations - Fick's law of diffusion, isothermal equi-mass - Equimolal diffusion- - diffusion of gases and liquids- mass transfer coefficient.

### **Learning Outcomes:**

After completion of this unit, students will be able to

- Interpret the basic modes of condensation heat transfer (L2)
- Identify different regimes of boiling in design of boilers (L3)
- Understand the basic mechanism of mass transfer (L2)

- Differentiate between mass transfer due to convection and diffusion (L4)

### **Course Outcomes**

At the end of the course, the student will be able to

- Apply the concepts of different modes of heat transfer. (13)
- Apply knowledge of conduction heat transfer in the design of insulation of furnaces and pipes. (13)
- Analyse free and forced convection phenomena in external and internal flows. (14)
- Design of thermal shields using the concepts of black body and non-black body radiation. (15)
- Apply the basics of mass transfer for applications in diffusion of gases. (13)

### **Text Book(s)**

1. P.K. Nag, "Heat Transfer", 3<sup>rd</sup> edition, Tata McGraw-Hill, 2011.
2. S.P. Sukhatme, "A Textbook of Heat Transfer", Universities Press, TMH publications 2005

### **References:**

1. J.P.Holman, "Heat Transfer", 9<sup>th</sup> edition, Tata McGraw-Hill,2008.
2. Cengel. A.Yunus, "Heat Transfer", A Practical Approach, 4<sup>th</sup> edition, Tata McGraw-Hill, 2007.
3. Lienhard and Lienhard, "A Heat and Mass Transfer", Cambridge Press, 2011.
4. C.P. Kothandaraman and S. Subramanyan, "Heat and Mass Transfer databook", New Age Publications, 2014

(19A03505) DYNAMICS OF MACHINERY

**Course Objectives:**

The Objectives of this course are to

- Explain the importance of friction and apply for brakes and dynamometers
- Analyze the turning moment diagrams and discuss the applications of flywheel
- Familiarizes the concept of gyroscope and its applications for aero plane, motor cycle and motor cars
- Uses of governors and its applications
- Explain the need of balancing of rotating and reciprocating masses

**UNIT I**

**FRICTION:** Inclined plane, friction of screws and nuts, pivot and collar, uniform pressure, uniform wear. Friction circle and friction axis, lubricated surfaces, boundary friction, film lubrication.

**CLUTCHES:** Friction clutches- Single Disc or plate clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch.

**BRAKES AND DYNAMOMETERS:** Simple block brakes, Band brake, internal expanding brake, braking of vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Know the applications and concepts of friction. (L3)
- Understand the significance of clutches. (L2)
- Know the applications of breaks and dynamometers. (L3)

**UNIT II**

**PRECESSION:** Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aeroplanes and ships. **TURNING MOMENT DIAGRAMS AND FLY**

**WHEELS:** Turning moment diagrams for steam engine, IC Engine and multi cylinder engine. Crank effort - coefficient of Fluctuation of energy, coefficient of Fluctuation of speed – Fly wheels and their design, Fly wheels for Punching machines.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- To understand the concept and applications of gyroscopic couple. (L3)
- To draw the turning moment diagram for energy storage . (L2)
- To study the applications of flywheels. (L3)

### UNIT III

**GOVERNORS:** Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung governors with auxiliary springs. Sensitiveness, isochronism and hunting. Effort and power of a governor.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Understand different types of governors. (L3)
- Analyse the sensitiveness and isochronisms of governors. (L2)
- Estimate the effort and power of governors. (L3)

### UNIT IV

**BALANCING:** Balancing of rotating masses - single and multiple – single and different planes.  
**BALANCING OF RECIPROCATING MASSES:** Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples -V-engine, multi cylinder inline and radial engines for primary and secondary balancing.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the importance of balancing. (L3)
- Analyzing the balancing of reciprocating masses. (L2)
- Apply the balancing techniques. (L3)

### UNIT V

**VIBRATION:** Free and forced vibration of single degree of freedom system, Role of damping, whirling of shafts and critical speeds. Simple problems on free, forced and damped vibrations.

**Vibration Isolation & Transmissibility.** Transverse vibrations of beams with concentrated and distributed loads. Dunkerly's method, Raleigh's method. Torsional vibrations - two and three rotor systems.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Formulate the equations of motion and solve single degree of freedom system with damping. (L3)
- Estimate the natural frequency of vibrating systems. (L2)
- Explain the concept of vibration isolation of transmissibility. (L3)

**Course Outcomes:**

At the end of the course, the student will be able to

- Understand the effect of reactive gyroscopic couple on the stability of vehicles
- Understand the power lost and power transmitted due to friction
- Identify and correct the unbalances of rotating body
- Reduce the magnitude of vibration and isolate vibration of dynamic systems
- Determine dimensions of Governors for speed control.

**TEXT BOOKS:**

1. S.S. Rattan, "Theory of Machines", MGH Publishers, 3<sup>rd</sup> Edition, 2013.
2. R.L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw Hill.

**REFERENCES:**

1. Thomas bevan, "Theory of machines", Pearson, 3<sup>rd</sup> edition, 2012.
2. J.E. Shigley, "The theory of machine", Mcgraw hill .
3. Shigley et.al. "Theory of machines and mechanisms" of Oxford international student edition.
4. R.S Khurm, "Theory of machines", S.Chand publications

**(19A03504a) AUTOMOBILE ENGINEERING**  
**PROFESSIONAL ELECTIVE - I**

**Course objectives:**

- Impart the knowledge of vehicle structure and its components.
- Demonstrate various components of petrol engines and diesel engines.
- Trains various electrical system, circuits, and testing of automobiles.
- Explain the concepts of steering, suspension and braking system in automobile.

**UNIT - I**

**Introduction to vehicle structure and engine components:** Vehicle construction - Chassis and body - Specifications - Engine - Types - Construction - Location of engine - Cylinder arrangement - Construction details - Cylinder block - Cylinder head - Cylinder liners - Piston – piston rings - Piston pin - Connecting rod - Crankshaft - Valves. Lubrication system - Types - Oil pumps - Filters - Cooling system - Types - Water pumps - Radiators - Thermostats - Anti-freezing compounds.

**Learning Outcomes:**

At the end of the unit, the student will be able to

- Identify different parts of the automobile.(13)
- Explain various parts of the engine.(12)
- Describe the lubrication and cooling system in ic engines.(12)

**UNIT - II**

**Ignition, fuel supply and emission control system:** Ignition system - Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – UNIT Injector – Nozzle types - Electronic Fuel Injection system (EFI) – GDI, MPFI, DTSI-Automobile Emissions - Source of formation – Effects on human health and environment - Control techniques - Exhaust Gas Recirculation (EGR) - Catalytic converter - Emission tests and standards (Indian and Europe)

**Learning Outcomes:**

At the end of the unit, the student will be able to

- Explain the working principles of ignition, fuel supply and emission control systems.(12)
- Compare the types of ignition systems and fuel systems.(12)
- Interpret the about effects of automobile emissions on human health and environment.(16)

**UNIT - III**



**Transmission system:** Clutches - Function - Types - Single plate, Multiple plate and Diaphragm Clutch – Fluid coupling - Gearbox - Manual - Sliding - Constant - Synchronesh - Overdrive – Automatic transmission - Torque converter - Epicylic and Hydromatic transmission – Continuously variable transmission - Universal joint - Propeller shaft - Hotchkiss drive – Final drive - Rear axle assembly - Types -Differential - Need - Construction – Non-slip differential – Differential locks – Front wheel and rear wheel drive-Four wheel drive.

### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Describe different transmission systems.(12)
- Illustrate working principle of different gearbox transmission systems.(12)
- Demonstrate various types of clutches and differentials.(12)
- Explain the rear axle assembly.(12)

## **UNIT - IV**

**Steering, suspension and braking system:** Principle of steering - Steering Geometry and wheel alignment - Steering linkages – Steering gearboxes - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers – Wheels and Tyre - Construction - Type and specification - Tyre wear and causes - Brakes - Needs – Classification –Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders – Anti-lock Braking System(ABS)

### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Describe the steering and the suspension systems.(12)
- Classify the brakes in automobile.(11)
- Explain power steering system in automobiles.(12)
- Illustrate working principle of anti-lock breaking system.(12)

## **UNIT - V**

**Automobile electrical systems, instrumentation and advances in automobile engineering:** Battery-General electrical circuits-Dash board instrumentation - Passenger comfort – Safety and security - HVAC - Seat belts - Air bags - Automotive Electronics - Electronic Control Unit (ECU) - Variable Valve Timing (VVT) - Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program(ESP) Traction Control System (TCS) - Global Positioning System (GPS) - X-by-wire - Electric - Hybrid vehicle.

### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Explain the working principles of various automobile electrical systems. (12)
- Identify the various electrical components in automobile.(13)

- Explain about ecu, vvt, ass, esp, ebd, tcs and gps in automobile.(12)
- Examine the recent developments of automobile engineering.(14)

**Course Outcomes:**

After successful completion of this course, the student will be able to

- Identify different parts of automobile.(13)
- Explain the working of various parts like engine, transmission, clutch, brakes.(12)
- Describe the working of steering and the suspension systems. (12)
- Summarize the environmental implications of automobile emissions.(12)
- Outline the future developments in the automobile industry.(12)

**TEXTBOOKS:**

1. Kirpal Singh, “Automobile Engineering”, Vol 1 & 2.
2. S.K. Gupta, “A text book of Automobile Engineering”, S. Chand Publications.

**REFERENCES:**

1. K.K. Ramalingam, “Automobile Engineering” , 2<sup>nd</sup> edition, 2014.
2. K. Newton and W. Steeds, “The motor vehicle”, 13<sup>th</sup> edition, Butterworth-Heinemann Publishing Ltd. (year).
3. Kirpal Singh, “Automobile Engineering”, Vol.1&2, Standard Publications year.

(19A03504b) MANUFACTURING METHODS IN PRECISION ENGINEERING  
PROFESSIONAL ELECTIVE - I

**Course Objectives:**

- Familiarize with surface treatments and their industrial applications.
- Explain powder metal production sintering techniques for metal powders, glass, ceramics and plastics.
- Explain wafer preparation, optical lithography including current best practice and perceived limits and equipment required for micro-device packaging processes.
- Demonstrate plastics processing.
- Different liquefied, solidified and particulate methods for different MMC, CMC, Polymer matrix composites.

**UNIT I**

**Surface treatment:** Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Identify the phenomenon related to different surface modification by physical and chemical treatments: (L2)
- Develop the basics of CVD (Chemical Vapour Deposition) and PVD (Physical Vapour Deposition) technologies for surface coating deposition, description of thermal spraying technology for surface coating applications. (L2)
- Explain properties and characteristics of different surface coatings and their applications.(L3)

**UNIT II**

**Processing of Powder metals, Glass and Superconductors:** Introduction, production of metal powders, compaction of metal powders, sintering, secondary and finishing operations, design considerations for powder metallurgy, Process capabilities, economics of powder metallurgy, forming and shaping of Glass, techniques for strengthening and treating Glass, design considerations for Glass, processing of superconductors.

**Processing of ceramics:** Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application , finishing of ceramics.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Explain powder metallurgy and ceramics applications. (12)

- Demonstrate processing of powders and sintering techniques. (12)
- Outline mechanism of sintering properties and characteristics of powder metals, glass and superconductors. (13)

### UNIT III

**Fabrication of Microelectronic devices:** Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics. E-Manufacturing, nanotechnology, and micro machining, High speed Machining.

#### Learning Outcomes:

After completion of this unit, students will be able to

- Illustrate wafer preparation, optical lithography. (11)
- Explain the basic packaging and its levels, different ic chip mounting and interconnect methods. (12)
- Summarize mechanisms like e-manufacturing, nanotechnology, and micromachining, high speed machining.(13)

### UNIT IV

**Processing Of Plastics,** injection and blow moulding, calendaring, thermo forming, compression moulding, transfer moulding, High energy rate forming methods Rapid manufacturing: - Introduction - concepts of rapid manufacturing, information flow for rapid prototyping, classification of rapid prototyping process, sterer holography fused deposition modeling, selective laser sintering, Applications of rapid prototyping process.

#### Learning Outcomes:

After completion of this unit, students will be able to

- Build basic knowledge of manufacturing of plastics. (11)
- Explain the rapid prototyping methods in plastic processing. (12)

### UNIT V

**Processing of Composites:** Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

#### Learning Outcomes:

After completion of this unit, students will be able to

- Use of fibre-reinforced composites in engineering applications. (11)
- Summarize the use of composite materials, micromechanics of layered composites. (12)
- Explain different liquefied, solidified and particulate methods for mmc, cmc, polymer matrix composites. (13)

**Course Outcomes:**

After completing the course, the student will be able to

- Classify different surface treatment methods.(12)
- Explain processing of powder metals, glass and super conductors. (12)
- Develop fabrication of microelectronic devices.(12)
- Process plastics and composites.(12)

**TEXT BOOKS:**

1. Schmid and Kalpakjin, “Manufacturing Engineering and Technology”, 7<sup>th</sup> edition, Pearson Education India, 2001.
2. Rafiq Noorani, “Rapid Prototyping Principles and Applications”, Illustrated edition, Wiley, 2006.

**REFERENCE BOOKS:**

1. R.K. Jain, “Production Technology”, 17<sup>th</sup> edition, Khanna Publishers, 2012.
2. Roy A. Lindberg, “Process and materials of manufacturing”, 2<sup>nd</sup> edition, Allyn and Bacon, 1978.
3. Sreeramulu moinkumta Production technology Voi 1, Wiley Publishes,2018.

(19A03504c) DESIGN OF TRANSMISSION SYSTEMS  
PROFESSIONAL ELECTIVE - I

**Course Objectives:**

- Explain the various elements involved in a transmission system.
- Focus on the various forces acting on the elements of a transmission system.
- Design the system based on the input and the output parameters.
- Produce working drawings of the system involving pulleys, gears, clutches and brakes.
- Demonstrate the energy considerations in the design of motion control elements.

**UNIT I**

**Flexible power transmission systems:** Design of Belts – Flat Belts and Pulleys – V Belts and Pulleys – Design of chain drives – Wire ropes

**Design of bearing:** Lubrication- hydrodynamic lubrication theory, Design of sliding contact bearing using Sommerfield number – Design using McKee's equation – Selection of rolling contact bearings.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Demonstrate the importance of bearings in the transmission system. (12)
- Design sliding contact bearing using Somerfield number (14)
- Solve problem on design of sliding contact bearing using McKee's equation. (13)
- Identify the factors required for the selection rolling contact bearings (12)
- Choose various types of flexible power transmission systems. (13)

**UNIT II**

**Spur gear:** Gear geometry – Kinematics – Forces on gear tooth – Stresses in Gear tooth – Selection of gear material based on bending stress and contact stress – Design of Spur gear – Power transmitting capacity.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain Kinematics of different types of gears. (L2)
- Predict various forces and stresses acting on the gear tooth. (L3)
- Select materials for a gear based on bending and contact stresses (L3)
- Analyze the power transmitting capacity of a gear. (L4)
- Design a spur gear (L5)

### UNIT III

**Helical, bevel and worm gears:** Parallel Helical Gears – Kinematics – Tooth proportions – Force analysis – Stresses in Helical gear – Design of helical gear – Crossed Helical gears – Straight Bevel gears – Kinematics – Force analysis – Stresses in straight bevel gear tooth – Design of bevel gear – Worm gearing – Kinematics – Forces - Friction and Efficiencies – Stresses in worm gear tooth.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Identify the differences between the helical gear and a bevel gear. (12)
- Solve problems on the design of helical gear. (13)
- Explain the kinematics of helical, straight bevel gears and worm gears. (13)
- Predict the various forces acting on the worm gear tooth. (13)
- Select of helical, bevel and worm gears in power transmission (13)

### UNIT IV

**Design of gear boxes:** Design of Speed reducers – Design of multi speed gear boxes for machine tools – Structural and ray diagrams.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Select the speed reducers in power transmission (L3)
- Design speed reducers (L4)
- Design of multi speed gear boxes for various applications (L5)
- Draw ray diagrams of gear boxes (L4)

### UNIT V

**Elements of motion control:** Internal – Expanding Rim clutches and Brakes – External – Contracting Rim clutches and Brakes – Band type Clutches – Cone clutches and Brakes – Energy considerations – Temperature rise – Friction materials.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Explain on elements of motion control (L2)
- Outline the importance of clutches and brakes in power transmission (L2)
- Model various types of clutches and brakes. (L3)
- Solve problems on the design of clutches and brakes (L3)
- Calculate the temperature rise due to friction and select materials according. (L4)

#### Course Outcomes:

At the end of this Unit the student will be able to

- Design pulleys, chain drives, rope drives and belt drives. (15)
- Determine performance requirements in the selection of commercially available transmission drives. (14)
- Design brakes and clutches (14)
- Design various types of gear boxes. (15)
- Select materials for various applications in the transmission elements. (13)

#### **TEXT BOOKS:**

1. Joseph Edward Shigley and Charles, R. Mischke, “Mechanical Engineering Design”, McGraw –Hill International Editions, 2000.
2. Robert L. Norton, “Machine Design”- an integrated approach, (5th Edition) Pearson publisher, 2000

#### **REFERENCES:**

1. “Design Data”, PSG College of Technology, DPV Printers, Coimbatore, 2005.
2. Malisa, “Hand Book of Gear Design”, Tata Mc Graw Hill, International Edition, 2000.
3. V.B. Bhandari , “Design of Machine Elements”, Tata Mc Graw Hill, 2001.



(19A03504d) POWER PLANT ENGINEERING  
PROFESSIONAL ELECTIVE - I

**Course Objective:**

- Familiarize the sources of energy, power plant economics and environmental aspects.
- Outline the working components of different power plant.
- Explain renewable energy sources; characteristics, working principle, classify types, layouts, and plant operations.
- Impart types of nuclear power plants, and outline working principle and advantages and hazards.

**UNIT I**

Introduction to the Sources Of Energy - Resources and Development of Power in India. Convectional and non- conventional energy sources, Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor - Tariff - Related Exercises. Effluents from Power Plants and Impact on Environment - Pollutants and Pollution Standards - Methods of Pollution Control. Inspection And Safety Regulations.

**Learning Outcomes**

At the end of this unit, the student will be able to

- Outline sources of energy, compare and selection of types of power plants.(12)
- Explain cost factors, load and power distribution factors. (12)
- Select tariff based on load and demand factors. (13)
- Summarize the impact of power plant on the environment, pollution mitigation and regulations. (12)

**UNIT II**

**Steam Power Plant :** Introduction to Boilers- Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Steam Power Plant : Combustion Process : Properties of Coal - Overfeed and Under Feed Fuel Beds, Travelling Grate Stokers, Spreader Stokers, Retort Stokers, Pulverized Fuel Burning System And Its Components, Combustion Needs and Draught System, Cyclone Furnace, Design and Construction, Dust Collectors, Cooling Towers And Heat Rejection. Analysis of Pollution from Thermal Power Plants - Pollution Controls.CO2 Recorders

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Demonstrate latest high pressure boilers, power plant cycles and their improvements. (12)
- Explain various types of coals, coal handling operations and associated systems. (12)
- Outline and compare types of feeders, stokers, combustion systems. (12)
- Illustrate draught, dust collector, furnace, cooling tower and heat rejection systems. (12)
- Evaluate pollution levels from power plants, pollution control methods, and application of pollution recorders. (14)

### UNIT III

**Diesel Power Plant:** Diesel Power Plant, Construction, Plant lay out with auxiliaries, fuel storage.

**GAS TURBINE PLANT:** Introduction - Classification - Construction - Layout with Auxiliaries - Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Explain working principle, and compare types of diesel power plant. (12)
- Outline the diesel power plant layout with its supporting equipment. (12)
- Illustrate the working principle of open cycle and closed cycle gas turbine. (12)
- Demonstrate combined cycle power plants with benefits and shortcomings. (12)

### UNIT IV

**Hydro Electric Power Plant:** Water Power - Hydrological Cycle / Flow Measurement - Drainage Area Characteristics - Hydrographs - Storage and Pondage - Classification of Dams and Spill Ways.

**Hydro Projects And Plant:** Classification - Typical Layouts - Plant Auxiliaries - Plant Operation Pumped Storage Plants.

#### Learning Outcomes

At the end of this unit, the student will be able to

- Explain hydrological cycle, infer flow measurements from hydrographs. (12)
- Summarize working principle of hydro electric power plant. (12)
- Illustrate typical layout of hydro electric power plant, and its auxiliary equipments. (12)

### UNIT V

**Power from Non-Conventional Sources:** Utilization of Solar Collectors- Working Principle, Wind Energy - Types of Turbines - HAWT & VAWT-Tidal Energy. MHD power Generation.

**Nuclear Power Station:** Nuclear Fuel - Nuclear Fission, Chain Reaction, Breeding and Fertile Materials - Nuclear Reactor -Reactor Operation.

**Types of Reactors:** Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding - Radioactive Waste Disposal.

### **Learning Outcomes**

At the end of this unit, the student will be able to

- Familiarize the source of conventional and non conventional sources in India . (L2)
- Explain working principle of Nuclear power plants, nuclear fuels, and reactor operations. (L2)
- Outline the various types of nuclear reactors, their applications and limitations. (L2)
- Summarize the hazards of nuclear reactors and significance of nuclear waste disposal. (L2)

### **Course Outcomes:**

At the end of this course, the student will be able to

- Outline sources of energy, power plant economics, and environmental aspects. (I2)
- Explain power plant economics and environmental considerations.(I2)
- Describe working components of a steam power plant.(I2)
- Illustrate the working mechanism of diesel and gas turbine power plants.(I2)
- Summarize types of renewable energy sources and their working principle.(I2)
- Demonstrate the working principle of nuclear power plants. (I4)

### **TEXT BOOKS:**

1. P.K. Nag, “Power Plant Engineering”, 3<sup>rd</sup> edition, TMH, 2013.
2. Wakil, “Power plant technology”, M.M.EI TMH Publications.

### **REFERENCE BOOKS:**

1. Rajput, “A Text Book of Power Plant Engineering:”, 4<sup>th</sup> edition, Laxmi Publications, 2012.
2. Ramalingam, “Power plant Engineering”, Scietech Publishers, 2013
3. P.C. Sharma, “Power Plant Engineering”, S.K. Kataria Publications, 2012.
4. Arora and S.Domakundwar, “A course in Power Plant Engineering”, Dhanpat Rai & Co (p) Ltd, 2014.

(19A03504e) ERGONOMICS AND HUMAN FACTORS IN ENGINEERING  
PROFESSIONAL ELECTIVE - I

**Course Objectives**

- Familiarize the fundamentals of human factors in engineering.
- Explain principles Hours Anthropometry, Ergonomics and product design.
- Describe the Improvement of human work place through controls.
- Evaluate the sources of vibration and performance effect of vibration in machine tools.
- Know the Special purpose lighting for illumination and quality control.

**UNIT I**

**Fundamentals of Human Factors Engineering:** Human Biological, Ergonomic and psychological capabilities and limitations, Concepts of human factors engineering and ergonomics, Man-Machine system and Design philosophy.

**Physical work and energy expenditure:** Manual lifting, Work posture, Repetitive motion, Provision of energy for muscular work, Heat stress, Role of oxygen physical exertion, Measurement of energy expenditure, Respiration, Pulse rate and blood pressure during physical work, Physical work capacity and its evaluation.

**Learning Outcomes:**

At the end of this unit the student will be able to

- Define the fundamentals concepts of human factors in engineering.(11)
- Discuss the human biological, ergonomic and psychological capabilities in engineering.(16)
- Evaluate physical work capacity and energy expenditure.(14)
- Measure the energy expenditure, respiration, pulse rate and blood pressure during physical exertion. (14)

**UNIT-II**

**Hours Anthropometry:** Physical dimensions of the human body as a working machine, Motion size relationships, Static and dynamic anthropometry, Anthropometric design principles, Using anthropometric measures for industrial design.

**Ergonomics and product design:** Ergonomics in automated systems, Expert systems for ergonomic design, Anthropometric data and its application in ergonomic design, Limitations of anthropometric data, Use of computerized database.

**Learning Outcomes:**

At the end of this unit the student will be able to

- Explain the concept of hours anthropometry. (12)
- Illustrate the physical dimensions of the human body as a working machine. (12)
- Discuss anthropometric data and its application in ergonomic design. (16)
- State the limitations of anthropometric data in ergonomic design. (14)

### UNIT -III

**Machine controls:** Improvement of human work place through controls, Displays and Controls, Shapes and sizes of various controls and displays, Multiple display and control situations, Design of major controls in automobiles and machine tools, Principles of hand tool design.

**Work place and seating design:** Design of office furniture, Redesign of instruments, Work process: Duration of rest periods, Design of visual displays, Design for shift work.

#### Learning Outcomes:

At the end of this unit the student will be able to

- Describe the concept of improvement of human work place through controls.(12)
- Explain the principles of hand tool design. (12)
- Illustrate the design of major controls in automobiles and machine tools. (12)
- Design the work place and seating plane in machine controls.(16)

### UNIT-IV

**Color and light:** Color and the eye, Color consistency, Color terms, Reactions to color and color continuation, Color on engineering equipments.

**Temperature-Humidity-Illumination and Contrast:** Use of Photometers, Recommended illumination levels, The ageing eye, Use of indirect (Reflected) lighting, Cost efficiency of illumination, Special purpose lighting for illumination and quality control.

#### Unit Outcomes:

At the end of this unit the student will be able to

- Explain the terms color consistency, reactions to color and color continuation.(12)
- Describe effects of color on engineering equipments.(12)
- Identify recommended illumination levels. (13)
- Explain about special purpose lighting for illumination and quality control. (12)

### UNIT-V

**Hours Measurement of sound:** Noise exposure and hearing loss, Hearing protectors, Analysis and reduction of noise, Effects of noise, Performance annoyance of noise and interface with communication, Sources of vibration and performance effect of vibration, Vibrations in machine tools.

#### Learning Outcomes:

At the end of this unit the student will be able to

- Describe the sources of vibration and performance effect of vibrations in machine tools.(16)
- Illustrate the effects of noise on machine tool operation. (12)
- Explain the terms noise exposure, hearing loss and hearing protectors. (12)
- Explain the terms analysis and reduction of noise in machine tools.(12)

### **Course Outcomes**

After completing the course, the student will be able to

- Describe the sources of vibration and performance effect of vibrations in machine tools.(16)
- Identify recommended illumination levels. (13)
- Illustrate the design of major controls in automobiles and machine tools. (12)
- State the limitations of anthropometric data in ergonomic design. (14)
- Measure the energy expenditure, respiration, pulse rate and blood pressure during physical exertion. (14)

### **TEXT BOOK(S)**

1. M. S. Sanders and E. J. McCormick, "Human Factors in Engineering Design", 7<sup>th</sup> edition, McGraw- Hill International, 1993.

### **REFERENCES**

1. P. V. Karpovich and W. E. Sinning, "Physiology of Muscular Activity", 7<sup>th</sup> edition, Saunders (W.B.) Co Ltd., 1971.
2. "Applied Ergonomics Handbook", I.P.C. Science and Technology Press Limited, 1974.
3. M. Helander, "A Guide to the Ergonomics of Manufacturing", 2<sup>nd</sup> edition, CRC Press, 1997.
4. K. H. E. Kroemer, H. B. Kroemer and K. E. Kroemer Elbert, "Ergonomics: How to design for ease and efficiency", 2<sup>nd</sup> edition, Pearson Publications, 2001.

**(19A01506a) EXPERIMENTAL STRESS ANALYSIS**  
**OPEN ELECTIVE-I**

**Course Objective:**

To bring awareness on experimental method of finding the response of the structure to different types of load.

- Demonstrates principles of experimental approach.
- Teaches regarding the working principles of various strain gauges.
- Throws knowledge on strain rosettes and principles of non destructive testing of concrete.
- Gives an insight into the principles of photo elasticity.

**UNIT-I**

**PRINCIPLES OF EXPERIMENTAL APPROACH:** - Merits of Experimental Analysis Introduction, uses of experimental stress analysis advantages of experimental stress analysis, Different methods –Simplification of problems.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Demonstrate the merits and principles of experimental approach
- Give an insight into the uses and advantages of experimental stress analysis

**UNIT-II**

**STRAIN MEASUREMENT USING STRAIN GAUGES:** - Definition of strain and its relation of experimental Determinations Properties of Strain Gauge Systems-Types of Strain Gauges – Mechanical, Acoustic and Optical Strain Gauges. Introduction to Electrical strain gauges - Inductance strain gauges – LVDT – Resistance strain gauges – various types –Gauge factor – Materials of adhesion base.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Introduce various strain gauge systems and their properties
- Give information regarding the gauge factor and materials of adhesion bases

**UNIT-III**

**STRAIN ROSSETTES AND NON – DESTRUCTIVE TESTING OF CONCRETE:-** Introduction – the three elements Rectangular Rosette – The Delta Rosette Corrections for Transverse Strain Gauge. Ultrasonic Pulse Velocity method –Application to Concrete. Hammer Test – Application to Concrete.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Introduces various strain rosettes and corrections for strain gauges
- Gives an insight into the destructive and non destructive testing of concrete

#### **UNIT-IV**

**THEORY OF PHOTOELASTICITY:** - Introduction –Temporary Double refraction – The stress Optic Law –Effects of stressed model in a polariscope for various arrangements – Fringe Sharpening. Brewster’s Stress Optic law.

#### **Learning outcomes:**

At the end of the unit, students will be able to:

- Introduces stress optic laws.
- Gives the arrangements and working principles of polariscope.

#### **UNIT-V**

**TWO DIMENSIONAL PHOTOELASTICITY:** - Introduction – Iso-chromatic Fringe patterns- Isoclinic Fringe patterns passage of light through plane Polariscope and Circular polariscope Isoclinic Fringe patterns – Compensation techniques – Calibration methods – Separation methods – Scaling Model to prototype Stresses – Materials for photo – Elasticity Properties of Photoelastic Materials.

#### **Learning outcomes:**

At the end of the unit, students will be able to:

- Introduces the understanding of different fringe patterns.
- Introduces model analysis and properties of photo elastic materials.

#### **Course Outcomes:**

After completion of the course

- The student will be able to understand different methods of experimental stress analysis
- The student will be able to understand the use of strain gauges for measurement of strain
- The student will be exposed to different Non destructive methods of concrete
- The student will be able to understand the theory of photo elasticity and its applications in analysis of structures

#### **TEXT BOOKS:-**

1. J.W.Dally and W.F.Riley, “Experimental stress analysis College House Enterprises”
2. Dr.Sadhu Singh, “Experimental stress analysis”, khanna Publishers

#### **REFERENCE BOOKS:**

1. U.C.Jindal, “Experimental Stress analysis”, Pearson Publications.
2. L.S.Srinath, “Experimental Stress Analysis”, MC.Graw Hill Company Publishers.



(19A01506b) BUILDING TECHNOLOGY  
OPEN ELECTIVE-I

**Course Objectives:**

- To impart to know different types of buildings, principles and planning of the buildings.
- To identify the termite control measure in buildings, and importance of grouping circulation, lighting and ventilation aspects in buildings.
- To know the different modes of vertical transportation in buildings.
- To know the utilization of prefabricated structural elements in buildings.
- To know the importance of acoustics in planning and designing of buildings.

**UNIT-I**

Overview of the course, basic definitions, buildings-types-components- economy and design-principles of planning of buildings and their importance. Definitions and importance of grouping and circulation-lighting and ventilation-consideration of the above aspects during planning of building.

**Learning outcomes:**

At the end of the unit, students will be able to:

- To be able to plan the building with economy and according to functional requirement.

**UNIT-II**

Termite proofing: Inspection-control measures and precautions- lighting protection of buildings-general principles of design of openings-various types of fire protection measures to be considered while panning a building.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Able to know the termite proofing technique to the building and protection form lightening effects.
- To be able to know the fire protection measure that are to be adopted while planning a building.

**UNIT-III**

Vertical transportation in a building: Types of vertical transportation-stairs-different forms of stairs- planning of stairs- other modes of vertical transportation – lifts-ramps-escalators.

**Learning outcomes:**

At the end of the unit, students will be able to:

- To be able to know the different modes of vertical transportation and their suitability

## **UNIT-IV**

Prefabrication systems in residential buildings- walls-openings-cupboards-shelves etc., planning and modules and sizes of components in prefabrication. Planning and designing of residential buildings against the earthquake forces, principles, seismic forces and their effect on buildings.

### **Learning outcomes:**

At the end of the unit, students will be able to:

- Identify the adoption of prefabricated elements in the building.
- Know the effect of seismic forces on buildings

## **UNIT-V**

Acoustics – effect of noise – properties of noise and its measurements, principles of acoustics of building. Sound insulation- importance and measures.

### **Learning outcomes:**

At the end of the unit, students will be able to:

- To know the effect of noise, its measurement and its insulation in planning the buildings

### **Course Outcomes:**

After completion of the course the student will be able to

- Understand the principles in planning and design the buildings.
- Know the different methods of termite proofing in buildings.
- Know the different methods of vertical transportation in buildings.
- Know the implementation of prefabricated units in buildings and effect of earthquake on buildings.
- Know the importance of acoustics in planning and designing of buildings.

### **TEXT BOOKS :**

1. Varghese, “Building construction”, PHI Learning Private Limited.
2. Punmia.B.C, “Building construction”, Jain.A.K and Jain.A.K Laxmi Publications.
3. S.P.Arora and S.P.Brndra “Building construction”, Dhanpat Rai and Sons Publications, New Delhi
4. “Building construction-Technical teachers training institute”, Madras, Tata McGraw Hill.

### **REFERENCE BOOKS:**

1. National Building Code of India, Bureau of Indian Standards

**(19A02506a) ELECTRICAL ENGINEERING MATERIALS**  
**(OPEN ELECTIVE-I)**

**Course Objectives:**

To make the students learn about

- Classification of materials.
- Properties of materials and its applications.
- Domestic wiring and earthing

**UNIT-I Conducting Materials**

Introduction – classification of materials – Metals and Non metals, physical, thermal, mechanical and electrical properties of materials – classification of electrical materials – concept of atom – electron configuration of atom, conductors, general properties of conductors, factors effecting resistivity of electrical materials –electrical/mechanical/thermal properties of copper, aluminum, iron, steel, lead, tin and their alloys – applications.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Understand the classification of conducting materials.
- Analyze the properties of different conducting materials
- Apply the materials where it is applicable
- Know about electron configuration of atom

**UNIT-II Dielectric and High Resistivity Materials**

Introduction – solid, liquid and gaseous dielectrics, leakage current, permittivity, dielectric constant, dielectric loss – loss angle – loss constant, Breakdown voltage and dielectric strength of – solid, liquid and gaseous dielectrics, effect of break down– electrical and thermal effects, Polarization – electric, ionic and dipolar polarization. Effect of temperature and Frequency on dielectric constant of polar dielectrics. High Resistivity materials – electrical / thermal / mechanical properties of Manganin, Constantan, Nichrome, Tungsten, Carbon and Graphite and their applications in electrical equipment.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Understand the classification of dielectric and high resistivity materials.
- Analyze the properties of dielectric and high resistivity materials
- Understand about concept of polarization and dipolar polarization
- Apply the materials where it is applicable

**UNIT-III Solid Insulating Materials**

Introduction – characteristics of a good electrical insulating materials – classification of insulating materials – electrical, thermal, chemical and mechanical properties of solid insulating materials -

Asbestos, Bakelite, rubber, plastics, thermo plastics. Resins, polystyrene, PVC, porcelain, glass, cotton and paper.

### **Learning outcomes:**

At the end of the unit, students will be able to:

- Understand about various characteristics of solid insulating materials
- Understand the classification of solid insulating materials.
- Analyze the properties of solid insulating materials
- Apply the materials where it is applicable

### **UNIT-IV Liquid & Gas Insulating Materials**

Liquid insulating materials – Mineral oils, synthetic liquids, fluorinated liquids – Electrical, thermal and chemical properties – transformer oil – properties – effect of moisture on insulation properties Gaseous insulators – classification based on dielectric strength – dielectric loss, chemical stability properties and their applications.

### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Understand the classification of liquid insulating materials.
- Analyze the properties of liquid insulating materials
- Apply the materials where it is applicable
- Understand about properties and classification of gaseous insulators

### **UNIT-V Domestic Wiring**

Wiring materials and accessories – Types of wiring – Types of Switches - Specification of Wiring – Stair case wiring - Fluorescent lamp wiring- Godown wiring – Basics of Earthing – single phase wiring layout for a residential building.

### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Understand about wiring materials and accessories
- Understand about earthing and wiring layout of domestic buildings
- Design and develop Residential wiring
- Know about godown wiring

### **Course Outcomes:**

After completing the course, the student should be able to:

- Understand the classification of materials, domestic wiring materials and earthing.
- Analyze the properties of different electrical materials
- Apply where the materials are applicable based on properties of materials
- Design and develop Residential wiring, godown wiring and earthing.

**Text Books:**

1. G.K. Mithal, “Electrical Engineering Materials”, Khanna publishers, 2<sup>nd</sup> edition, 1991.
2. R.K. Rajput, A course in “Electrical Engineering Materials”, Laxmi publications, 2009.

**Reference Books:**

1. C.S. Indulkar and S. Thiruvengadam, “An Introduction to Electrical Engineering Materials” S Chand & Company, 2008.
2. Technical Teachers Training Institute, “Electrical engineering Materials”, 1<sup>st</sup> Edition, Madras, McGraw Hill Education, 2004.
3. by S.P. Seth, “A course in Electrical Engineering Materials Physics Properties & Applications”, Dhanapat Rai & Sons Publications, 2018.

**(19A04506a) ANALOG ELECTRONICS**  
**OPEN ELECTIVE-I**

**Course Objectives:**

- To understand the characteristics of various types of electronic devices and circuits (L1).
- To apply various principles of electronic devices and circuits to solve complex Engineering problems (L2).
- To analyze the functions of various types of electronic devices and circuits (L3).
- To evaluate the functions of various types of electronic devices and circuits in real time applications (L3).
- To design various types of electronic circuits for use in real time applications (L4).

**UNIT-I:**

**Diodes and Applications**

Properties of intrinsic and extrinsic semiconductor materials. Characteristics of PN junction diode and Zener diode. Applications of PN diode as a switch, rectifier and Zener diode as regulator. Special purpose diodes: Schottky diode, Tunnel diode, Varactor diode, photodiode and LED.

**Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the characteristics of various types of diodes (L1).
- Apply the principles of diodes to solve complex Engineering problems (L2).
- Analyze the functions of diodes in forward and reverse bias conditions (L3).
- Evaluate the functions of diodes in real time applications (L3).
- Design rectifiers and switches using diodes (L4).

**UNIT-II:**

**BJT and its Applications**

Construction, Operation, and Characteristics in CE, CB and CC configurations. Fixed-Bias and Voltage Divider-Bias. Applications as switch and amplifier.

**Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the characteristics and biasing of BJT (L1).
- Apply the principles of BJT to solve complex Engineering problems (L2).

- Analyse the functions of BJT in various configurations (L3).
- Evaluate the functions of BJT in real time applications (L3).
- Design amplifiers and switches using BJT (L4).

### **UNIT-III:**

#### **FETs and Applications**

**JFETs:**Construction, Operation, and Characteristics in CS configurations. Fixed-Bias and Voltage Divider -Bias. Applications as switch and amplifier.

**MOSFETs:**Construction, Operation, and Characteristics of Enhancement and Depletion modes in CS configurations. Biasing in Enhancement and Depletion modes. Applications as switch.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the characteristics and biasing of FETs (L1).
- Apply the principles of FETs to solve complex Engineering problems (L2).
- Analyze the functions of FETs in CS configuration (L3).
- Evaluate the functions of FETs in real time applications (L3).
- Design amplifiers and switches using FETs (L4).

### **UNIT-IV:**

#### **Feedback Amplifiers and Oscillators**

**Feedback Amplifiers:** Concept of feedback, General characteristics of negative feedback amplifiers, Voltage-series, Current-series, Voltage-shunt, and Current-shunt feedback amplifiers.

**Oscillators:**Conditions for oscillations, Hartley and Colpitts oscillators, RC phase-shift and Wien-bridge oscillators.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of negative & positive feedback and characteristics feedback amplifiers (L1).
- Apply the principles of feedback amplifiers and oscillators to solve complex Engineering problems (L2).
- Analyze the functions of feedback amplifiers and oscillators (L3).
- Evaluate the functions of feedback amplifiers and oscillators in real time applications (L3).
- Design feedback amplifiers and oscillators for specific applications (L4).

### **UNIT-V:**

#### **Wave-Shaping & Multivibrator Circuits and Linear Integrated Circuits**

**Wave-Shaping & Multivibrator Circuits:** Introduction, Waveform Shaping Circuits –RC and RL Circuits. Clippers, Comparator and Clampers. Bistable, Schmitt Trigger, Monostable and Astable Multivibrators.

**Linear Integrated Circuits:** Operational Amplifier: Introduction, Block diagram, Basic applications – Inverting, Non-inverting, Summing amplifier, Subtractor, Voltage Follower. IC 555 Timer and IC 7805 Regulator.

### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the operation of Wave-Shaping & Multivibrator Circuits and Linear Integrated Circuits (L1).
- Apply the principles of Wave-Shaping & Multivibrator Circuits and Linear Integrated Circuits to complex Engineering solve problems (L2).
- Analyse the functions of Wave-Shaping & Multivibrator Circuits and Linear Integrated Circuits (L3).
- Evaluate the functions of Wave-Shaping & Multivibrator Circuits and Linear Integrated Circuits in real time applications (L3).
- Design Wave-Shaping & Multivibrator Circuits and Linear Integrated Circuits for specific applications (L4).

Note: In all the units, only qualitative treatment is required.

### **Course Outcomes:**

At the end of the course, the student should be able to

- Understand the characteristics of various types of electronic devices and circuits
- Apply various principles of electronic devices and circuits to solve complex Engineering problems
- Analyse the functions of various types of electronic devices and circuits, Evaluate the functions of various types of electronic devices and circuits in real time applications
- Design various types of electronic circuits for use in real time applications.

### **TEXT BOOKS:**

1. S. Salivahanan and N. Suresh Kumar, “Electronic Devices and Circuits”, 4<sup>th</sup> Edition, McGraw Hill Education (India) Pvt Ltd., 2017.

### **REFERENCES:**

1. J. Milliman, Christos C Halkias, and Satyabrata Jit, “Electronics Devices and Circuits”, 4<sup>th</sup> Edition, McGraw Hill Education (India) Pvt Ltd., 2015.
2. David A. Bell “Electronics Devices and Circuits”, 5<sup>th</sup> Edition, Oxford University Press, 2008.



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**Blooms' learning levels:**

L1: Remembering and Understanding

L2: Applying

L3: Analyzing/Derive

L4: Evaluating/Design

L5: Creating

**(19A04506b) DIGITAL ELECTRONICS**  
**OPEN ELECTIVE-I**

**Course Objectives:**

- To introduce different methods for simplifying Boolean expressions
- To analyze logic processes and implement logical operations using combinational logic circuits
- To understand characteristics of memory and their classification.
- To understand concepts of sequential circuits and to analyze sequential systems in terms of state machines
- To understand concept of Programmable Devices

**UNIT- I**

Minimization Techniques and Logic Gates Minimization Techniques: Boolean postulates and laws – De-Morgan’s Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions — Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don’t care conditions – Quine - McCluskey method of minimization. Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR Implementations of Logic Functions using gates, NAND– NOR implementations – Multi level gate implementations- Multi output gate implementations. TTL and CMOS Logic and their characteristics – Tristate gates.

**Learning Outcomes:**

At the end of the unit, the student should be able to:

- Learn Boolean algebra and logical operations in Boolean algebra. (L1)
- Apply different logic gates to functions and simplify them. (L2)
- Analyze the redundant terms and minimize the expression using Kmaps and tabulation methods (L3)

**UNIT- II**

Combinational Circuits -Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.

**Learning Outcomes:**

At the end of the unit, the student should be able to:

- Apply the logic gates and design of combinational circuits(L2)
- Design of different combinational logic circuits(L4)

### **UNIT -III**

Sequential Circuits-Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation –Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – serial adder/subtractor- Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Design of Synchronous counters: state diagram- State table –State minimization –State assignment - Excitation table and maps-Circuit implementation - Modulo-n counter, Registers – shift registers - Universal shift registers – Shift register counters – Ring counter – Shift counters - Sequence generators.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Understand the clock dependent circuits (L1)
- Identify the differences between clocked and clock less circuits, apply clock dependent circuits(L2)
- Design clock dependent circuits(L4)

### **UNIT -IV**

Memory Devices Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM –EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle - Timing wave forms – Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell –Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL

#### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Understand the principle of operation of basic memory devices, and programmable logic devices. (L1)
- Implement combinational logic circuits using memory and programmable logic devices (L2)

### **UNIT -V**

Synchronous and Asynchronous Sequential Circuits Synchronous Sequential Circuits: General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Understand how synchronous and asynchronous sequential circuit works (L1)
- Understand the FSM and its design principles. (L1)
- Analyze the procedure to reduce the internal states in sequential circuits (L3)
- Illustrate minimization of complete and incomplete state machines and to write a minimal cover table(L2)

### **Course Outcomes:**

- Explain switching algebra theorems and apply them for logic functions, discuss about digital logic gates and their properties, Identify the importance of SOP and POS canonical forms in the minimization of digital circuits.
- Evaluate functions using various types of minimizing algorithms like Boolean algebra, Karnaugh map or tabulation method.
- Analyze the design procedures of Combinational & sequential logic circuits.
- Design of different combinational logic circuits, and compare different semiconductor memories.

### **Text Books:**

1. M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
2. Zvi Kohavi, "Switching and Finite Automata Theory", 3<sup>rd</sup> Edition, South Asian Edition, 2010,

### **References:**

1. John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008
2. John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
3. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
4. Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.
5. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011
6. Donald D.Givone, "Digital Principles and Design", TMH, 2003.

**(19A05506a) FREE AND OPEN SOURCES SYSTEMS**  
**(Open Elective –I)**  
**(Common to CSE & IT)**

**Course Objectives:**

This course is designed to:

- Understand the context and operation of free and open source software (FOSS) communities and associated software projects.
- Motivate the students to contribute in FOSS projects
- Familiarize with programming languages like Python, Perl, Ruby
- Elucidate the important FOSS tools and techniques

**UNIT I PHILOSOPHY**

Notion of Community--Guidelines for effectively working with FOSS community--, Benefits of Community based Software Development --Requirements for being open, free software, open source software –Four degrees of freedom - FOSS Licensing Models - FOSS Licenses – GPL-AGPL-LGPL - FDL - Implications – FOSS examples.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Analyze the benefits of Community based Software Development. (L4)
- Explain the degrees of Freedom. (L2)

**UNIT II LINUX**

Linux Installation and Hardware Configuration – Boot Process-The Linux Loader (LILO) - The Grand Unified Bootloader (GRUB) - Dual-Booting Linux and other Operating System - Boot-Time Kernel Options- X Windows System Configuration-System Administration – Backup and Restore Procedures- Strategies for keeping a Secure Server.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Demonstrate Linux Installation and hardware configuration. (L2)
- Compare Linux and Windows System Configurations. (L4)

**UNIT III PROGRAMMING LANGUAGES**

Programming using languages like Python, Perl, Ruby

**Learning outcomes:**

At the end of the unit, students will be able to:

- Explain the syntax of programming Languages Python, Perl and Ruby. (L2)
- Develop applications in the Open source programming Languages. (L6)

#### **UNIT IV PROGRAMMING TOOLS AND TECHNIQUES**

Usage of design Tools like Argo UML or equivalent, Version Control Systems like Git or equivalent, – Bug Tracking Systems- Package Management Systems

##### **Learning outcomes:**

At the end of the unit, students will be able to:

- List various programming tools and explain their uses (L1)
- Make use of the various tools while building applications (L3)

#### **UNIT V FOSS CASE STUDIES**

Open Source Software Development - Case Study – Libre office -Samba

##### **Learning outcomes:**

At the end of the unit, students will be able to:

- Elaborate the open Source Software Development(L6)
- Compare Libre office with its proprietary equivalent (L5)

##### **Course Outcomes:**

Upon completion of the course, the students should be able to:

- Demonstrate Installation and running of open-source operating systems.(L2)
- Justify the importance of Free and Open Source Software projects. (L5)
- Build and adapt one or more Free and Open Source Software packages. (L6)
- Utilize a version control system. (L3)
- Develop software to and interact with Free and Open Source Software development projects.(L3)

##### **TEXT BOOK:**

Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, “Linux in a Nutshell”, Sixth Edition, OReilly Media, 2009.

##### **REFERENCES:**

1. Philosophy of GNU URL: <http://www.gnu.org/philosophy/>.
2. Linux Administration URL: <http://www.tldp.org/LDP/lame/LAME/linux-admin-made-easy/>.
3. The Python Tutorial available at <http://docs.python.org/2/tutorial/>.
4. Perl Programming book at <http://www.perl.org/books/beginning-perl/>.
5. Ruby programming book at <http://ruby-doc.com/docs/ProgrammingRuby/>.
6. Version control system URL: <http://git-scm.com/>.
7. Samba: URL : <http://www.samba.org/>.
8. Libre office: <http://www.libreoffice.org/>.

**(19A05506b) COMPUTER GRAPHICS and MULTIMEDIA ANIMATION**  
**(Open Elective –I)**  
**(Common to CSE & IT)**

**Course Objectives:**

This course is designed to:

- Introduce the use of the components of a graphics system and become familiar with the building approach of graphics system components and related algorithms.
- Understand the basic principles of 3- 3-dimensional computer graphics.
- Provide insites on how to scan, convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
- Provide an understanding of mapping from world coordinates to device coordinates, clipping, and projections.
- Discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.

**UNIT I OVERVIEW OF COMPUTER GRAPHICS SYSTEM**

OverView of Computer Graphics System – Video display devices – Raster Scan and random scan system – Input devices – Hard copy devices.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Explain the overview of computer graphics with visualization. (L2)
- Classify the Input devices. (L2)
- Distinguish raster scan and random scan systems. (L4)

**UNIT II OUTPUT PRIMITIVES AND ATTRIBUTES**

Drawing line, circle and ellipse generating algorithms – Scan line algorithm – Character Generation – attributes of lines, curves and characters – Antialiasing.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Analyse output primitives and attributes. (L4)
- Design algorithms based on output. (L6)

**UNIT III TWO DIMENSIONAL GRAPHICS TRANSFORMATIONS AND VIEWING:**

Two-dimensional Geometric Transformations – Windowing and Clipping – Clipping of lines and clipping of polygons.

## **Learning outcomes:**

At the end of the unit, students will be able to:

- Create two-dimensional graphics. (L6)
- Examine the clipping of polygon. (L4)
- Compare different forms of variations. (L2)

## **UNIT IV THREE DIMENSIONAL GRAPHICS AND VIEWING**

Three-dimensional concepts – Object representations- Polygon table, Quadric surfaces, Splines, Bezier curves and surfaces – Geometric and Modelling transformations – Viewing - Parallel and perspective projections.

## **Learning outcomes:**

At the end of the unit, students will be able to:

- Create three-dimensional graphics. (L6)
- Explain the Quadric surfaces and polygon table. (L2)
- Define modelling transformations. (L1)

## **UNIT V REMOVAL OF HIDDEN SURFACES**

Visible Surface Detection Methods – Computer Animation.

## **Learning outcomes:**

At the end of the unit, students will be able to:

- List the different types of detection methods. (L1)
- Compare various computer animations. (L2)

## **Course outcomes:**

Upon completion of the course, the students should be able to:

- Explain the basic concepts used in computer graphics. (L2)
- Inspect various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping. (L4)
- Assess the importance of viewing and projections. (L5)
- Define the fundamentals of animation, virtual reality and its related technologies. (L3)
- Analyze the typical graphics pipeline (L4)

## **TEXTBOOK**

1. Hearn, D. and Pauline Baker, M., Computer Graphics (C-Version), 2nd Edition, Pearson Education, 2002.



## **REFERENCES**

1. Neuman, W.M., and Sproull, R.F., Principles of Interactive Computer Graphics, Mc Graw Hill Book Co., 1979.
2. Roger, D.F., Procedural elements for Computer Graphics, Mc Graw Hill Book Co., 1985.
3. Asthana, R.G.S and Sinha, N.K., Computer Graphics, New Age Int. Pub. (P) Ltd., 1996.
4. Floey, J.D., Van Dam, A, Feiner, S.K. and Hughes, J.F, Computer Graphics, Pearson Education, 2001.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– III-I** **L T P C**  
**3 0 0 3**  
**(19A27506a) BREWING TECHNOLOGY**  
**OPEN ELECTIVE - I**

**PREAMBLE**

This course covers the origin of brewing and ingredients used, methods and equipment used and innovations in this field.

**Course Objectives**

- To understand the Beer manufacturing, ingredients and their roles.
- To understand overall view of a brewing industry

**UNIT – I**

Introduction of brewing, history of brewing; Raw materials: barley, hops, water, yeast; Adjuncts for beer production: Maize, rice, millet, wheat, sugar etc. Malt production, role of enzymes for malting; Barley storage, steeping, germination, kilning, cooling, storage;

**Learning Outcomes:**

At the end of the unit, the student should be able to:

- Introduction of brewing, history of brewing
- Raw materials like barley, hops, water, yeast
- Adjuncts for beer production: Maize, rice, millet, wheat, sugar etc
- Malt production, role of enzymes for malting
- Barley storage, steeping, germination, kilning, cooling, storage

**UNIT – II**

Malt from other cereals, caramel malt, roasted malt, smoked malt, malt extract; Malt quality evaluation, Wort production, malt milling, Mashing, Mashing vessels; Wort boiling, clarification, cooling and aeration Enzyme properties, starch degradation, b-glucan degradation; Conversion of fatty matter, Biological acidification

**Learning Outcomes:**

At the end of the unit, the student should be able to:

- Malt from other cereals, caramel malt, roasted malt, smoked malt, malt extract
- Malt quality evaluation, Wort production, malt milling, Mashing, Mashing vessels
- Wort boiling, clarification, cooling and aeration Enzyme properties, starch degradation, b-glucan degradation
- Conversion of fatty matter, Biological acidification

### **UNIT – III**

Beer production methods, fermentation technology, changes during fermentation; Filtration procedure and equipment, beer stabilization conditions and durations, beer carbonation process; Packaging equipment and packaging materials, storage conditions and distribution process

#### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Beer production methods, fermentation technology, changes during fermentation
- Filtration procedure and equipment, beer stabilization conditions and durations, beer carbonation process
- Packaging equipment and packaging materials, storage conditions and distribution process

### **UNIT – IV**

Brewing Equipment. Grain mill, kettles, siphons, carboys, fermentation equipment, wort chillers, pumps beer bottles, cans, labels, bottle caps, sanitation equipments Preventive Production of beer against technology, ling phenomenon of beer, possible measures against staling reactions, oxidation

#### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Brewing Equipments like Grain mill, kettles, siphons, carboys, fermentation equipment, wort chillers
- pumps beer bottles, cans, labels, bottle caps, sanitation equipments
- Preventive Production of beer against technology, ling phenomenon of beer, possible measures against staling reactions, oxidation

### **UNIT – V**

Recent advances: Immobilized Cell Technology in Beer Production, immobilized yeast cell technology Energy management in the brewery and maltings; waste water treatment Automation and plant planning

#### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Immobilized Cell Technology in Beer Production, immobilized yeast cell technology
- Energy management in the brewery and maltings
- waste water treatment Automation and plant planning

### **Course Outcomes:**

By the end of this course, students will attain the:

- Knowledge of beer making, chemistry of ingredients used for brewing,
- Knowledge on brewing industry, Unit operations and equipments involved.

### **TEXT BOOKS**

1. Brewing: "Science and Practice, Brookes and Roger Stevens", Dennis E. Briggs, Chris A. Boulton, Peter A. 2004, Woodhead publishing limited.
2. Die Deutsche "Bibliothek Technology: "Brewing and Malting", Wolfgang Kunze. 2010, Bibliographic information published

### **REFERENCES**

1. "Handbook of Brewing": Process, Technology, Markets, Hans Michael Eblinger. 2009, Wiley-VCH Verlag GmbH & Co.
2. Brewing: "New Technologies", Charles W. Bamforth. 2006, Woodhead Pub.

**(19A27506b) COMPUTER APPLICATIONS IN FOOD INDUSTRY**  
**(OPEN ELECTIVE – I)**

**PREAMBLE**

This course covers all facets of computerization and various software's used and their usage.

**Course Objectives**

- Able to know about “The necessity of Software & their applications in Food Industries”
- Able to Implement the Programs in ‘C’ to perform various operations that are related to Food Industries.

**UNIT – I**

Computerization, Importance of Computerization in food industry and IT applications in food industries. Computer operating environments and information system for various types of food industries. Introduction to Bar charts and Pie charts & the procedure to develop bar charts and pie charts on given Data.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Computerization, Importance of Computerization in food industry and IT applications in food industries.
- Computer operating environments and information system for various types of food industries.
- Introduction to Barcharts and Piecharts & the procedure to develop barcharts and piecharts on given Data.

**UNIT – II**

Introduction to Software & Programming Languages, Properties, Differences of an Algorithm and Flowcharts, Advantages and disadvantages of Flowcharts & Algorithms. Introduction, Fundamentals & advantages of ‘C’. Steps in learning ‘C’ (Character set, Identifiers, Keywords) Steps in learning ‘C’ (Data types, Constants, Variables, Escape sequences).

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Introduction to Software & Programming Languages, Properties, Differences of an Algorithm and Flowcharts

- Advantages and disadvantages of Flowcharts & Algorithms. Introduction, Fundamentals & advantages of 'C'.
- Steps in learning 'C' (Character set, Identifiers, Keywords)
- Steps in learning 'C' (Data types, Constants, Variables, Escape sequences).

### **UNIT – III**

Steps in learning 'C' (Operators, Statements) Steps in learning 'C' (Header Files, Input & Output functions: Formatted I/O functions, Unformatted I/O functions). Basic Structure of a simple 'C' program. Decision Making/Control Statements. Branching, Concept of Looping & Looping statements.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Steps in learning 'C' (Operators, Statements)
- Steps in learning 'C' (Header Files, Input & Output functions: Formatted I/O functions, Unformatted I/O functions).
- Basic Structure of a simple 'C' program. Decision Making/Control Statements.
- Branching, Concept of Looping & Looping statements.

### **UNIT – IV**

Concept of Functions (Defining a function & Function Prototypes, Types of functions: Library functions & User defined functions. Concept of various types of User Defined Functions (i.e., About 4 types). Concept of Arrays & Types of Arrays (Single, Double and Multi-Dimensional Arrays). Concept of a String Library Functions.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Concept of Functions (Defining a function & Function Prototypes, Types of functions: Library functions & User defined functions).
- Concept of various types of User Defined Functions (i.e., About 4 types).
- Concept of Arrays & Types of Arrays (Single, Double and Multi-Dimensional Arrays).
- Concept of a String Library Functions.

### **UNIT – V**

Concept of Pointers, Structures & Unions. Introduction to Data Structures, Types of Data Structures (Primary & Secondary Data Structures) Concept of Linked Lists, Types of Linked Lists & Basic operations on linked Lists. Concept of Stacks & Operations on Stacks (PUSH & POP Operations) Concept of Queues and types of Queues Operations on a Queue (ENQUEUE & DEQUEUE Operations)

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Concept of Pointers, Structures & Unions. Introduction to Data Structures, Types of Data Structures (Primary & Secondary Data Structures)
- Concept of Linked Lists, Types of Linked Lists & Basic operations on linked Lists.
- Concept of Stacks & Operations on Stacks (PUSH & POP Operations)
- Concept of Queues and types of Queues Operations on a Queue (ENQUEUE & Dequeue Operations)

### **Course Outcomes**

By the end of the course, the students will be able to

- know about the various steps which are related to computer and Software and their application in Food Industries
- know about the various steps which are necessary to implement the programs in 'C'

### **TEXT BOOKS**

1. Yeswanth Kanethkar, Let us 'C'
2. Balaguruswamy E., "Computer Programming in 'C'"
3. Mark Allen Waise , "Data Structures"

### **REFERENCES**

1. M. S Excel 2000, Microsoft Corporation
2. M. S. Office – Microsoft Corporation
3. Verton M.V. "Computer concepts for Agri Business", AVI Pub. Corp., West Port, USA.

**(19A54506a) OPTIMIZATION TECHNIQUES**  
**(OPEN ELECTIVE-I)**

**Course Objectives:**

The student will be able to learn:

- The basic concepts of Optimization
- The emphasis of this course is on different classical Optimization techniques linear programming and simplex algorithms.
- About optimality of balanced transportation Problems
- About Constrained and unconstrained nonlinear programming.
- About principle of optimality and dynamic programming

**UNIT – I Introduction and Classical Optimization Techniques:**

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems. Classical Optimization Techniques: Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions – Numerical examples.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- To know how to formulate statement of optimization problem with or without constraints
- To know about classification of single and multivariable optimization problems
- To know about necessary and sufficient conditions in defining the optimization problems
- To understand how to formulate Kuhn-Tucker conditions and to solve numerical problems

**UNIT – II Linear Programming**

Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm – Numerical examples.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- To know about formulation of LPP
- To know about formulations of GPP



- To understand various theorems in solving simultaneous equations
- To understand about necessity of Simplex method and to solve numerical problems

### **UNIT – III Nonlinear Programming – One Dimensional Minimization methods**

Introduction, Unimodal function, Elimination methods- Unrestricted Search, Exhaustive Search, Dichotomous Search, Fibonacci Method, Golden Section Method and their comparison; Interpolation methods - Quadratic Interpolation Method, Cubic Interpolation Method and Direct Root Methods – Numerical examples.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- To know about NLP in one dimensional optimization problems
- To understand about various search methods
- To learn about various interpolation methods
- To distinguish and compare the various elimination methods with numerical examples

### **UNIT – IV Unconstrained & Constrained Nonlinear Programming**

**Unconstrained Optimization Techniques:** Introduction- Classification of Unconstrained Minimization Methods, General Approach, Rate of Convergence, Scaling of Design Variables; Direct Search methods- Random Search Methods, Grid Search Method, Pattern Directions, Powell’s Method and Simplex Method

**Constrained Optimization Techniques:** Introduction, Characteristics of a Constrained Problem, Direct Search Methods - Random Search Methods, Basic Approach in the Methods of Feasible Directions, Rosen’s Gradient Projection Method, Generalized Reduced Gradient Method and Sequential Quadratic Programming.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- To distinguish between unconstrained and constrained optimization problems
- To learn about direct search methods in unconstrained NLP problems and comparison
- To understand about direct search methods in constrained NLP problems and comparison
- To do exercises for solving numerical examples of various methods

### **UNIT – V Dynamic Programming**

Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution – Numerical examples.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- To know what is DP problem?

- To know about computational procedure in solving DPP
- To know Calculus and Tabular methods of solving with numerical examples of various methods

**Course Outcomes:**

The student gets thorough knowledge on:

- Basic methods, principles in optimization
- Formulation of optimization models, solution methods in optimization
- Finding initial basic feasible solutions.
- Methods of linear and non-linear (constrained and unconstrained) programming.
- Applications to engineering problems.

**TEXT BOOKS:**

1. S. S. Rao, “Engineering optimization”: Theory and practice 3rd edition, New Age International (P) Limited, 1998.
2. H.S. Kasana & K.D. Kumar, “Introductory Operations Research Springer (India)”, 2004.

**REFERENCES:**

1. R Fletcher, “Practical Methods of Optimization” , 2<sup>nd</sup> Edition, Wiley Publishers, 2000.
2. Jorge Nocedal and Wright S, “Numerical Optimization Springer”, 1<sup>st</sup> Edition, 1999.
3. by K.V. Mital and C. Mohan, “Optimization Methods in Operations Research and systems Analysis” 3<sup>rd</sup> Edition, New Age International (P) Limited, 1996.
4. by S.D. Sharma, “Operations Research”, Kedar Nath, 2012.
5. by H.A. Taha, “Operations Research”, 9<sup>th</sup> Edition, An Introduction Pearson, 2010.
6. G. Hadley, “Linear Programming”, Narosa, 2002.

**(19A52506a) TECHNICAL COMMUNICATION AND PRESENTATION SKILLS**  
**(OPEN ELECTIVE)**

**Course Objectives:**

- To develop awareness in students of the relevance and importance of technical communication and presentation skills.
- To prepare the students for placements
- To sensitize the students to the appropriate use of non-verbal communication
- To train students to use language appropriately for presentations and interviews
- To enhance the documentation skills of the students with emphasis on formal and informal writing

**SYLLABUS**

**UNIT -1:**

**Basics of Technical Communication** – Introduction – Objectives & Characteristics of Technical Communication – Importance and need for Technical communication - LSRW Skills – Barriers to effective communication

**Learning Outcomes:**

At the end of the module, the learners will be able to

- Understand the importance of LSRW skills
- Identify and overcome the barriers to effective communication
- Realize the need and importance of technical communication

**UNIT -II**

**Informal and Formal Conversation** - Verbal and Non-verbal communication –Kinesics, Proxemics, Chronemics, Haptics, Paralanguage

**Learning Outcomes:**

At the end of the module, the learners will be able to

- State the difference between formal and informal conversation.
- Apply the knowledge of the difference between the verbal and non-verbal communication
- Evaluate the different aspects of non-verbal communication.

**UNIT -III**

**Written communication** – Differences between spoken and written communication – Features of effective writing –Advantages and disadvantages of spoken and written communication- Art of condensation- summarizing and paraphrasing

**Learning Outcomes:**

At the end of the module, the learners will be able to

- Know the difference between written and spoken communication
- Apply the awareness of features of effective writing.
- Implement the understanding of summarizing and paraphrasing.

**UNIT -IV**

**Presentation Skills** – Nature and importance of oral presentation – Defining the purpose – Analyzing the audience - Planning and preparing the presentation, organizing and rehearsing the presentation –Individual and group presentations - Handling stage fright

**Learning Outcomes:**

At the end of the module, the learners will be able to

- State the importance of presentation skills in corporate climate.
- Analyze the demography of the audience.
- Plan, prepare and present individual and group presentations.

**UNIT -V**

**Interview Skills** – The Interview process –Characteristics of the job interview – Pre-interview preparation techniques – Projecting the positive image – Answering Strategies

**Learning Outcomes:**

At the end of the module, the learners will be able to

- Identify the characteristics of the job interview.
- Understand the process of Interviews.
- Develop a positive image using strategies in answering FAQs in interviews

**Course Outcomes**

- Understand the importance of effective technical communication
- Apply the knowledge of basic skills to become good orators
- Analyze non-verbal language suitable to different situations in professional life
- Evaluate different kinds of methods used for effective presentations
- Create trust among people and develop employability skills

**TEXT BOOKS:**

1. Ashrif Rizvi, "Effective Technical Communication", TataMcGrahill, 2011
2. Meenakshi Raman & Sangeeta Sharma, "Technical Communication", 3<sup>rd</sup> Edition, O U Press 2015

**REFERENCES:**

1. Pushpalatha & Sanjay Kumar, "Communication Skills", Oxford Univsesity Press
2. Barron's/Books on TOEFL/GRE/GMAT/CAT/IELTS DELTA/Cambridge University Press.2012.
3. Butterfield Jeff, "Soft Skills for Everyone", Cengage Publications, 2011.
4. Universities Press (India) Pvt Ltd., "Management Shapers Series", Himayatnagar, Hyderabad 2008.
5. John Hughes & Andrew Mallett, "Successful Presentations" Oxford.
6. Edgar Thorpe and Showick Thorpe, "Winning at Interviews" Pearson
7. Munish Bhargava, "Winning Resumes and Successful Interviews", McGraw Hill

(19A51506a) CHEMISTRY OF ENERGY MATERIALS

**Course Objectives:**

- To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
- To understand the basic concepts of processing and limitations of fossil fuels and Fuel cells & their applications.
- To impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification method
- Necessity of harnessing alternate energy resources such as solar energy and its basic concepts.
- To understand and apply the basics of calculations related to material and energy flow in the processes.

**UNIT-1: Electrochemical Systems:** Galvanic cell, standard electrode potential, application of EMF, electrical double layer, dipole moments, polarization, Batteries-Lead-acid and Lithium ion batteries.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Solve the problems based on electrode potential (L3)
- Describe the Galvanic Cell (L2)
- Differentiate between Lead acid and Lithium ion batteries (L2)
- Illustrate the electrical double layer (L2)

**UNIT-2: Fuel Cells:** Fuel cell working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency, Basic design of fuel cell,.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Describe the working Principle of Fuel cell (L2)
- Explain the efficiency of the fuel cell (L2)
- Discuss about the Basic design of fuel cells (L3)
- Classify the fuel cell (L2)

**UNIT-3: Hydrogen Storage:** Hydrogen Storage, Chemical and Physical methods of hydrogen storage, Hydrogen Storage in metal hydrides, metal organic frame works (MOF), Carbon structures, metal oxide porous structures, hydrogel storage by high pressure methods. Liquifaction method.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Differentiate Chemical and Physical methods of hydrogen storage (L2)
- Discuss the metal organic frame work (L3)
- Illustrate the carbon and metal oxide porous structures (L2)
- Describe the liquifaction methods (L2)

**UNIT-4: Solar Energy:** Solar energy introduction and prospects, photo voltaic (PV) technology, concentrated solar power (CSP), Solar Fuels, Solar cells.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Apply the photo voltaic technology (L3)
- Demonstrate about solar energy and prospects (L2)
- Illustrate the Solar cells (L2)
- Discuss about concentrated solar power (L3)

**UNIT-5: Photo and Photo electrochemical Conversions:** Photochemical cells and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Differentiate between Photo and Photo electrochemical Conversions (L2)
- Illustrate the photochemical cells (L2)
- Identify the applications of photochemical reactions (L3)
- Interpret advantages of photoelectron catalytic conversion (L2)

**Course Outcome:**

- Ability to perform simultaneous material and energy balances.
- Student learn about various electrochemical and energy systems
- Knowledge of solid, liquid and gaseous fuels
- To know the energy demand of world, nation and available resources to fulfill the demand
- To know about the conventional energy resources and their effective utilization
- To acquire the knowledge of modern energy conversion technologies

- To be able to understand and perform the various characterization techniques of fuels
- To be able to identify available nonconventional (renewable) energy resources and techniques to utilize them effectively

**References :**

1. Physical chemistry **by** Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins
4. Fuel Cell Hand Book 7<sup>th</sup> Edition, by US Department of Energy (EG&G technical services and corporation)
5. Hand book of solar energy and applications by Arvind Tiwari and Shyam.
6. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
7. Hydrogen storage by Levine Klebonoff



**(19A03501P) APPLIED THERMODYNAMICS LAB**

**Course Objectives:**

- Understand the functioning and performance of I.C. Engines
- To find heat losses in various engines

**LIST OF EXPERIMENTS**

1. Demonstration of diesel and petrol engines by cut models
2. Valve timing diagram of 4-stroke diesel engine
3. Port timing diagram of 2-stroke petrol engine
4. Performance of 2-stroke single cylinder petrol engine
5. Morse test on multi cylinder petrol engine
6. Performance of 4-stroke single cylinder diesel engine
7. Performance of two stage reciprocating air compressor
8. Performance of Refrigeration system
9. Performance of Air conditioning system
10. Assembly and disassembly of diesel and petrol engines
11. Performance of heat pipe
12. Performance of heat pump
13. Exhaust gas analysis of orsat apparatus.
14. Determinations of nozzle characteristics.

**Course Outcomes**

Upon the successful completion of course, students will be able to

- Explain different working cycles of engine
- Describe various types of combustion chambers in ic engines
- Illustrate the working of refrigeration and air conditioning systems
- Evaluate heat balance sheet of ic engine.

**(19A03502P) MANUFACTURING TECHNOLOGY LAB**

**Course objectives:**

- Familiarize the construction and working of various machine tools.
- Teach selection of parameters for different machining processes.

**Contents:**

1. Demonstration of construction and operations of general purpose machines : Lathe, drilling machine, milling machine, shaper, slotting machine, cylindrical grinder and surface grinder.
2. Measure the characteristic features of lathe with simple step turning operation.
3. Job on step turning, taper turning, knurling, thread cutting on lathe machine.
4. Perform drilling, reaming and tapping operations.
5. Job on milling (Groove cutting/Gear cutting).
6. Job on shaping and planing.
7. Job on slotting.
8. Job on cylindrical and surface grinding.
9. Job on grinding of tool angles.

**Course outcomes:**

After completion of this course the student may be able to

- Explain the concept of machining with various machine tools.
- Get hands on experience on various machine tools and machining operations.

**(19A03403P) FLUID MECHANICS AND HYDRAULIC MACHINERY LAB**

**OBJECTIVE:** The object of the course to make the students understand the fluid flow concepts and get familiarity with flow measuring devices.

**LIST OF EXERCISES:**

- Calibration of Venturi meter
- Calibration of Orifice meter
- Determination of Coefficient of discharge for a small orifice by a constant head method.
- Determination of Coefficient of discharge for an external mouth piece by variable head method.
- Calibration of contracted Rectangular Notch and /or Triangular Notch.
- Determination of Coefficient of loss of head in a sudden contraction and friction factor.
- Verification of Bernoulli's equation.
- Impact of jet on vanes.
- Study of Hydraulic jump.
- Performance test on Pelton wheel turbine.
- Performance test on Francis turbine.
- Efficiency test on centrifugal pump.

Course out comes:

At the end of the course the student will be able to know

- The various flow properties using various flow measuring devices
- The performance of various turbines and pumps

**(19A03507) SOCIALLY RELEVANT PROJECT (15 HRS / SEM)**

1. Solid waste conversion into energy (Gasification)
2. Plastic waste into fuel.
3. Bio-gas digester.
4. Development of mechanisms for farmers.
5. Smart irrigation for saving water.
6. Mechanized water segregation.
7. Applications of solar technologies for rural purpose.
8. Power generation from wind turbine.
9. Applications of drones for agriculture.
10. Solar drying.

**(19A99501) MANDATORY COURSE: CONSTITUTION OF INDIA**

**COURSE OBJECTIVES :** The objective of this course is

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and Election Commission of India.
- To understand the central-state relation in financial and administrative control

**Syllabus**

**UNIT-I**

Introduction to Indian Constitution – Constitution -Meaning of the term - Indian Constitution- Sources and constitutional history - Features– Citizenship – Preamble - Fundamental Rights and Duties - Directive Principles of State Policy.

**Learning Outcomes:-**

After completion of this unit student will

- Understand the concept of Indian constitution
- Apply the knowledge on directive principle of state policy
- Analyze the History and features of Indian constitution
- Learn about Preamble, Fundamental Rights and Duties

**UNIT-II**

Union Government and its Administration Structure of the Indian Union - Federalism - Centre-State relationship – President’s Role, power and position - PM and Council of ministers - Cabinet and Central Secretariat –Lok Sabha - Rajya Sabha - The Supreme Court and High Court - Powers and Functions

**Learning Outcomes:-**

After completion of this unit student will

- Understand the structure of Indian government
- Differentiate between the state and central government

- Explain the role of President and Prime Minister
- Know the Structure of supreme court and High court

### **UNIT-III**

State Government and its Administration - Governor - Role and Position -CM and Council of ministers - State Secretariat-Organization Structure and Functions

#### **Learning Outcomes:-**

After completion of this unit student will

- Understand the structure of state government
- Analyze the role of Governor and Chief Minister
- Explain the role of State Secretariat
- Differentiate between structure and functions of state secretariat

### **UNIT-IV**

Local Administration - District's Administration Head - Role and Importance - Municipalities - Mayor and role of Elected Representatives -CEO of Municipal Corporation Pachayati Raj - Functions- PRI -Zilla Parishath - Elected officials and their roles - CEO,Zilla Parishath - Block level Organizational Hierarchy - (Different departments) - Village level - Role of Elected and Appointed officials - Importance of grass root democracy

#### **Learning Outcomes:-**

After completion of this unit student will

- Understand the local Administration
- Compare and contrast district administration's role and importance
- Analyze the role of Mayor and elected representatives of Municipalities
- Learn about the role of Zilla Parishath block level organization

### **UNIT-V**

Election Commission - Election Commission- Role of Chief Election Commissioner and Election Commissionerate - State Election Commission -Functions of Commissions for the welfare of SC/ST/OBC and Women

#### **Learning Outcomes:-**

After completion of this unit student will

- Know the role of Election Commission
- Contrast and compare the role of Chief Election commissioner and Commissionerate
- Analyze the role of state election commission

- Evaluate various commissions viz SC/ST/OBC and women

### **Course Outcomes:**

At the end of the course, students will be able to

- Understand historical background of the constitution making and its importance for building a democratic India.
- Understand the functioning of three wings of the government i.e., executive, legislative and judiciary.
- Understand the value of the fundamental rights and duties for becoming good citizen of India.
- Analyze the decentralization of power between central, state and local self-government
- Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

### **TEXT BOOKS**

1. Durga Das Basu, “Introduction to the Constitution of India”, Prentice – Hall of India Pvt. Ltd.. New Delhi
2. Subash Kashyap, “Indian Constitution”, National Book Trust

### **REFERENCES:**

1. J.A. Siwach, “Dynamics of Indian Government & Politics”.
2. H.M.Sreevai, “ Constitutional Law of India”, 4<sup>th</sup> edition in 3 volumes (Universal Law Publication)
3. J.C. Johari, “ Indian Government and Politics”, Hans India
4. M.V. Pylee, “Indian Constitution”, Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi

### **E-RESOURCES:**

1. [nptel.ac.in/courses/109104074/8](https://nptel.ac.in/courses/109104074/8)
2. [nptel.ac.in/courses/109104045/](https://nptel.ac.in/courses/109104045/)
3. [nptel.ac.in/courses/101104065/](https://nptel.ac.in/courses/101104065/)
4. [www.hss.iitb.ac.in/en/lecture-details](http://www.hss.iitb.ac.in/en/lecture-details)
5. [www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution](http://www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution)

(19A03601) DESIGN OF MACHINE ELEMENTS

**Course Objectives:**

- Provide an introduction to design of machine elements.
- Familiarize with fundamental approaches to failure prevention for static and dynamic loading.
- Explain design procedures to different types of joints.
- Teach principles of clutches and brakes and design procedures.
- Instruct different types of bearings and design procedures.

**UNIT I**

**12 hours**

**Mechanical Engineering Design:** Design process, design considerations, codes and standards of designation of materials, selection of materials.

**Design for Static Loads:** Modes of failure, design of components subjected to axial, bending, torsional and impact loads. Theories of failure for static loads.

**Design for Dynamic Loads:** Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, fatigue design for infinite life. Fatigue theories of failure. Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Identify materials suitable for machine elements. (11)
- Apply codes and standards in design. (13)
- Contrast the difference between static and dynamic loads. (12)
- Apply failures theories in designing components subjected to static and dynamic loads. (13)

**UNIT II**

**10 hours**

**Design of Bolted Joints:** Threaded fastness, preload of bolts, various stresses induced in the bolts. Torque requirement for bolt tightening, eccentrically loaded bolted joints, gasketed joints.

**Riveted Joints:** Design of lap, butt and eccentrically loaded joints, failure and efficiency of riveted joints.

**Welded Joints:** Strength of lap and butt welds, eccentrically loaded welded joints. Joints subjected to bending and torsion.

**Learning Outcomes:**

After completion of this unit, students will be able to



- Identify different types of joints. (11)
- Analyse stresses induced in joints subjected to different loads. (14)
- Design different joints subjected to combined loading. (16)

### UNIT III

**10 hours**

**Keys:** Function, types, design of sunk, saddle, Kennedy and Woodruff keys.

**Power Transmission Shafts:** Design of shafts subjected to bending, torsion and axial loading. Shafts subjected to fluctuating loads using shock factors.

**Couplings:** Design of flange and bushed pin couplings, universal coupling.

**Springs:** Design of helical compression, tension, torsion and leaf springs.

#### Learning Outcomes:

After completion of this unit, students will be able to

- Explain the functions of different keys. (12)
- Design shafts subjected to fluctuating loads. (16)
- Select coupling for a given application and outline the design procedure. (13)
- Explain construction and design procedure for helical and leaf springs. (12)

### UNIT IV

**10 hours**

**Friction Clutches:** Torque transmitting capacity of disc and centrifugal clutches. Uniform wear theory and uniform pressure theory.

**Brakes:** Different types of brakes. Concept of self-energizing and self-locking of brake. Band and block brakes, disc brakes.

#### Learning Outcomes:

After completion of this unit, students will be able to

- Explain the difference between brake and clutch. (12)
- Calculate the torque transmitting capacity in clutches. (13)
- Compare different types of brakes and their applications. (14)
- Explain the concepts of self-energizing and self-locking brakes. (12)
- Discuss procedures to design different types of brakes. (12)

### UNIT V

**12 hours**

**Design of Sliding Contact Bearings:** Lubrication modes, bearing modulus, McKee's equations, design of journal bearing. Bearing Failures.

**Design of Rolling Contact Bearings:** Static and dynamic load capacity, Stribeck's Equation, equivalent bearing load, load-life relationships, load factor, selection of bearings from manufacturer's catalogue.

**Design of Gears:** Spur gears, beam strength, Lewis equation, design for dynamic and wear loads.

## **Learning Outcomes:**

After completion of this unit, students will be able to

- Contrast the difference between sliding and rolling contact bearings. (12)
- Explain the mechanics of lubrication in sliding contact bearings. (12)
- Identify failures in bearings. (13)
- Evaluate static and dynamic load capacity of rolling contact bearings. (15)
- Explain the procedure to select bearings from manufacturer's catalogue. (13)

## **Course Outcomes:**

At the end of the course the students will be able to

- Estimate safety factors of machine members subjected to static and dynamic loads. (15)
- Design fasteners subjected to variety of loads. (16)
- Select of standard machine elements such as keys, shafts, couplings, springs and bearings. (11)
- Design clutches, brakes and spur gears. (16)

## **Text Book(s)**

1. J.E. Shigley, "Mechanical Engineering Design", 2<sup>nd</sup> edition, Tata McGraw Hill, 1986.
2. V.B.Bhandari, "Design of Machine Elements", 3<sup>rd</sup> edition, Tata McGraw Hill, 2010.

## **References**

1. R.L. Norton, "Machine Design an Integrated approach", 2<sup>nd</sup> edition, Pearson Education, 2004.
2. R.K. Jain, "Machine Design:", Khanna Publications, 1978.
3. M.F.Spotts and T.E.Shoup, "Design of Machine Elements", 3<sup>rd</sup> edition, Prentice Hall (Pearson Education), 2013.

**Note: PSG Design data book is permitted.**

(19A03602T) INTRODUCTION TO CAD/CAM

**Course Objectives:**

- Understand the basics of CAD/CAM, geometric representation, transformations.
- Explain geometric modeling methods in CAD.
- Familiarize numerical control (NC), computer numerical control (CNC) and direct numerical control (DNC) machines.
- Impart knowledge on manual part programming and computer aided part programming.
- Explain the principles robotics, CIM, AR,VR and AI in CIM

**UNIT I**

**8hrs**

**CAD/CAM:** Introduction, hardware and software, I/O devices, benefits. graphics standards- Neutral file formats – IGES, STEP.

**2D and 3D geometric transformations:** Translation, scaling, rotation, mirroring, homogenous transformations, concatenation of transformations, viewing transformations.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- List various input and output devices (L1)
- Apply geometric transformations in 2D and 3D (L3)
- Apply window to viewport transformation (L3)

**UNIT II: Geometric Modeling:**

**10hrs**

**Parametric representation:** Representation of curves, Hermite curves, Spline, Bezier and B-spline curves in two dimensions; Geometric modelling of surfaces: Surface patch, Coons and bicubic patches, Bezier and B-spline surfaces, sweep surfaces, surface of revolution, blending of surfaces;

**Geometric Modelling of Solids:** Wireframe, surface modelling, solid entities, boolean operations, CSG approach and B-rep of solid modelling, geometric modelling of surfaces.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Apply the concepts of parametric representation to curves and surfaces. (13)
- Create surfaces such as coons, bezier and b-spline (16)
- Differentiate wireframe, surface and solid modeling. (14)
- Apply the solid modeling concepts. (13)

### UNIT III

8hrs

**Computer Aided Manufacturing (CAM):** Structure of numerical control (NC) machine tools, designation of axes, drives and actuation systems, feedback devices, computer numerical control (CNC) and direct numerical control (DNC), adaptive control system, CNC tooling, automatic tool changers and work holding devices, functions of CNC and DNC systems.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Identify the differences between NC, CNC and DNC. (L3)
- Use devices and activation systems. (L3)
- Apply adaptive control system. (L3)
- Apply different tooling and tool changers, working holding devices. (L3)

### UNIT IV

8 hrs

**Part Programming:** Part programming instruction formats, information codes, preparatory functions, miscellaneous functions (G-codes, M-codes). Tool codes and tool length offset, interpolations canned cycles.

APT Programming: APT language structure, APT geometry, Definition of point, line, circle, plane.

APT Motion Commands: set-up commands, point to point motion commands; continuous path motion commands part programming preparation for typical examples (milling and turning operation)

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Apply the fundamentals of part programming in CNC. (L3)
- Use G codes, M codes in CNC part programs. (L3)
- Apply the concept of canned or fixed cycles for the hole making operations. (L3)
- Identify geometric features in APT language. (L3)
- Apply motion commands in APT to generate surfaces. (L3)

### UNIT V

8 hrs

**Automation:** Anatomy and configuration of robot, characteristics of robots, grippers, application of robots in manufacturing, robot programming languages. Computer integrated manufacturing (CIM): Elements of CIM, Virtual Reality (VR), Augmented Reality (AR), Artificial Intelligence (AI) and expert systems in CIM.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Summarize the fundamentals of robotics. (12)
- Categorize the cim environment and its elements. (14)

- Explain the role vr, ar and ai in manufacturing engineering. (13)

### **Course Outcomes:**

At the end of the course, the student will be able to

- Apply the basics of geometric representation and transformations in CAD/CAM. (L3)
- Choose geometric modeling methods for building CAD models. (L1)
- Compare NC, CNC and DNC. (L2)
- Develop manual and computer aided part programming for turning and milling operations. (L3)
- Summarize the principles of robotics AR,VR and AI in CIM. (L2)

### **Text books:**

1. P. N. Rao, CAD/CAM: “Principles and applications”, 3<sup>rd</sup> edition, Tata McGraw-Hill, Delhi, 2017
2. Ibrahim Zeid, R.Siva Subramanian, “CAD/CAM: Theory and Practice”, 2<sup>nd</sup> edition, Tata McGraw-Hill, Delhi, 2009

### **Reference books:**

1. Mikell P. Groover, Emory W. Zimmers , “CAD/CAM”, 5<sup>th</sup> edition, Pearson Prentice Hall of India, Delhi, 2008
2. P. Radhakrishnan, S. Subramanyan & V. Raju, “CAD/CAM/CIM”, 3<sup>rd</sup> edition, New Age International Publishers, 2008
3. Tien Chien Chang, “Computer Aided Manufacturing”, 3<sup>rd</sup> edition, Pearson, 2008
4. SJ Martin, “Numerical control of machine tools”, London, Hidden & Stoughton, 1982.
5. Solid cam, “Software packages”, solid works or equivalent.

(19A52601T) ENGLISH LANGUAGE SKILLS

**Introduction**

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language skills in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. They should be able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

**Course Objectives**

- Facilitate active listening to enable inferential learning through expert lectures and talks
- Impart critical reading strategies for comprehension of complex texts
- Provide training and opportunities to develop fluency in English through participation in formal group discussions and presentations using audio-visual aids
- Demonstrate good writing skills for effective paraphrasing, argumentative essays and formal correspondence
- Encourage use of a wide range of grammatical structures and vocabulary in speech and writing

**UNIT -I**

**Text:**

1. **Lines Composed a Few Miles above Tintern Abbey - William Wordsworth**
2. **The Lotos-Eaters - Alfred Tennyson**

**Listening:** Listening to famous speeches for structure and style

**Speaking:** Oral presentations on general topics of interest.

**Reading:** Reading for meaning and pleasure – reading between the lines.

**Writing:** Appreciating and analyzing a poem –Paraphrasing, note-taking.

**Grammar and Vocabulary: Tenses (Advanced Level)** Correcting errors in punctuation -Word roots and affixes.

**Learning Outcomes**

At the end of the module, the learners will be able to

- Understand the purpose of rhythm and rhyme and the use of figures of speech in making the presentation lively and attractive

- Apply the knowledge of structure and style in a presentation, identify the audience and make note of key points
- Make formal structured presentations on general topics using grammatical understanding
- Prioritize information from reading texts after selecting relevant and useful points
- Paraphrase short academic texts using suitable strategies and conventions

## UNIT -II

### **Text: The Model Millionaire – Oscar Wilde**

**Listening:** Following the development of theme; answering questions on key concepts after listening to stories online.

**Speaking:** Narrating personal experiences and opinions.

**Reading:** Reading for summarizing and paraphrasing; recognizing the difference between facts and opinions.

**Writing:** Summarizing, précis writing, letter and note-making

**Grammar and Vocabulary:** Subject-verb agreement, noun-pronoun agreement, collocations.

### **Learning Outcomes**

At the end of the module, the learners will be able to

- Comprehend academic lectures, take notes and answer questions
- Make formal structured presentations on academic topics
- Distinguish facts from opinions while reading
- Summarize and make a précis of reports
- Use correct English avoiding common errors in formal speech and writing

## UNIT – III

### **Text: Speech at IIM Calcutta – Azim Premji**

**Listening:** Identifying views and opinions expressed by different speakers while listening to speeches.

**Speaking:** Small talks on general topics; agreeing and disagreeing, using claims and examples/evidences for presenting views, opinions and position.

**Reading:** Identifying claims, evidences, views, opinions and stance/position.

**Writing:** Writing structured persuasive/argumentative essays on topics of general interest using suitable claims, examples and evidences.

**Grammar and Vocabulary:** The use of Active and passive Voice, vocabulary for academic texts

### **Learning Outcomes**

At the end of the module, the learners will be able to

- Critically follow and participate in a discussion

- participate in group discussions using appropriate conventions and language strategies
- comprehend complex texts and identify the author's purpose
- produce logically coherent argumentative essays
- use appropriate vocabulary to express ideas and opinions

## UNIT – IV

### **Text: A Biography of Steve Jobs**

**Listening:** Listening to identify important moments - Understanding inferences; processing of information using specific context clues from the audio.

**Speaking:** Group discussion; reaching consensus in group work (academic context).

**Reading:** Reading for inferential comprehension.

**Writing:** Applying for internship/ job - Writing one's CV/Resume and cover letter.

**Grammar and Vocabulary: Phrasal verbs, phrasal prepositions and technical vocabulary.**

### **Learning Outcomes**

At the end of the module, the learners will be able to

- Draw inferences and conclusions using prior knowledge and verbal cues
- Express thoughts and ideas with acceptable accuracy and fluency
- Develop advanced reading skills for deeper understanding of texts
- Prepare a cv and write a cover letter to seek internship/ job
- Understand the use of technical vocabulary in academic writing

## UNIT –V

### **Text: How I Became a Public Speaker - George Bernard Shaw**

**Listening:** Understanding inferences - processing of explicit information presented in the text and implicit information inferable from the text or from previous/background knowledge.

**Speaking:** Formal team presentations on academic/ general topics.

**Reading:** Intensive and extensive reading.

**Writing:** Structure and contents of a Report – Abstract – Project report features.

**Grammar and Vocabulary:** Correcting common errors, improving vocabulary and avoiding clichés and jargons.

### **Learning Outcomes**

At the end of the module, the learners will be able to

- Develop advanced listening skills for in-depth understanding of academic texts
- Collaborate with a partner to make effective presentations
- Understand and apply the structure of project reports
- Demonstrate ability to use grammatically correct structures and a wide range of vocabulary



## **Course Outcomes**

At the end of the course, the learners will be able to

- Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English
- Apply grammatical structures to formulate sentences and correct word forms
- Analyze discourse markers to speak clearly on a specific topic in informal discussions
- Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.
- Create a coherent paragraph interpreting a figure/graph/chart/table

## **Text Book**

- “Forging Ahead”: A Course Book for B.Tech Students. Orient BlackSwan, 2020.

## **Reference Books**

- 1) Bailey, Stephen. “Academic writing: A handbook for international students”. Routledge, 2014.
- 2) Chase, Becky Tarver. Pathways: Listening, “Speaking and Critical Thinking”. Heinley ELT; 2nd Edition, 2018.
- 3) Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- 4) Hewings, Martin. “Cambridge Academic English” (B2). CUP, 2012. (Student Book, Teacher Resource Book, CD & DVD)

**(19A03603a) INTRODUCTION TO TURBO MACHINERY  
PROFESSIONAL ELECTIVE - II**

**UNIT 1**

Introduction and Classification: Axial flow, radial flow and mixed flow machines, the equations of motion in rotating frame of reference, effects of Coriolis and Centrifugal forces, momentum and energy equation, Euler work and illustrative examples.

**UNIT 2**

Gas Turbine Cycle: Brayton Cycle, regenerative cycle, reheat, inter-cooling, turboprop, turbojet and turbofan engine, thrust augmentation and illustrative examples.

**UNIT 3**

Similarity Analysis: Similarity rules, specific speed, Cordier diagram and illustrative examples.

Cascade Analysis: Two-dimensional cascade theory, lift and drag, blade efficiency, estimation of loss, compressor and turbine cascade, blade geometry and illustrative examples.

**UNIT 4**

Axial Flow Compressor: Two-dimensional pitch line design and analysis, h-s diagram, degree of reaction, the effect of Mach number, performance and efficiency, three-dimensional flow, tip clearance, losses, compressor performance and illustrative examples.

Centrifugal Pump and Compressor: Theoretical analysis and design, the effect of circulation and Coriolis forces, reversal eddies, slip factor, head and efficiency, diffuser, introduction to the combustion system and illustrative examples.

**UNIT 5**

Axial Flow Turbine: Two-dimensional pitch line design, stage loading capacity, degree of reaction, stage efficiency, turbine performance, blade cooling, and illustrative examples.. CFD Applied to Turbomachinery Flows: Governing equations, numerical methods, and test cases illustrating flow and heat transfer related to turbo machines.

**Books and references:**

- (1). Fluid Mechanics and Thermodynamics of Turbomachinery, S. L. Dixon and C. A. Hall, Butterworth-Heinemann, Seventh Edition, 2014.
- (2). Gas Turbine Theory, H. Cohen, GFC Rogers and HIH Saravanamuttoo, Addison Wesley Longman Limited, 4th Edition, 1996.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– III-II Sem**

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**(19A03603b) FUNDAMENTALS OF ADDITIVE MANUFACTURING**

**PROFESSIONAL ELECTIVE - 2**

**UNIT 1**

Introduction to Additive Manufacturing , Additive manufacturing processes, Extrusion, Beam deposition, sheet lamination, photo polymerization, sintering, powder bed fusion

**UNIT 2:**

Computer Aided Process Planning for Additive Manufacturing, Liquid Additive Manufacturing

**UNIT 3:**

Sheet Additive Manufacturing, process and material selection, applications

**UNIT 4:**

Wire Additive Manufacturing, process and material selection, applications

**UNIT 5**

Powder Additive Manufacturing, process and material selection, applications, trends and future directions

**Books and references**

- 1.Venuvinod, Patri K., and Weiyin Ma. Rapid prototyping: laser-based and other technologies. Springer Science & Business Media, 2013.
2. Ian Gibson, David Rosen, and Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, New York, NY, 2015.
3. Kumar, L. Jyothish, Pulak M. Pandey, and David Ian Wimpenny, eds. 3D printing and additive manufacturing technologies. Singapore: Springer, 2019.
4. Jacobs, Paul F. "Fundamentals of stereolithography." In 1992 International Solid Freeform Fabrication Symposium. 1992.

**(19A03603c) INTRODUCTION TO COMPOSITES**  
**PROFESSIONAL ELECTIVE - II**

**UNIT 1**

Introduction and terminology, Concept Review, Fibres : Glass Fibres, Graphite Fibres, Aramid Fibres, Metallic Fibres and others

**UNIT 2**

Matrix materials and Polymers, Metals and Fillers, Manufacture of Thermoset composites, other composite fabrication methods

**UNIT 3**

Behaviour of Uni directional composites, Short fiber composites,

**UNIT 4**

Behaviour of Orthotropic laminates, laminated composites,

**UNIT 5**

Failure of composites, Hygro thermal effects, Residual thermal stresses

**Books and references**

- Analysis & Performance of Fiber Composites: Bhagwan D. Agarwal & Lawrence J. Broutman

**(19A03603d) COMPUTATIONAL FLUID DYNAMICS**

**UNIT 1**

Introduction to Computational Fluid Dynamics, classification of partial differential equations their physical behaviour, Fundamentals of discretization

**UNIT 2**

Finite Volume approach and discretization of unsteady-state problems, Important consequences of discretization of time-dependent diffusion type problems

**UNIT 3**

Discretization of time-dependent diffusion type problems (contd.); finite volume discretization of 2-D unsteady state diffusion type problems

**UNIT 4**

Solution of systems of linear algebraic equations

**UNIT 5**

A finite volume discretization of convection-diffusion equations  
Discretization of Navier-Stokes equations

**Books and references**

1. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill.
2. John D. Anderson Jr, Computational Fluid Dynamics, McGraw Hill Book Company
3. John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Taylor & Francis.
4. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press.

**(19A03603e) ENGINEERING FRACTURE MECHANICS**  
**PROFESSIONAL ELECTIVE - 2**

**UNIT 1**

EFM Course outline and Spectacular Failures, Introduction to LEFM and EPFM, Fatigue Crack Growth Model

**UNIT 2**

Crack Growth and Fracture Mechanisms, Griffith TMs Theory of Fracture, Energy Release Rate

**UNIT 3**

Review of Theory of Elasticity , Westergaard Solution for Stress and Displacements for Mode I, Relationship between K and G

**UNIT 4**

Introduction to multi parameter stress field for Mode I, Mode II and Mixed Modes, SIF for Various Geometries, Modeling Plastic Deformation, Irwin TMs model, Dugdale Model

**UNIT 5**

Fracture Toughness Testing, Paris Law and Sigmoidal curve, Crack Closure, Crack Growth Models, J-Integral, Failure Assessment Diagram, Mixed Mode Fracture, Crack Arrest and Repair Methodologies

**Books and references**

- 1.K. Ramesh, e-Book on Engineering Fracture Mechanics, IIT Madras, 2007. Visit Page
2. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New Delhi, India, 2009.
3. K. R.Y. Simha, Fracture Mechanics for Modern Engineering Design, Universities Press (India) Limited,2001
4. D. Broek, Elementary Engineering Fracture Mechanics, Kluwer Academic Publishers, Dordrecht, 1986.
5. T.L. Anderson, Fracture Mechanics "Fundamentals and Applications, 3rd Edition, Taylor and Francis Group, 2005.

**(19A01604a) INDUSTRIAL WASTE AND WASTE WATER MANAGEMENT**  
**OPEN ELECTIVE-II**

**Course Objectives:**

- To teach Health and Environment Concerns in waste water management
- To teach material balance and design aspects of the reactors used in waste water treatment.
- To impart knowledge on selection of treatment methods for industrial waste water
- To teach common methods of treatment in different industries
- To provide knowledge on operational problems of common effluent treatment plant

**UNIT –I**

**Industrial water Quantity and Quality requirements:**

Boiler and cooling waters–Process water for Textiles, Food processing, Brewery Industries, power plants, fertilizers, sugar mills Selection of source based on quality, quantity and economics. Use of Municipal wastewater in Industries – Adsorption, Reverse Osmosis, Ion Exchange, Ultra filtration, Freezing, Elutriation, Removal of Colour, Odour and Taste.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Learn the procedures for assessment of quality of Industrial water
- Suggest different processes of handling waste water

**UNIT –II**

**Basic theories of Industrial Wastewater Management:** Industrial waste survey - Measurement of industrial wastewater Flow-generation rates – Industrial wastewater sampling and preservation of samples for analysis -Wastewater characterization-Toxicity of industrial effluents-Treatment of wastewater-unit operations and processes-Volume and Strength reduction – Neutralization and Equalization, Segregation and proportioning- recycling, reuse and resources recovery

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Measure industrial waste water flow
- Characterize waste water
- Suggest techniques for treatment of waste water.

**UNIT –III**

**Industrial wastewater disposal management:** Discharges into Streams, Lakes and oceans and associated problems, Land treatment - Common Effluent Treatment Plants: advantages and suitability, Limitations and challenges- Recirculation of Industrial Wastes- Effluent Disposal Method

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand options for waste water disposal.
- Explain functioning of common effluent treatment plants

**UNIT – IV**

**Process and Treatment of specific Industries-1:** Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Steel plants, Fertilizers, Textiles, Paper and Pulp industries, Oil Refineries, Coal and Gas based Power Plants

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand the character of waste water from Steel plants and refineries
- Suggest suitable waste water treatment techniques

**UNIT – V**

**Process and Treatment of specific Industries-2:** Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Tanneries, Sugar Mills, Distillers, Dairy and Food Processing industries, Pharmaceutical Plants

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand the character of waste water from tanneries and distilleries
- Suggest suitable waste water treatment techniques

**Course Outcomes:**

Upon the successful completion of this course, the students will be able to:

- Design treatment methods for any industrial wastewater.
- Examine the manufacturing process of various industries.
- Assess need for common effluent treatment plant for an industry
- Test and analyze BOD, COD, TSS and MPN in waste water.

**TEXT BOOK**



1. M. N. Rao and A. K. Dutta, "Wastewater Treatment", Oxford & IBH, New Delhi.
2. K.V. S. G. Murali Krishna, "Industrial Water and Wastewater Management".

## **REFERENCES**

1. A. D. Patwardhan, "Industrial Wastewater treatment", PHI Learning, Delhi
2. Metcalf and Eddy Inc., "Wastewater Engineering", Tata McGraw Hill co., New Delhi.
3. G. L. Karia & R.A. "Christian Wastewater Treatment- Concepts and Design Approach", Prentice Hall of India.

**(19A01604b) BUILDING SERVICES AND MAINTAINANCE**  
**OPEN ELECTIVE-II**

**Course Objectives:**

- To impart knowledge in concepts of building maintenance
- To insist the student to observe various practices of good building maintenance
- To teach the importance safety in buildings
- To demonstrate the use of ventilation in buildings.
- To give the list of different types of machineries in buildings

**UNIT – I**

**PLUMBING SERVICES:** Water supply system- fixing of pipes in buildings – maintenance of buildings- water meters-sanitary fittings-design of building drainage- gas supply systems

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand water supply system
- Understand the building drainage system.

**UNIT – II**

**VENTILATION:** Necessity of ventilation – functional requirements – systems of ventilation-natural ventilation-artificial ventilation-air conditioning-systems of air conditioning-essentials of air conditioning-protection against fire caused by air conditioning systems.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand concepts of ventilation
- Understand concepts of air conditioning

**UNIT – III**

**THERMAL INSULATION:** Heat transfer system-thermal insulating materials-methods of thermal insulation-economics of thermal insulation-thermal insulation of exposed walls, doors, windows and roofs.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand methods of insulation
- Understand materials of insulation

## **UNIT – IV**

**FIRE SAFETY:** Causes of fire in buildings-fire safety regulations-characteristics of fire resisting materials- fire resistant construction-heat and smoke detectors-fire alarms-fire fighting pump and water storage.

### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand safety regulations of fire system
- Know about the implementation and usage of various fire resistant materials in building construction

## **UNIT – V**

**MACHINERIES IN BUILDINGS:** Lifts-essential requirements-design considerations-escalators-essential requirements-electrical installations in buildings-lighting in buildings-methods of electrical wiring-earthing

### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Understanding of different machineries of buildings
- Understanding of electrical installation of buildings

### **Course Outcomes:**

Student will be able to understand

- Concepts of plumbing, drainage system and gas supply system
- Concepts of ventilation and air conditioning
- Concepts of thermal insulation and economics of thermal insulation
- Concepts of fire safety in buildings and fire resistant construction
- Concepts of different machineries of buildings

### **TEXT BOOKS:**

1. B.C.Punmia, Er. Ashok K Jain, Arun K Jain “Building construction”, Laxmi publications pvt.ltd. New Delhi.
2. Janardhan Jah, S.K Sinha, “Building construction”, Khanna publishers
3. Rangwala, “Building construction”, Charohtar publishing house.

### **REFERENCE BOOKS:**

1. David V Chaddrton, “Building services engineering”, Outledge
2. P.C Varghees “Building construction”, Printice hall india

**(19A02604a) INDUSTRIAL AUTOMATION**  
**OPEN ELECTIVE-II**

**Course Objectives:**

- To understand the basic concepts of Automation
- To understand the concepts of automation cycle and hardware components
- To gain knowledge about pneumatic and hydraulic devices
- To understand the concepts of sensors and actuators
- To know the use of Robotics used in industries automation

**UNIT -I:**

**Introduction to Automation**

Definition and fundamentals of automation, reasons for Automating, basic elements of an automated system: Power, Program and control system, safety, maintenance & repair diagnosis, error detection and recovery, Automation principles and strategies: USA principle, strategies of automation and production system, automation migration strategy

**Learning Outcomes:**

At the end of the unit, students will be able to:

- To understand the fundamental concepts of automation and its basic elements
- To understand system safety requirements
- To understand about maintenance and repair strategies
- To know about production system automation

**UNIT- II:**

**Mechanization and Automation**

Basic principles of Mechanization and automation, product cycle, hard Vs flexible automation, Capital- intensive Vs low cost automation. Types of systems-mechanical, electrical, hydraulic, pneumatic and hybrid systems, Automation using CAMS, Geneva mechanisms, gears etc. Assembly line Automation: automated assembly systems, transfer systems, vibratory bowl feeders, non-vibratory feeders, part orienting, feed track, part placing & part escapement systems. Introduction to Material storage/ handling and transport systems, and its automation using AS/RS, AGVS and conveyors etc.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- To know about how to analyse the various automation methods

- To know about assembling and placing of various parts
- To distinguish between mechanization and automation of systems
- To know about material storage, handling and automation using various approaches

### **UNIT -III:**

#### **Pneumatics and hydraulics**

Hydraulic and pneumatic devices-Different types of valves, Actuators and auxiliary elements in Pneumatics & hydraulics , their applications and use of their ISO symbols. Synthesis and design of circuits (up to 3 cylinders)–pneumatic, electro pneumatics and hydraulics. Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves; with and without grouping.

#### **Learning Outcomes:**

At the end of the unit, students will be able to:

- To know design of various pneumatic and hydraulic components
- To understand about synthesis and design of Pneumatic circuits
- To understand about electro pneumatic circuits
- To design using various solenoid valves with and without grouping

### **UNIT -IV:**

#### **Sensors & Actuators Sensors**

Selection of sensors (Displacement, temperature, acceleration, force /pressure) based on static and dynamic characteristics. Interfacing: Concept of interfacing, bit accuracy and sampling speed, amplifying electronics, and microcontroller. Actuators: Principle and selection of electro mechanical actuators (1) DC motors (2) Stepper Motors (3) Solenoid Actuators (4) Servo Motors (5) BLDC

#### **Learning Outcomes:**

At the end of the unit, students will be able to:

- To know about selection of sensors and actuators based on dynamic characteristics
- To understand about necessity of interfacing sensors with Microcontroller
- To understand principle and selection of actuators
- To apply various electro mechanical actuators to certain machines

### **UNIT- V:**

#### **Robots and their applications**

Introduction to robots, Types, Classifications, Selection of robots, Robot Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a robot, Robot feedback controls: Point to point control and Continuous path control, Control system for robot joint, Adaptive control, Drives and transmission systems, End effectors, Industrial robot applications of robots

## **Learning Outcomes:**

At the end of the unit, students will be able to:

- To know about Robots, classification, selection and specifications
- To understand the use of robotics in industrial applications
- To know about various feedback controls of Robot
- To understand how adaptive control strategies can be used in Robots

## **Course Outcomes:**

1. Understand the basic concepts of Industrial automation
2. Design and analysis of automation methods, placing and assembling of various parts
3. Design of various processing and control circuits using pneumatic and hydraulic elements
4. Selection of sensors based on the industrial application
5. Role of robotics in industrial applications

## **TEXT BOOKS:**

1. Stamatis Manesis and George Nikolakopoulos, "Introduction to Industrial Automation", CRC Press, 2018.
2. Frank Lamb, "Industrial Automation", Hands on, Mc Graw Hill Education, 2013.

## **REFERENCES:**

1. Richerd L. Shell and Ernest L. Hall, "Hand Book of Industrial Automation", CRC Press, 2000.

**(19A02604b) SYSTEM RELIABILITY CONCEPTS**  
**(OPEN ELECTIVE-II)**

**Course Objectives:**

To make the students learn about:

- The Basic concepts, rules for combining probabilities of events, failure density and distribution functions.
- Evaluation of network Reliability / Unreliability and types of redundancies.
- Evaluation of network Reliability / Unreliability using conditional probability method.
- Expected value and standard deviation of Exponential distribution and Measures of reliability.
- Evaluation of Limiting State Probabilities of one, two component repairable models.

**UNIT-I:**

**Basic Probability Theory**

Basic concepts – Rules for combining Probabilities of events – Failure Density and Distribution functions – Bernoulli's trials – Binomial distribution – Expected value and standard deviation for binomial distribution – Examples

**Learning Outcomes:**

At the end of the unit, students will be able to:

- To know about basic rules for probabilities of events
- To distinguish between pdf and cdf
- Get detailed information about Probability of failure density and distribution functions
- Obtain the expected value and standard deviation for binomial distribution.

**UNIT-II:**

**Network Modeling and Reliability Evaluation**

Basic concepts – Evaluation of network Reliability / Unreliability – Series systems, Parallel systems, Series - Parallel systems, partially redundant systems – Types of redundancies - Evaluation of network Reliability / Unreliability using conditional probability method – Paths based and Cutset based approach – complete event tree and reduced event tree methods - Examples.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- How to find the Probability of success and failures of network using different approaches for series-parallel configurations.
- Classification of redundancies.
- To find reliability / unreliability of complex systems using different methods

- Comparison of approaches to solve probability index of SISO system

### **UNIT-III:**

#### **Time Dependent Probability**

Basic concepts – Reliability functions  $f(t)$ ,  $Q(t)$ ,  $R(t)$ ,  $h(t)$  – Relationship between these functions – Bath tub curve – Exponential failure density and distribution functions - Expected value and standard deviation of Exponential distribution – Measures of reliability – MTTF, MTTR, MTBF – Evaluation of network reliability / Unreliability of simple Series, Parallel, Series-Parallel systems - Partially redundant systems - Evaluation of reliability measure – MTTF for series and parallel systems – Examples.

#### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Understand the concepts of time domain functions and relationship between them.
- Obtain the expected value and standard deviation for exponential distribution.
- Obtain the values of probabilistic measures for series and parallel configurations.
- To obtain probabilistic measures for fully redundant and partially redundant configurations

### **UNIT-IV:**

#### **Discrete Markov Chains & Continuous Markov Processes**

**Markov Chains:** Basic concepts – Stochastic transitional Probability matrix – time dependent probability evaluation – Limiting State Probability evaluation – Absorbing states.

**Markov Processes:** Modeling concepts – State space diagrams – time dependent reliability evaluation of single component repairable model – Evaluation of Limiting State Probabilities of one, two component repairable models – Frequency and duration concepts – Frequency balance approach - Examples.

#### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Understand the concepts of Stochastic Transitional Probability Matrix, Limiting State Probability
- To know about evaluation for one and two component repairable models.
- Understand the concept of Frequency balance approach.
- To distinguish between Markov chains and Markov processes

### **UNIT-V:**

#### **Multi Component & Approximate System Reliability Evaluation**



Recursive relation for evaluation of equivalent transitional rates– cumulative probability and cumulative frequency and ‘n’ component repairable model – Series systems, Parallel systems, Basic probability indices – Series, Parallel systems – Complex Systems– Cutset approach – Examples.

### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Understand the concepts of recursive relation for evaluation of equivalent transitional rates.
- Obtain the cumulative probability and cumulative frequency for different systems
- To know about computation of basic probability indices for series, parallel configurations
- To know how to evaluate basic probability indices using cut set approach

### **Course Outcomes:**

After completing the course, the student should be able to do the following:

- Understand the concepts for combining Probabilities of events, Bernoulli’s trial, and Binomial distribution.
- Network Reliability/Unreliability using conditional probability, path and cutset based approach, complete event tree and reduced event tree methods.
- Understanding Reliability functions and to develop relationship between these functions, expected value and standard deviation of Exponential distribution and measures of reliabilities.
- Analyze the time dependent reliability evaluation of single component repairable model, frequency and duration concepts, Frequency balance approach.
- Recursive relation for evaluation of equivalent transitional rates, cumulative probability and cumulative frequency and ‘n’ component repairable model.

### **Text Books:**

1. Roy Billinton and Ronald N. Allan, “Reliability Evaluation of Engineering Systems”, Reprinted in India B. S. Publications, 2007.
2. E. Balagurusamy, “Reliability Engineering”, Tata McGraw Hill, 2003.

### **Reference Books:**

1. E. E. Lewis , “Introduction to Reliability Engineering” Wiley Publications.
2. Charles E. Ebeling, “Reliability and Maintainability Engineering”, Tata McGraw Hill, 2000.
3. by Ajit Kumar Verma, Srividya Ajit and Durga Rao Karanki, Springer, “Reliability and Safety Engineering” 2<sup>nd</sup> edition, 2016.
4. Rausand and Arnljot Hoyland, “System Reliability Theory Marvin”, Wiley Publications.

(19A04604a) **BASICS OF VLSI  
OPEN ELECTIVE-II**

**Course Objectives:**

The objectives of the course are to

- Learn and Understand IC Fabrication process steps required for various MOS circuits
- Understand and Experience VLSI Design Flow
- Learn Transistor-Level CMOS Logic Design
- Understand VLSI Fabrication and Experience CMOS Physical Design
- Learn to Analyze Gate Function and Timing Characteristics

**UNIT – I**

**Introduction:** Introduction to MOS Technology – MOS, PMOS, NMOS, CMOS and BiCMOS technologies, fabrication fundamentals: Oxidation, Lithography, Diffusion, Ionimplantation, Metallization and Encapsulation.

**Basic Electrical Properties:** Basic Electrical Properties of MOS, CMOS and BiCMOS Circuits,  $I_{DS}$ - $V_{DS}$  relationships, MOS transistor threshold Voltage,  $g_m$ ,  $g_{ds}$ , figure of merit  $\omega_0$ , Pass transistor, NMOS inverter, Various pull - ups, Determination of pull-up to pulldown ratio ( $Z_{pu} / Z_{pd}$ ), CMOS Inverter analysis and design, BiCMOS inverters, Latch-up in CMOS circuits.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Demonstrate a clear understanding of CMOS fabrication flow and technology scaling (L2)
- Analyze the electrical properties of MOS and BiCMOS circuits (L3)
- Design MOSFET based logic circuit (L4)

**UNIT – II**

**VLSI Circuit Design Processes:** VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layouts, Lambda based design rules, Contact cuts, CMOS Lambda based design rules, Layout Diagrams for logic gates, Transistor structures, wires and vias, Scaling of MOS circuits- Scaling models, scaling factors, scaling factors for device parameters, Limitations of Scaling.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Understand the design rules and layout diagram for logic gates, limitations of scaling (L1)
- Draw the Layout of simple MOS circuit using Lambda based design rules (L2)

### UNIT – III

**Gate Level Design and Layout:** Architectural issues, Switch logic networks: Gate logic, Alternate gate circuit: Pseudo-NMOS Dynamic CMOS logic. Basic circuit concepts, Sheet Resistance  $R_s$  and its concept to MOS, Area Capacitance Units, Calculations, The delay unit  $T$ , Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out, Choice of layers

#### Learning Outcomes:

After completion of this unit, students will be able to

- Apply basic circuit concepts to MOS circuits. (L2)
- Estimate the propagation delays in CMOS circuits (L3).

### UNIT – IV

**Subsystem Design:** Subsystem Design, Shifters, Adders, ALUs, Multipliers: Array multiplier, Serial Parallel multiplier, Parity generator, Comparators, Zero/One Detectors, Up/Down Counter, Memory elements: SRAM, DRAM, ROM, Serial Access Memories.

#### Learning Outcomes:

After completion of this unit, students will be able to

- Apply the Lambda based design rules for subsystem design (L2)
- Design of Adders, Multipliers and memories etc (L4)
- Design digital systems using MOS circuits (L4)

### UNIT – V

**Semiconductor Integrated Circuit Design:** PLDs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Programmable Logic Array Design Approach.

#### Learning Outcomes:

After completion of this unit, students will be able to

- Analyze various architectures and device technologies of PLDs (L3)
- Design simple logic circuit using PLA, PAL, FPGA and CPLD. (L4)

#### Course Outcomes:

- Learn the basic fabrication process of MOS transistors, study CMOS inverter circuits, basic circuit concepts such as Sheet Resistance, Area Capacitance and Delay calculation,

Field programmable gate arrays and realization techniques, CPLDs and FPGAs for implementing the various logic functions.

- Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality.
- Analyze the performance of CMOS Inverter circuits
- Compare various Scaling models and understand the effect of scaling on device parameters

#### **TEXT BOOKS:**

1. Kamran Eshraghian, “Essentials of VLSI circuits and systems”, EshraghianDouglas and A. Pucknell, PHI, 2005 Edition
2. Wayne Wolf, “Modern VLSI Design”, 3rd Edition, Pearson Education, 1997.

#### **REFERENCE BOOKS:**

1. John .P. Uyemura, “CMOS logic circuit Design”, Springer, 2007.
2. Neil H. E Weste, “CMOS VLSI Design – A Circuits and Systems Perspective”, 3<sup>rd</sup> edition, DavidHarris, Ayan Banerjee, Pearson, 2009.

**(19A04604b) PRINCIPLES OF COMMUNICATION SYSTEMS**  
**OPEN ELECTIVE-II**

**Course Objectives:**

- To understand the concept of various modulation schemes and multiplexing.
- To apply the concept of various modulation schemes to solve engineering problems.
- To analyse various modulation schemes.
- To evaluate various modulation scheme in real time applications.

**UNIT-I:**

**Amplitude Modulation**

Introduction to Noise and Fourier Transform. An overview of Electronic Communication Systems. Need for Frequency Translation, Amplitude Modulation: DSB-FC, DSB-SC, SSB-SC and VSB. Frequency Division Multiplexing. Radio Transmitter and Receiver.

**Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of noise, Fourier transform, carrier modulation and frequency division multiplexing (L1).
- Apply the concept of amplitude modulation to solve engineering problems (L2).
- Analyse various amplitude modulation schemes (L3).
- Evaluate various amplitude modulation schemes in real time applications (L3).

**UNIT-II:**

**Angle Modulation**

Angle Modulation, Tone modulated FM Signal, Arbitrary Modulated FM Signal, FM Modulation and Demodulation. Stereophonic FM Broadcasting.

**Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of angle modulation and its components (L1).
- Apply the concept of frequency modulation to solve engineering problems (L2).
- Analyse angle modulation schemes (L3).
- Evaluate frequency modulation scheme in real time applications (L3).

### **UNIT-III:**

#### **Pulse Modulation**

Sampling Theorem: Low pass and Band pass Signals. Pulse Amplitude Modulation and Concept of Time Division Multiplexing. Pulse Width Modulation. Digital Representation of Analog Signals.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of various pulse modulation schemes and time division multiplexing (L1).
- Analyse various pulse modulation schemes (L3).

### **UNIT-IV:**

#### **Digital Modulation**

Binary Amplitude Shift Keying, Binary Phase Shift Keying and QuadraturePhase Shift Keying, Binary Frequency Shift Keying. Regenerative Repeater.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of various digital modulation schemes (L1).
- Analyze various digital modulation schemes (L3).

### **UNIT-V:**

#### **Communication Systems**

Satellite, RADAR, Optical, Mobile and Computer Communication (Block diagram approach only).

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of various communication systems (L1).

Note: The main emphasis is on qualitative treatment. Complex mathematical treatment may be avoided.

#### **Course Outcomes:**

- Understand the concept of various modulation schemes and multiplexing (L1).

- Apply the concept of various modulation schemes to solve engineering problems (L2).
- Analyse various modulation schemes, and evaluate various modulation scheme in real time applications (L3).

**TEXT BOOKS:**

1. Herbert Taub, Donald L Schilling and Goutam Saha, “Principles of Communication Systems”, 3<sup>rd</sup>Edition, Tata McGraw-Hill Publishing Company Ltd., 2008.

**REFERENCES:**

1. B. P. Lathi, Zhi Ding and Hari M. Gupta, “Modern Digital and Analog Communication Systems”, 4<sup>th</sup> Edition, Oxford University Press, 2017.
2. K. Sam Shanmugam “Digital and Analog Communication Systems”, Wiley India Edition, 2008.

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**Blooms’ Learning levels:**

L1: Remembering and Understanding

L2: Applying

L3: Analyzing, Evaluating

(19A05604a) FUNDAMENTALS OF VR/AR/MR  
Open Elective-II  
(Common to CSE & IT)

**Course Objectives:**

This course is designed to:

- Explore the history of spatial computing and design interactions
- Understand the foundational principles describing how hardware, computer vision algorithms function
- Learn Virtual reality animation and 3D Art optimization
- Demonstrate Virtual reality
- Introduce to the design of visualization tools

UNIT-I

**How Humans interact with Computers:** Common term definition, introduction, modalities through the ages (pre- 20<sup>th</sup> century, through world war-II, post world war-II, the rise of personal computing, computer miniaturization), why did we just go over all of this?, types of common HCI modalities, new modalities, the current state of modalities for spatial computing devices, current controllers for immersive computing systems, a note on hand tracking and hand pose recognition.

**Designing for our Senses, Not our Devices:** Envisioning a future, sensory technology explained, who are we building this future for?, sensory design, five sensory principles, Adobe's AR story.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Explain common modalities and their pros and cons.(L2)
- Demonstrate Mapping modalities to current industry inputs(L2)
- Explore the importance of design with spatial computing(L5)

UNIT-II

**Virtual Reality for Art:** A more natural way of making 3D art, VR for animation.

**3D art optimization:** Introduction, draw calls, using VR tools for creating 3D art, acquiring 3D models vs making them from scratch.

**How the computer vision that makes augmented reality possible works:** Who are we?, a brief history of AR, how and why to select an AR platform, mapping, platforms, other development considerations, the AR cloud.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Utilize VR tools for creating 3D Animations(L3)
- Analyze how and why to Select an AR Platform(L4)



### UNIT-III

**Virtual reality and augmented reality:** cross platform theory: Why cross platform? The role of game engines, understanding 3D graphics, portability lessons from video game design, simplifying the controller input.

**Virtual reality toolkit:** open source framework for the community: What is VRTK and why people use it?, the history of VRTK, welcome to the steam VR unity toolkit, VRTK v4, the future of VRTK, success of VRTK.

**Three virtual reality and augmented reality development practices:** Developing for virtual reality and augmented reality, handling locomotion, effective use of audio, common interaction paradigms.

#### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Explain why the design approach should be considered at a holistic high level based on the goal of the experience(L2)
- Build VR solutions using Virtual reality toolkit(L6)
- Interpret the development practices in three Virtual reality and Augmented reality development(L2)

### UNIT-IV

**Data and machine learning visualization design and development in spatial computing:** Introduction, understanding data visualization, principles for data and machine learning visualization design and development in spatial computing, why data and machine learning visualization works in spatial computing, 2D data visualization vs 3D data visualization in spatial computing, interactivity in data visualizations and in spatial computing, animation, failures in data visualization, good data visualization design optimize 3D spaces, data representations, info graphics, and interactions, defining distinctions in data visualization and big data for machine, how to create data visualization: data visualization creation pipeline, webXR, data visualization challenges in XR, data visualization industry use case examples of data visualization, 3D reconstruction and direct manipulation of real world data, data visualization is for everyone, hands on tutorials, how to create data visualization, resources.

#### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand, define, and set data and machine learning visualization design and development principles in embodied reality(L1)
- Demonstrate best practices, and practical tools to create beautiful and functional data visualizations.(L2)

### UNIT-V

**Character AI and Behaviors:** Introduction, behaviors, current practice: Reactive AI, more intelligence in the system, Deliberative AI, machine learning.

**The virtual and augmented reality health technology ecosystem:** VR/AR health technology application design, standard UX isn't intuitive, tutorial: insight Parkinson's experiment, companies, case studies from leading Academic institutions.

### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Design a behavioral AI system for a video game(L6)
- Identify issues related to design of virtual reality (VR) and augmented reality (AR) experiences deployed in a health-care context(L3)
- Explain the use of motion data from controllers to reduce the visible tremor of a Parkinson's patient in a virtual environment(L2)

### **Course outcomes**

Upon completion of the course, the students should be able to:

- Explain how the humans interact with computers (L2)
- Apply technical and creative approaches to make successful applications and experiences. (L3)
- Design audio and video interaction paradigms (L6)
- Design Data visualization tools (L6)
- Apply VR/MR/AR in various fields in industry (L3)

### **Text book**

1. Erin Pangilinan, Steve lukas, and Vasanth Mohan, "Creating Augmented & Virtual Realities", 1<sup>st</sup> edition, O'REILLY, 2019.

### **References**

1. Steve Aukstakalnis, "Practical Augmented Reality", Pearson Education, 2017.

**(19A05604b) DATA SCIENCE**  
**Open Elective-II**  
**(Common to CSE & IT)**

**Course Objectives**

This course is designed to:

- Understand the approaches for handling data related problems
- Explore the mathematical concepts required for Data science
- Explain the basic concepts of data science.
- Elucidate various Machine Learning algorithms.
- Introduce Natural Language Processing and Recommender Systems

**UNIT- I**

Introduction to Data Science, A Crash Course in Python, Visualising Data.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Describe the importance of data analysis (L1).
- Identify the key connectors of Data Science (L4).
- Interpret and Visualize the data using bar charts, line charts and scatter plots (L3).

**UNIT-II**

Linear Algebra, Statistics, Probability, Hypothesis and Inference, Gradient Descent.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Identify the Correlation between two vectors (L4).
- Test a given hypothesis (L3).
- Compute mean, median and mode for the given data (L3).

**UNIT-III**

Getting Data, Working with Data, Machine Learning, k-Nearest Neighbors, Naïve Bayes.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Compute dimensionality reduction using PCA (L3).
- Differentiate supervised and unsupervised learning methods (L4).

- Describe overfitting, under fitting, bias, variance and goodness of learning (L1).
- Solve classification problem using k-nearest neighbour classifier (L3).
- Apply Naïve Bayes classifier to solve decision making problem (L3).

#### **UNIT-IV**

Simple Linear Regression, Multiple Regression, Logistic Regression, Decision Trees, Neural Networks.

#### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Describe gradient descent approach, maximum likelihood estimation and method of least squares (L1).
- Apply SVM to determine a hyperplane with maximum margin (L3).
- Determine decision tree for given data (L5).
- Describe Perceptron and Back Propagation (L3).

#### **UNIT-V**

Clustering, Natural Language Processing, Network Analysis, Recommender Systems.

Database and SQL, MapReduce

#### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Determine Clusters in data using k-means and Hierarchical Clustering methods (L5).
- Apply basic SQL Operations using NotQuiteABase (L3).
- Compare User-Based and Item-Based Collaborative Filtering (L2).
- Describe Grammer and MapReduce (L1).

#### **Course Outcomes:**

After completion of this course the student would be able to

- Visualize the data using bar charts, line charts and scatter plots (L4).
- Analyse Correlation between two data objects (L4).
- Demonstrate feature selection and dimensionality reduction.(L2)
- Solve decision making problems using k-NN, Naïve Bayes, SVM and Decision. Trees (L3).
- Determine Clusters in data using k-means and Hierarchical Clustering methods (L3).
- Design basic SQL Operations using NotQuiteABase (L6)
- Demonstrate the way to use machine learning algorithms using python. (L2)

#### **Text Books:**

1. Data Science from Scratch, First Principles with Python - Joel Grus, O'Reilly, First Edition.

**Reference Books:**

1. The Data Science Handbook, Field Cady, WILEY.
2. An Introduction to Data Science, Jeffrey M. Stanton, Jeffrey Stanton, 2012

**(19A27604a) FOOD TOXICOLOGY**  
**OPEN ELECTIVE II**

**PREAMBLE**

This text covers about toxins and their relation in food. Examination, identification and prevention of toxins.

**Course Objectives**

- To know the various toxins and their evaluation.
- To understand their tolerance and control measures.

**UNIT – I**

Principles of Toxicology: classification of toxic agents; characteristics of exposure; spectrum of undesirable effects; interaction and tolerance; biotransformation and mechanisms of toxicity. Evaluation of toxicity: risk vs. benefit: experimental design and evaluation: prospective and retrospective studies: Controls :Statistics (descriptive, inferential): animal models as predictors of human toxicity: Legal requirements and specific screening methods: LD50 and TD50: in vitro and in vitvo studies; clinical trials.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Classification of toxic agents; characteristics of exposure;
- Spectrum of undesirable effects; interaction and tolerance; biotransformation and mechanisms of toxicity.
- Evaluation of toxicity: risk vs. benefit: experimental design and evaluation:
- Prospective and retrospective studies: Controls: Statistics (descriptive, inferential): animal models as predictors of human toxicity:
- Legal requirements and specific screening methods: LD50 and TD50: in vitro and in vitvo studies; clinical trials.

**UNIT – II**

Natural toxins in food: natural toxins of importance in food- toxins of plant and animal origin; microbial toxins (e.g., bacterial toxins, fungal toxins and Algal toxins), natural occurrence, toxicity and significance, determination of toxicants in foods and their management.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Natural toxins in food: natural toxins of importance in food- toxins of plant and animal origin
- Microbial toxins (e.g., bacterial toxins, fungal toxins and algal toxins), natural occurrence, toxicity and significance
- Determination of toxicants in foods and their management

### **UNIT – III**

Food allergies and sensitivities: natural sources and chemistry of food allergens; true/untrue food allergies; handling of food allergies; food sensitivities (anaphylactoid reactions, metabolic food disorders and idiosyncratic reactions); Safety of genetically modified food: potential toxicity and allergenicity of GM foods. Safety of children consumables.

#### **Learning outcomes:**

At the end of unit, students will be able to understand the following

- Natural sources and chemistry of food allergens; true/untrue food allergies; handling of food allergies
- Food sensitivities (anaphylactoid reactions, metabolic food disorders and idiosyncratic reactions)
- Potential toxicity and allergenicity of gm foods. Safety of children consumables.

### **UNIT – IV**

Environmental contaminants and drug residues in food: fungicide and pesticide residues in foods; heavy metal and their health impacts; use of veterinary drugs (e.g. Malachite green in fish and  $\beta$ - agonists in pork); other contaminants in food, radioactive contamination of food, Food adulteration and potential toxicity of food adulterants.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Fungicide and pesticide residues in foods; heavy metal and their health impacts
- Use of veterinary drugs (e.g. Malachite green in fish and  $\beta$ - agonists in pork); other contaminants in food, radioactive contamination of food
- Food adulteration and potential toxicity of food adulterants.

### **UNIT – V**

Food additives and toxicants added or formed during food processing: safety of food additives; toxicological evaluation of food additives; food processing generated toxicants: nitroso-compounds, heterocyclic amines, dietary Supplements and toxicity related to dose: common dietary supplements; relevance of the dose; possible toxic effects.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Safety of food additives; toxicological evaluation of food additives;
- Nitroso-compounds, heterocyclic amines, dietary supplements and toxicity related to dose
- Common dietary supplements; relevance of the dose; possible toxic effects.

### **Course Outcomes**

By the end of course

- Student will gain knowledge on principles of toxicity and characteristics of toxins and their classification. Examination and prevention of toxins in foods and etc.

### **TEXT BOOKS**

1. Helferich, W., and Winter, C.K “Food Toxicology”,. CRC Press, LLC. Boca Raton, FL. 2007.
2. Shibamoto, T., and Bjeldanes, L. “Introduction to Food Toxicology”, 2009, 2<sup>nd</sup> Edition. Elsevier Inc., Burlington, MA.
3. Watson, D.H. “Natural Toxicants in Food”, CRC Press, LLC. Boca Raton, FL1998.

### **REFERENCES**

1. Duffus, J.H., and Worth, H.G. J. “Fundamental Toxicology”, The Royal Society of Chemistry. 2006.
2. Stine, K.E., and Brown, T.M. “Principles of Toxicology”, 2<sup>nd</sup> Edition. CRC Press. 2006.
3. Tönu, P. “Principles of Food Toxicology”. CRC Press, LLC. Boca Raton, FL. 2007.



**(19A27604b) FOOD PLANT EQUIPMENT DESIGN**  
**OPEN ELECTIVE - II**

**PREAMBLE**

This text focuses on materials used for food plant equipment and factors considered for design of various equipment.

**Course Objectives:**

- To understand the material properties and codes used.
- To know the design considerations.
- To study the design of evaporators, dryers, crystallizers and etc.

**UNIT – I**

Materials and properties: Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings, corrosion prevention linings equipment, choice of materials, material codes. Design considerations: Stresses created due to static and dynamic loads, combined stresses, design stresses and theories of failure, safety factor, temperature effects, radiation effects, effects of fabrication method, economic considerations

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings
- Corrosion prevention linings equipment, choice of materials, material codes
- Stresses created due to static and dynamic loads, combined stresses, design stresses and theories of failure, safety factor
- Temperature effects, radiation effects, effects of fabrication method, economic considerations

**UNIT – II**

Design of pressure and storage vessels: Operating conditions, design conditions and stress; Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories. Design of heat exchangers: Design of shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger, sterilizer and retort

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Design of pressure and storage vessels includes operating conditions, design conditions and stress
- Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories
- Design of heat exchangers like shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger, sterilizer and retort

### **UNIT – III**

Design of evaporators and crystallizers: Design of single effect and multiple effect evaporators and its components; Design of rising film and falling film evaporators and feeding arrangements for evaporators; Design of crystallizer and entrainment separator

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Design of evaporators like single effect and multiple effect evaporators and its components; rising film and falling film evaporators and feeding arrangements for evaporators;
- Design of crystallizer and entrainment separator

### **UNIT – IV**

Design of agitators and separators: Design of agitators and baffles; Design of agitation system components and drive for agitation. Design of centrifuge separator; Design of equipment components, design of shafts, pulleys, bearings, belts, springs, drives, speed reduction systems. Design of freezing equipment: Design of ice-cream freezers and refrigerated display system

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Design of agitators and baffles like Design of agitation system components and drive for agitation.
- Design of centrifuge separator like equipment components, design of shafts, pulleys, bearings, belts, springs, drives, speed reduction systems.
- Design of freezing equipment like ice-cream freezers and refrigerated display system

### **UNIT – V**

Design of dryers: Design of tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer. Design of extruders: Cold and hot extruder design, design of screw and barrel, design of twin screw extruder. Design of fermenters: Design of fermenter vessel, design problems

## **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Design of dryers like tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer
- Design of extruders like Cold and hot extruder design, design of screw and barrel, design of twin screw extruder.
- Design of fermenter vessel, design problems

## **Course Outcomes**

By the end of the course, the students will

- acquires knowledge on theoretical aspects to be design considerations for a food plant equipment and designing of evaporators, separators, storage vessels and etc.

## **TEXT BOOKS**

1. Antonio Lopez-Gomez, Gustavo V. Barbosa-Canovas, "Food plant design", CRC press 2005.
2. George D. Saravacos and Zacharias B. Maroulis, "Food Plant Economics", CRC Press 2007.

## **REFERENCES**

1. Peters M., Timmerhaus K. & Ronald W., "Plant Design & Economics for Chemical Engineers", McGraw Hill.
2. James R Couper, "Process Engg. Economics (Chemical Industries) CRC Press 3. Aries & Newton, Chemical Engg. Cost Estimation", McGraw Hill.

**(19A54604a) WAVELET TRANSFORMS AND ITS APPLICATIONS**

**OPEN ELECTIVE-II**

**Course Objective:**

This course provides the students to understand Wavelet transforms and its applications.

**UNIT-I-**

**Wavelets**

Wavelets and Wavelet Expansion Systems - Wavelet Expansion- Wavelet Transform- Wavelet System- More Specific Characteristics of Wavelet Systems -Haar Scaling Functions and Wavelets -effectiveness of Wavelet Analysis -The Discrete Wavelet Transform The Discrete-Time and Continuous Wavelet Transforms.

**Learning Outcomes:**

Students will be able to

- Understand wavelets and wavelet expansion systems.
- Find wavelet transforms in continuous as well as discrete domains.

**UNIT-II-**

**A Multiresolution Formulation of Wavelet Systems**

Signal Spaces -The Scaling Function -Multiresolution Analysis - The Wavelet Functions - The Discrete Wavelet Transform- A Parseval's Theorem - Display of the Discrete Wavelet Transform and the Wavelet Expansion.

**Learning Outcomes:**

Students will be able to

- Illustrate the multi resolution analysis, scaling function.
- Implement parseval theorem.

**UNIT-III-**

**Filter Banks and the Discrete Wavelet Transform :** Analysis - From Fine Scale to Coarse Scale- Filtering and Down-Sampling or Decimating -Synthesis - From Coarse Scale to Fine Scale -Filtering and Up-Sampling or Stretching - Input Coefficients - Lattices and Lifting - - Different Points of View.

**Learning Outcomes:**

Students will be able to

- Form fine scale to coarse scale analysis.
- Perform decimating synthesis.
- Find the lattices and lifting.

#### **UNIT-IV**

Multiresolution versus Time-Frequency Analysis- Periodic versus Nonperiodic Discrete Wavelet Transforms -The Discrete Wavelet Transform versus the Discrete-Time Wavelet Transform- Numerical Complexity of the Discrete Wavelet Transform.

##### **Learning Outcomes:**

Students will be able to

- Perform multi resolution versus time frequency analysis.
- Perform numerical complexity of discrete wavelet transforms.

#### **UNIT-V**

Bases, Orthogonal Bases, and Biorthogonal Bases -Matrix Examples - Fourier Series Example - Sine Expansion Example - Frames and Tight Frames - Matrix Examples -Sine Expansion as a Tight Frame Example.

##### **Learning Outcomes:**

Students will be able to

- Understand the orthogonal bases and Biorthogonal Bases.
- Find the Frames and Tight Frames using Fourier series.

##### **Course Outcomes:**

After the completion of course, students will be able to

- Understand wavelets and wavelet expansion systems.
- Illustrate the multi resolution analysis and scaling functions.
- Form fine scale to coarse scale analysis.
- Find the lattices and lifting.
- Perform numerical complexity of discrete wavelet transforms.
- Find the frames and tight frames using fourier series.

#### **TEXT BOOKS:**

1. C. Sidney Burrus, Ramesh A. Gopinath, "Introduction to Wavelets and Wavelets Transforms", Prentice Hall, (1997).
2. James S. Walker, "A Primer on Wavelets and their Scientific Applications", CRC Press, (1999).

#### **REFERENCE BOOKS:**

1. Raghuvveer Rao, "Wavelet Transforms", Pearson Education, Asia.

**(19A52604a) SOFT SKILLS**  
**(OPEN ELECTIVE-II)**

**Course Objectives**

- To develop awareness in students of the relevance and importance of soft skills
- To provide students with interactive practice sessions to make them internalize soft skills
- To develop Time management, Positive thinking & Decision making skills
- To enable to manage stress effectively
- To enable them to develop employability skills

**SYLLABUS**

**UNIT – I**

**INTRODUCTION**

Definition – Scope – Importance- – Methods of improving soft skills – Limits- Analysis – Interpersonal and intrapersonal skills - Verbal and Non-verbal skills.

**Learning Outcomes:**

At the end of the module, the learners will be able to

- Understand the importance of soft skills
- Identify the methods of improving soft skills
- Analyze various soft skills in different situations
- Distinguish various soft skills
- Apply various soft skills in day to day life and in workplace

**UNIT – II INTRAPERSONAL SKILLS**

Knowing self/temperaments/traits - Johari windows – quotient skills(IQ, EQ, SQ), creativity, decision-making-Attitude – Confidence Building - Positive Thinking –Time Management – Goal setting.

**Learning Outcomes:**

At the end of the module, the learners will be able to

- Understand self and its temperament.
- Apply various techniques to know the self.
- Develop positive thinking

- Develop creative thinking and decision-making skills
- Apply self-knowing tools in day to day and professional life.

### **UNIT – III**

#### **INTERPERSONAL SKILLS**

Leadership Skills – Negotiation skills – Team-building – Crisis Management – Event Management – Ethics and Etiquettes.

#### **Learning Outcomes:**

At the end of the module, the learners will be able to

- Understand the importance of interpersonal skills
- Analyze various tactics in negotiation skills.
- Develop team building spirit.
- Develop crisis management
- Apply interpersonal skills through etiquettes.

### **UNIT – IV**

#### **VERBAL SKILLS**

Importance of verbal skills in corporate climate, Listening skills –Mother Tongue Influence (MTI) - Speaking skills – Public speaking - Oral presentations - Writing skills –E-mail etiquettes – Memos - Indianism

#### **Learning Outcomes:**

At the end of the module, the learners will be able to

- Understand the importance of verbal skills in corporate climate.
- Explain the need of listening skills.
- Explore MTI and suggest remedies to avoid it.
- Interpret various contexts of speaking.
- Apply verbal skills in personal and professional life.

### **UNIT – V NON-VERBAL SKILLS**

Importance of body language in corporate culture – body language-Facial expressions – eye contact – posture – gestures – Proxemics – Haptics – Dress Code – Paralanguage –Tone, pitch, pause& selection of words

#### **Learning Outcomes:**

At the end of the module, the learners will be able to

- Comprehend the importance of non-verbal communication.
- Expound the need of facial expressions, postures and gestures.
- Analyze proxemics, haptics etc.
- Understand the importance of dress code.
- Apply various techniques to use para language

### **Course Outcomes**

- Recognize the importance of verbal and non verbal skills
- Develop the interpersonal and intrapersonal skills
- Apply the knowledge in setting the SMART goals and achieve the set goals
- Analyze difficult situations and solve the problems in stress-free environment
- Create trust among people and develop employability skills

### **Text Books**

1. Meenakshi Raman & Shalini Upadhyay “ Soft Skills”, Cengage Learning, 2018.
2. S. Balasubramaniam, “Soft Skills for Interpersonal Communication”, Orient Black Swan, 2017.

### **References**

1. Barun K. Mitra, “Personality Development and Soft Skills”, –OXFORD Higher Education 2018.
2. Alka Wadkar, “Life Skills for Success “, Sage Publications 2016.
3. Robert M Sheffield, “Developing Soft Skills”, Pearson, 2010.
4. Diana Booher, “Communicate With Confidence”, Tata McGrawhill, 2012.



**(19A51604a) CHEMISTRY OF POLYMERS AND ITS APPLICATIONS**

**Course Objectives:**

- To understand the basic principles of polymers
- To synthesize the different polymeric materials and their characterization by various instrumental methods.
- To impart knowledge to the students about fundamental concepts of Hydro gels of polymer networks, surface phenomenon by micelles
- To enumerate the applications of polymers in engineering

**Unit – I : Polymers-Basics and Characterization**

Basic concepts: monomers, repeat units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: condensation, addition, radical chain, ionic and coordination and copolymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution Measurement of molecular weight: end group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Classify the polymers (L3)
- Explain polymerization mechanism (L2)
- Differentiate addition, condensation polymerizations (L2)
- Describe measurement of molecular weight of polymer (L2)

**Unit – II : Synthetic Polymers**

Addition and condensation polymerization processes – Bulk, Solution, Suspension and Emulsion polymerization.

Preparation and significance, classification of polymers based on physical properties, Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications.

Preparation of Polymers based on different types of monomers, Olefin polymers, Diene polymers, nylons, Urea - formaldehyde, phenol - formaldehyde and melamine Epoxy and Ion exchange resins. Characterization of polymers by IR, NMR, XRD.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Differentiate Bulk, solution, Suspension and emulsion polymerization (L2)

- Describe fibers and elastomers (L2)
- Identify the thermosetting and thermo polymers (L3)
- Characterize the properties of polymers by IR, NMR, XRD etc.,

### **Unit – III : Natural Polymers & Modified cellulotics**

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.

Modified cellulotics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEAK.

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Describe the properties and applications of polymers (L2)
- Interpret the properties of cellulose, lignin, starch, rosin, latex etc., (L2)
- Discuss the special plastics of PES, PAES, PEEK etc., (L3)
- Explain modified cellulotics (L2)

### **Unit-IV: Hydrogels of Polymer networks and Drug delivery**

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, **Applications** of hydrogels in drug delivery.

Introduction to drug systems including, drug development, regulation, absorption and disposition, routes of administration and dosage forms. Advanced drug delivery systems and controlled release.

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Identify types of polymer networks (L3)
- Describe methods involve in hydrogel preparation (L2)
- Explain applications of hydrogels in drug delivery (L2)
- Demonstrate the advanced drug delivery systems and controlled release (L2)

### **Unit – V : Surface phenomena**

Surface tension, adsorption on solids, electrical phenomena at interfaces including electrokinetics, micelles, reverse micelles, solubilization. Application of photoelectron spectroscopy, ESCA and Auger spectroscopy to the study of surfaces.

## **Learning Outcomes:**

At the end of this unit, the students will be able to

- Demonstrate electrical phenomena at interfaces including electrokinetics, micelles, reverse micelles etc., (L2)
- Explain photoelectron spectroscopy (L2)
- Discuss ESCA and Auger spectroscopy to the study of surfaces (L3)
- Differentiate micelles and reverse micelles (L2)

## **Course Outcomes**

At the end of the course, the student will be able to:

- Understand the state of art synthesis of Polymeric materials
- Understand the hydro gels preparation, properties and applications in drug delivery system.
- Characterize polymers materials using IR, NMR, XRD.
- Analyze surface phenomenon fo micelles and characterise using photoelectron spectroscopy, ESCA and Auger spectroscopy.

## **References :**

1. A Text book of Polymer science, Billmeyer
2. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
3. Advanced Organic Chemistry, B.Miller, Prentice Hall
4. Polymer Chemistry – G.S.Mishra
5. Polymer Chemistry – Gowarikar
6. Physical Chemistry –Galston
7. Drug Delivery- Ashim K. Misra

**HUMANITIES ELECTIVE-I**

**(19A52602a) ENTREPRENEURSHIP & INCUBATION**

**COURSE OBJECTIVES :**

The objective of this course is

- To make the student understand about Entrepreneurship
- To enable the student in knowing various sources of generating new ideas in setting up of New enterprise
- To facilitate the student in knowing various sources of finance in starting up of a business
- To impart knowledge about various government sources which provide financial assistance to entrepreneurs/ women entrepreneurs
- To encourage the student in creating and designing business plans

**Syllabus**

**UNIT-I**

Entrepreneurship - Concept, knowledge and skills requirement - Characteristics of successful entrepreneurs - Entrepreneurship process - Factors impacting emergence of entrepreneurship - Differences between Entrepreneur and Intrapreneur - Understanding individual entrepreneurial mindset and personality - Recent trends in Entrepreneurship.

**Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Understand the concept of Entrepreneur and Entrepreneurship in India
- Know Entrepreneurship process and emergence of Entrepreneurship
- Analyze the differences between Entrepreneur and Intrapreneur
- Develop a creative mind set and personality
- Understand recent trends in Entrepreneurship across the globe

**UNIT-II**

Starting the New Venture - Generating business idea – Sources of new ideas & methods of generating ideas - Opportunity recognition - Feasibility study - Market feasibility, technical/operational feasibility - Financial feasibility - Drawing business plan - Preparing project report - Presenting business plan to investors.

## **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the process of starting a new venture
- Analyze the sources of new methods in generating business idea
- Evaluate market feasibility, financial feasibility and technical feasibility
- Design and draw business plans in project preparation and prepare project reports

## **UNIT-III**

Sources of finance - Various sources of Finance available - Long term sources - Short term sources - Institutional Finance – Commercial Banks, SFC's in India - NBFC's in India - their way of financing in India for small and medium business - Entrepreneurship development programs in India - The entrepreneurial journey- Institutions in aid of entrepreneurship development

## **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the various sources of finance to start a new venture
- Contrast & compare between Long term & Short term finance sources
- Analyze the role of banks and other financial institutions in promoting entrepreneurship in India
- Evaluate the need and importance of MSMEs in the growth of country

## **UNIT-IV**

Women Entrepreneurship - Entrepreneurship Development and Government - Role of Central Government and State Government in promoting women Entrepreneurship - Introduction to various incentives, subsidies and grants – Export- oriented Units - Fiscal and Tax concessions available - Women entrepreneurship - Role and importance - Growth of women entrepreneurship in India - Issues & Challenges - Entrepreneurial motivations.

## **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Understand the role of government in promoting women entrepreneurship
- Know various incentives, subsidies and grants available to women entrepreneurs
- Analyze the role of export-oriented units
- Know about the tax concessions available for Women entrepreneurs
- Prepare to face the issues and challenges.

## **UNIT-V**

Fundamentals of Business Incubation - Principles and good practices of business incubation- Process of business incubation and the business incubator and how they operate and influence the Type/benefits of incubators - Corporate/educational / institutional incubators - Broader business

incubation environment - Pre-Incubation and Post - Incubation process - Idea lab, Business plan structure - Value proposition

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to:

- Understand the importance of business incubation
- Apply brilliant ideas in the process of business incubation
- Analyze the process of business incubation/incubators.
- Contrast & Compare between business incubation and business incubators.
- Design their own business incubation/incubators as viable-business unit.

### **Course Outcomes:**

At the end of the course, students will be able to

- Understand the concept of Entrepreneurship and challenges in the world of competition.
- Apply the Knowledge in generating ideas for New Ventures.
- Analyze various sources of finance and subsidies to entrepreneur/women Entrepreneurs.
- Evaluate the role of central government and state government in promoting Entrepreneurship.
- Create and design business plan structure through incubations.

### **TEXT BOOKS**

1. D F Kuratko and T V Rao, “Entrepreneurship” - A South-Asian Perspective – Cengage Learning, 2012. (For PPT, Case Solutions Faculty may visit : [login.cengage.com](http://login.cengage.com))
- 2 . Nandan H, “ Fundamentals of Entrepreneurship”, PHI, 2013

### **REFERENCES**

1. Vasant Desai, “Small Scale Industries and Entrepreneurship”, Himalaya Publishing 2012.
2. Rajeev Roy “Entrepreneurship”, 2<sup>nd</sup> Edition, Oxford, 2012.
3. B.Janakiramand M.Rizwanal “Entrepreneurship Development: Text & Cases”, Excel Books, 2011.
4. Stuart Read, Effectual “Entrepreneurship”, Routledge, 2013.

### **E-RESOURCES**

1. Entrepreneurship-Through-the-Lens-of-enture Capital
2. <http://www.onlinevideolecture.com/?course=mba-programs&subject=entrepreneurship>
3. [http://nptel.ac.in/courses/122106032/Pdf/7\\_4.pd](http://nptel.ac.in/courses/122106032/Pdf/7_4.pd)
4. <http://freevideolectures.com/Course/3514/Economics-/-Management-/-Entrepreneurhip/50>

**(19A52602b) MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS**

**Course Objectives :**

The objective of this course is

- To inculcate the basic knowledge of micro economics and financial accounting
- To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost
- To know the various types of Market Structures & pricing methods and its strategies
- To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
- To provide fundamental skills on Accounting and to explain the process of preparing Financial statements

**Syllabus**

**UNIT I -**

**INTRODUCTION TO MANAGERIAL ECONOMICS DEMAND**

Managerial Economics – Definition – Nature & Scope - Contemporary importance of Managerial Economics - Demand Analysis - Concept of Demand - Demand Function - Law of Demand - Elasticity of Demand - Significance - Types of Elasticity - Measurement of Elasticity of Demand - Demand Forecasting - Factors governing Demand Forecasting - Methods of Demand Forecasting - Relationship of Managerial Economics with Financial Accounting and Management.

**Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the nature and scope of Managerial Economics and its importance
- Understand the concept of demand and its determinants
- Analyze the Elasticity and degree of elasticity
- Evaluate Demand forecasting methods
- Design the process of demand estimation for different types of demand

**UNIT -II**

**THEORY OF PRODUCTION AND COST ANALYSIS**

**Production Function** – Least-cost combination - Short-run and Long-run Production Function - Isoquants and Isocosts, MRTS - Cobb-Douglas Production Function - Laws of Returns - Internal and External Economies of scale – **Cost & Break Even Analysis** - Cost concepts and Cost

behavior - Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems)  
- Managerial significance and limitations of Break-Even Analysis.

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the production function, Input-Output relationship and different cost concepts
- Apply the least-cost combination of inputs
- Analyze the behavior of various cost concepts
- Evaluate BEA for real time business decisions
- Develop profit appropriation for different levels of business activity

## **UNIT –III**

### **INTRODUCTION TO FORMS OF BUSINESS ORGANIZATIONS AND MARKETS**

**Market structures** - Forms of Business Organizations - Sole Proprietorship - Partnership - Joint Stock Companies - Public Sector Enterprises-Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition – Monopoly - Monopolistic Competition – Oligopoly - Price-Output Determination - Pricing Methods and Strategies.

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the structure of markets, features of different markets and forms of business organizations
- Apply the price output relationship in different markets
- Analyze the optimum output levels to maximize profit in different markets
- Evaluate price-output relationship to optimize cost, revenue and profit
- Interpret Pricing Methods and Strategies

## **UNIT -IV**

**CAPITAL AND CAPITAL BUDGETING** Concept of Capital - Significance - Types of Capital - Components of Working Capital - Sources of Short-term and Long-term Capital - Estimating Working capital requirements – Cash Budget - **Capital Budgeting** – Features of Capital Budgeting Proposals – Methods and Evaluation of Capital Budgeting Projects – Pay Back Method – Accounting Rate of Return (ARR) – Net Present Value (NPV) – Internal Rate Return (IRR) Method (simple problems)

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the concept of capital budgeting and its importance in business
- Contrast and compare different investment appraisal methods
- Analyze the process of selection of investment alternatives using different appraisal methods
- Evaluate methods of capital budgeting for investment decision making and for maximizing returns



- Design different investment appraisals and make wise investments

## **UNIT –V**

### **INTRODUCTION TO FINANCIAL ACCOUNTING AND ANALYSIS**

Accounting Concepts and Conventions - Introduction Double-Entry Book Keeping, Journal, Ledger, Trial Balance - Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). *Financial Analysis* - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

#### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the concept, convention and significance of accounting
- Apply the fundamental knowledge of accounting while posting the journal entries
- Analyze the process and preparation of final accounts and financial ratios
- Evaluate the financial performance of an enterprise by using financial statements

#### **Data Books Required:**

Present Value Factors table

#### **Course Outcomes:**

At the end of the course, students will be able to

- Understand the fundamentals of Economics viz., Demand, Production, cost, revenue and markets
- Apply concepts of production, cost and revenues for effective business decisions
- Students can analyze how to invest their capital and maximize returns
- Evaluate the capital budgeting techniques
- Prepare the accounting statements and evaluate the financial performance of business entity.

#### **TEXT BOOKS:**

1. Varshney & Maheswari: “Managerial Economics”, Sultan Chand, 2013.
2. Aryasri: “Business Economics and Financial Analysis”, 4<sup>th</sup> edition, MGH, 2019

#### **REFERENCES:**

1. Ahuja HI “Managerial economics” 3<sup>rd</sup> edition, Schand, ,2013
2. S.A. Siddiqui and A.S. Siddiqui: “Managerial Economics and Financial Analysis”, New Age International,. 2013.
3. Joseph G. Nellis and David Parker: “Principles of Business Economics”, 2<sup>nd</sup> edition, Pearson, New Delhi.
4. Domnick Salvatore: “Managerial Economics in a Global Economy”, Cengage, 2013.

**(19A52602c) BUSINESS ETHICS AND CORPORATE GOVERNANCE**

**Course Objectives :**

The objectives of this course are

- To make the student understand the principles of business ethics
- To enable them in knowing the ethics in management
- To facilitate the student role in corporate culture
- Impart knowledge about the fair trade practices
- Encourage the student in knowing them about the corporate governance

**Syllabus**

**BUSINESS ETHICS AND CORPORATE GOVERNANCE**

**UNIT -I**

**Introduction** – Meaning - Nature and Scope – Loyalty and Ethical Behaviour, Values across Cultures; Business Ethics – Ethical Practices in Management. Types of Ethics – Characteristics – Factors influencing , Business Ethics – Importance of Business Ethics - Arguments for and against business ethics Basics of business ethics Corporate Social Responsibility – Issues of Management – Crisis Management

**Learning Outcomes:**

After completion of this unit student will

- Understand the meaning of loyalty and ethical Behavior
- Explain various types of Ethics
- Know about the factors influencing business ethics
- Understand the corporate social responsibility of management

**UNIT –II**

**ETHICS IN MANAGEMENT**

Introduction – Ethics in HRM – Marketing Ethics – Ethical aspects of Financial Management- Technology Ethics and Professional ethics. The Ethical Value System – Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics – Ethical Values in different Cultures, Culture and Individual Ethics.

**Learning Outcomes:**

After completion of this unit student will

- Understand the meaning of Marketing Ethics
- Analyze Differentiate between Technical ethics and professional ethics
- Know about the ethical value system
- Understand the Code and culture

### **UNIT-III**

#### **ROLE OF CORPORATE CULTURE IN BUSINESS**

Meaning – Functions – Impact of corporate culture – cross cultural issues in ethics, Emotional Honesty – Virtue of humility – Promote happiness – karma yoga – proactive – flexibility and purity of mind. The Ethical Value System – Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom Choice, Professional Codes; Culture and Ethics – Ethical Values in different Cultures, Culture and Individual Ethics.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the corporate culture in business
- Analyze Ethical Value System Know about the ethical value system
- Know Universalism, Utilitarianism, Distributive Justice
- Differentiate Ethical Values in different Cultures

### **UNIT- IV**

Law and Ethics – Relationship between Law and Ethics, Other Bodies in enforcing Ethical Business Behavior, Impact of Laws on Business Ethics; Social Responsibilities of Business – Environmental Protection, Fair Trade Practices, Fulfilling all National obligations under various Laws, Safeguarding Health and wellbeing of Customers.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand Law and Ethics
- Analyze Social Responsibilities of Business
- Know Environmental Protection and Fair Trade Practices
- Implementing National Safeguarding Health and wellbeing of Customers

### **UNIT –V**

#### **CORPORATE GOVERNANCE**

Meaning – scope - Issues, need, corporate governance code, transparency & disclosure, role of auditors, board of directors and shareholders; Global issues of governance, accounting and regulatory frame work, corporate scams, committees in India and abroad, corporate social responsibility composition of BODs - Cadbury Committee - various committees - reports on corporate governance - Benefits and Limitations of Corporate Governance with living examples.

## **Learning Outcomes:**

After completion of this unit student will

- Understand corporate governance code
- Analyze role of auditors, board of directors and shareholders
- Know accounting and regulatory frame work
- Implementing corporate social responsibility

## **Course Outcomes:**

At the end of the course, students will be able to

- Understand business ethics and ethical practices in management.
- Understand the role of ethics in management
- Apply the knowledge in cross cultural ethics
- Analyze law and ethics
- Evaluate corporate governance

## **TEXT BOOKS:**

1. Murthy CSV: “Business Ethics and Corporate Governance”, HPH
2. Bholanath Dutta, S.K. Podder – “Corporation Governance”, VBH.

## **REFERENCE BOOKS:**

1. Dr. K. Nirmala, KarunakaraReaddy : “Business Ethics and Corporate Governance”, HPH
2. H.R.Machiraju: “Corporate Governance”
3. K. Venkataramana, “Corporate Governance”, SHBP.
4. N.M.Khandelwal : “Indian Ethos and Values for Managers”

**(19A52602d) ENTERPRISE RESOURCE PLANNING**

**Course Objectives :**

The objectives of this course are

- To provide a contemporary and forward-looking on the theory and practice of
- Enterprise Resource Planning
- To enable the students in knowing the Advantages of ERP
- To train the students to develop the basic understanding of how ERP enriches the
- Business organizations in achieving a multidimensional growth.
- Impart knowledge about the historical background of BPR
- To aim at preparing the students, technologically competitive and make them ready to self-upgrade with the higher technical skills.

**Syllabus**

**UNIT-I**

**Introduction to ERP:** Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM), Customer Relationship Management(CRM),

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of ERP
- Explain various Business modeling
- Know the contemporary technology like SCM, CRM
- Understand the OLAP

**UNIT-II**

**Benefits of ERP:** Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design-making Capability

**Learning Outcomes:**

After completion of this unit student will

- Understand the Advantages of ERP

- Explain the challenges associated with ERP System
- Analyze better customer satisfaction
- Differentiate Improved Information Accuracy and Design-making Capability

### **UNIT-III**

**ERP Implementation Lifecycle:** Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation Team Training, Testing, Going Live, End-user Training, Post-implementation (Maintenance mode)

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the implementation of ERP life cycle
- Explain the challenges associated with implementing ERP system
- Analyze the need of re-engineering
- Know the recent trends in team training testing and go-live

### **UNIT-IV**

**BPR:** Historical background: Nature, significance and rationale of business process reengineering (BPR), Fundamentals of BPR. Major issues in process redesign: Business vision and process objectives, Processes to be redesigned, Measuring existing processes,

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the business process reengineering
- Explain the challenges associated with BPR
- Analyze the need of process redesign
- Differentiate between process to be redesign and measuring existing process

### **UNIT-V**

**IT in ERP:** Role of information technology (IT) and identifying IT levers. Designing and building a prototype of the new process: BPR phases, Relationship between BPR phases. MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the role of IT
- Explain the challenges in Designing and building a prototype of the new process
- Analyze the need of MIS
- Differentiate between DSS and EIS

**Course outcomes:**

At the end of the course, students will be able to

- Understand the basic use of ERP Package and its role in integrating business functions.
- Explain the challenges of ERP system in the organization
- Apply the knowledge in implementing ERP system for business
- Evaluate the role of IT in taking decisions with MIS
- Create reengineered business processes with process redesign

**TEXT BOOKS:**

1. Pankaj Sharma. "Enterprise Resource Planning". Aph Publishing Corporation, New Delhi, 2004.
2. Alexis Leon, "Enterprise Resource Planning", IV Edition, Mc.Graw Hill, 2019

**REFERENCE BOOKS:**

1. Marianne Bradford "Modern ERP", 3<sup>rd</sup> edition.
2. "ERP making it happen Thomas f. Wallace and Michael
3. Directing the ERP Implementation Michael w pelphrey

**(19A52602e) SUPPLY CHAIN MANAGEMENT**

**Course Objectives :**

The objectives of this course are

- To provide Knowledge on logistics and supply chain management
- To enable them in designing the distribution network
- To train the students in knowing the supply chain Analysis
- Impart knowledge on Dimensions of logistic
- To know the recent trends in supply chain management

**Syllabus**

**UNIT-1**

**Introduction to Supply Chain Management**

Supply chain - objectives - importance - decision phases - process view -competitive and supply chain strategies - achieving strategic fit – supply chain drivers - obstacles – framework - facilities -inventory-transportation-information-sourcing-pricing.

**Learning Outcomes:-**

After completion of this unit student will

- Understand the meaning and objectives of supply chain management
- Explain supply chain drivers
- Know the steps involved in SCM frame work
- Understand transportation information and pricing

**UNIT-2**

**Designing the distribution network**

Role of distribution - factors influencing distribution - design options - e-business and its impact – distribution networks in practice –network design in the supply chain - role of network -factors affecting the network design decisions modeling for supply chain. Role of transportation - modes and their performance – transportation infrastructure and policies - design options and their trade-offs tailored transportation.

**Learning Outcomes:-**

After completion of this unit student will

- Understand the different distribution network
- Explain the factors influencing network design in the supply chain



- Know the Role of transportation
- Analyze design options and their trade-offs

### **UNIT-3**

#### **Supply Chain Analysis.**

Sourcing - In-house or Outsource - 3rd and 4th PLs - supplier scoring and assessment, selection - design collaboration - Procurement process - Sourcing planning and analysis. Pricing and revenue management for multiple customers, perishable products, seasonal demand, bulk and spot contracts.

#### **Learning Outcomes:-**

After completion of this unit student will

- Understand the concept of supply chain Analysis
- Explain design collaboration
- Know procurement process -sourcing planning and analysis
- Understand seasonal demand, bulk and spot contracts

### **UNIT-4**

#### **Dimensions of Logistics**

A macro and micro dimension - logistics interfaces with other areas - approach to analyzing logistics systems - logistics and systems analysis - techniques of logistics system analysis - factors affecting the cost and importance of logistics. Demand Management and Customer Service Outbound to customer logistics systems - Demand Management –Traditional Forecasting - CPFRP - customer service - expected cost of stock outs - channels of distribution.

#### **Learning Outcomes:-**

After completion of this unit student will

- Understand dimensions of logistics
- Explain logistics interfaces with other areas
- Know techniques of logistics system analysis
- Understand Demand Management

### **UNIT-5**

**Recent Trends in Supply Chain Management**-Introduction, New Developments in Supply Chain Management, Outsourcing Supply Chain Operations, Co-Maker ship, The Role of E-Commerce in Supply Chain Management, Green Supply Chain Management, Distribution Resource Planning, World Class Supply Chain Management

#### **Learning Outcomes:-**

After completion of this unit student will

- Understand the recent trend in supply chain management
- Explain The Role of E-Commerce in Supply Management
- Know Green Supply Chain Management
- Understand Distribution Resource Planning

### **Course Outcomes:**

At the end of the course, students will be able to

- Understand the strategic role of logistic and supply chain management in the cost reduction and offering best service to the customer
- Understand Advantages of SCM in business
- Apply the knowledge of supply chain Analysis
- Analyze reengineered business processes for successful SCM implementation
- Evaluate Recent trend in supply chain management

### **TEXT BOOKS:**

1. Sunil Chopra and Peter Meindl, Supply Chain Management – “Strategy, Planning and Operation”, 3<sup>rd</sup> Edition, Pearson/PHI, 2007.
2. Supply Chain Management by Janat Shah Pearson Publication 2008.

### **REFERENCE BOOKS:**

1. A Logistic approach to Supply Chain Management – Coyle, Bardi, Longley, Cengage Learning, 1/e
2. Donald J Bowersox, Dand J Closs, M Bixby Coluper, “Supply Chain Logistics Management”, 2<sup>nd</sup> edition, TMH, 2008.
3. Wisner, Keong Leong and Keah-Choon Tan, “Principles of Supply Chain Management A Balanced Approach”, Cengage Learning, 1/e
4. David Simchi-Levi et al, “Designing and Managing the Supply Chain” – Concepts

**(19A03503P) HEAT TRANSFER LAB**

**Course Objectives:**

Students undergoing this course would

- Understand different modes of heat transfer
- Gain knowledge about natural and force convection phenomenon
- Estimate experimental uncertainty in measurements

**LIST OF EXPERIMENTS**

1. Determine the overall heat transfer coefficient across the width of composite wall
2. Determine the thermal conductivity of a metal rod
3. Determine the thermal conductivity of insulating powder material through concentric sphere apparatus
4. Determine the thermal conductivity of insulating material through lagged pipe apparatus
5. Determine the efficiency of a pin fin in natural and forced convection.
6. Determine the heat transfer coefficient for a vertical cylinder in natural convection
7. Determine the heat transfer coefficient in forced convection of air in a horizontal tube.
8. Determine the heat transfer coefficients on film and drop wise condensation apparatus.
9. Determine the effectiveness of a parallel and counter flow heat exchanger.
10. Study the pool boiling phenomenon and different regimes of pool boiling.
11. Experiment on pool boiling
12. Determine the emissivity of the test plate surface.
13. Experiment on Stefan-Boltzmann apparatus
14. Determine the heat transfer rate coefficient in fluidized bed apparatus

**Course Outcomes**

Upon the successful completion of course, students will be able to

- Explain different modes of heat transfer
- Identify parameters for measurement for calculating heat transfer
- Determine effectiveness of heat exchanger
- Design new equipment related to heat transfer
- Apply principles of heat transfer in wide application in industries.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– III-II Sem**

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**(19A52601P) ENGLISH LANGUAGE SKILLS LAB**

**Course Objectives**

- students will be exposed to a variety of self instructional, learner friendly modes of language learning
- students will cultivate the habit of reading passages from the computer monitor. Thus providing them with the required facility to face computer based competitive exams like GRE, TOEFL, and GMAT etc.
- students will learn better pronunciation through stress, intonation and rhythm
- students will be trained to use language effectively to face interviews, group discussions, public speaking
- students will be initiated into greater use of the computer in resume preparation, report writing, format making etc

**UNIT I**

1. Phonetics for listening comprehension of various accents - 2
2. Formal Presentations using PPT slides without Graphic Elements
3. Paraphrasing

**Learning Outcomes**

At the end of the module, the learners will be able to

- Understand different accents spoken by native speakers of English
- Make formal structured presentations on general topics using PPT slides without graphical elements
- Paraphrase short academic texts using suitable strategies and conventions

**UNIT II**

1. Debate – 2 (Following Argument)
2. Listening to short speeches/ short stories for note-making and summarizing
3. E-mail Writing

**Learning Outcomes**

At the end of the module, the learners will be able to

- Participate in formal discussions and speak clearly on a specific topic using suitable discourse markers
- Make formal structured presentations on academic topics using ppt slides with relevant graphical elements
- Write formal emails in the standard format

### **UNIT III**

1. Listening for Discussions
2. Group Discussions
3. Writing Persuasive/argumentative essays on general topics

#### **Learning Outcomes**

At the end of the module, the learners will be able to

- Follow a discussion to identify the salient points
- Participate in group discussions using appropriate conventions and language strategies
- Produce logically coherent persuasive/argumentative essays

### **UNIT IV**

1. Reviewing film/ book
2. Group Discussions – reaching consensus in Group Work
3. Resume Writing – Cover Letter – Applying for Internship

#### **Learning Outcomes**

At the end of the module, the learners will be able to

- Judge a film or book
- Express thoughts and ideas with acceptable accuracy and fluency with a view to reach consensus in group discussions
- Prepare a CV and write a cover letter to seek internship/ job

### **UNIT V**

1. Writing Project Reports
2. Editing Short Texts
3. Answering FAQs in Interviews

#### **Learning Outcomes**

At the end of the module, the learners will be able to

- Collaborate with a partner to make effective presentations
- Understand the structure and produce an effective project report.
- Edit short texts according to different needs of the work place.

#### **Course Outcomes**

- Remember and understand the different aspects of the English language proficiency with emphasis on LSRW skills
- Apply communication skills through various language learning activities
- Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
- Evaluate and exhibit acceptable etiquette essential in social and professional settings
- Create awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.

### **SUGGESTED SOFTWARE:**

1. Walden Infotech English Language Communication Skills.
2. iTell- Orell Digital Language Lab
3. Digital Teacher
4. LES(Learn English Select) by British council
5. TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
6. DELTA's key to the Next Generation TOEFL Test: Advanced Skills Practice.
7. Lingua TOEFL CBT Insider, by Dreamtech
8. English Pronunciation in Use (Elementary, Intermediate, Advanced) CUP
9. Cambridge Advanced Learners' English Dictionary with CD.

### **REFERENCE BOOKS:**

The software consisting of the prescribed topics elaborated above should be procured and used.

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communication" O U Press 2009.
2. Barron's Books on TOEFL/GRE/GMAT/CAT/IELTS /DELTA/Cambridge University Press.2012.
3. Butterfield Jeff, "Soft Skills for Everyone", Cengage Publications, 2011.
4. "Practice Psychometric Tests": How to familiarize yourself with genuine recruitment tests, 2012.
5. David A McMurrey & Joanne Buckely "Handbook for Technical Writing" CENGAGE Learning 2008.
6. "A Textbook of English Phonetics for Indian Students", 2<sup>nd</sup> Edition, T.Balasubramanyam. (Macmillan), 2012.
7. "A Handbook for English Laboratories", E. Suresh Kumar, P. Sreehari, Foundation Books, 2011

Note: Links provided by APSHE on LSRW, grammar and vocabulary

**(19A99601) MANDATORY COURSE: RESEARCH METHODOLOGY**

**Course Objectives :**

The objective of this course is

- To understand the basic concepts of research and research problem
- To make the students learn about various types of data collection and sampling design
- To enable them to know the method of statistical evaluation
- To make the students understand various testing tools in research
- To make the student learn how to write a research report
- To create awareness on ethical issues in research

**Syllabus**

**UNIT I**

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – Research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

**Learning Outcomes:-**

After completion of this unit student will

- Understand the concept of research and its process
- Explain various types of research
- Know the steps involved in research design
- Understand the different research approaches

**UNIT II**

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design. Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation. Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

**Learning Outcomes:-**

After completion of this unit student will

- Understand the concept of sampling and sampling design
- Explain various techniques in measurement and scaling

- Learn various methods of data collection
- Design survey questionnaires for different kinds of research
- Analyze the questionnaires

### **UNIT III**

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

#### **Learning Outcomes:-**

After completion of this unit student will

- Know the association of two variables
- Understand the importance of correlation and regression
- Compare and contrast correlation and regression
- Learn various types of correlation
- Apply the knowledge of C&R Analysis to get the results

### **UNIT IV**

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multivariate Analysis

#### **Learning Outcomes:-**

After completion of this unit student will

- Know the statistical inference
- Understand the hypothesis testing procedure
- Compare and contrast Parametric and Non-parametric Tests
- Understand the use of chi-square test in investigating the distribution of categorical variables
- Analyze the significance of variance and covariance

### **UNIT V**

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

#### **Learning Outcomes:-**

After completion of this unit student will

- Learn about report writing
- Understand how to write research paper
- Explain various techniques of interpretation



- Understand the importance of professional ethics in research
- Design a scientific paper to present in the conferences/seminars

### **Course Outcomes:**

At the end of the course, students will be able to

- Understand basic concepts and its methodologies
- Demonstrate the knowledge of research processes
  
- Read, comprehend and explain research articles in their academic discipline
  
- Analyze various types of testing tools used in research
- Design a research paper without any ethical issues

### **Text books:**

1. C.R.Kothari, “Research Methodology:Methods and Techniques”,2<sup>nd</sup> edition, New Age International Publishers.
2. A Step by Step Guide for Beginners, “Research Methodology”: Ranjit Kumar, Sage Publications

### **REFERENCES:**

1. P.Narayana Reddy and G.V.R.K.Acharyulu, “Research Methodology and Statistical Tools”, 1<sup>st</sup> Edition, Excel Books,New Delhi.
2. Donald R. “Business Research Methods”, Cooper & Pamela S Schindler, 9<sup>th</sup> edition.
3. S C Gupta, “Fundamentals of Statistics”, 7<sup>th</sup> edition Himalaya Publications

**Course Objectives:**

- To impart the basic concepts of modeling, models and statements of the operations research.
- Formulate and solve linear programming problem/situations.
- Model strategic behaviour in different economic situations.
- To solve transportation problems to minimize cost.
- Apply Queuing theory to solve problems of traffic congestion, counters in banks, railway bookings etc.
- Explain scheduling and sequencing of production runs and develop proper replacement policies.

**UNIT I**

**Introduction to Operations Research (OR):** OR definition - Classification of Models, modeling – Methods of solving OR Models, limitations and applications of OR models

**Linear Programming(LP):** Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Two–Phase Simplex Method, Special Cases of LP- Degeneracy, Infeasibility and Multiple Optimal Solutions; Concept of dual theorem

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Formulate practical problems given in words into a mathematical model. (16)
- Quantify or models to solve optimization problems. (15)
- Formulate linear programming problems and appreciate their limitations. (16)

**UNIT II**

**Transportation and Assignment Problems:**Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution –North West Corner Rule, Least Cost Method, Vogel's Approximation Method; Optimality Method – Modified Distribution (MODI) Method; Special Cases – Unbalanced Transportation Problem, Degenerate Problem. Assignment Problem – Formulation, Hungarian Method for Solving Assignment Problems, Traveling Salesman problem.

**Learning Outcomes:**

At the end of the this unit, the student will be able to

- Model linear programming problems like the transportation. (13)
- Solve the problems of transportation from origins to destinations with minimum time and cost. (16)

### UNIT III

**Game theory:** Optimal solution of two person zero sum games, the max min and min max principle. Games without saddle points, mixed strategies. Reduction by principles of dominance, arithmetic, algebraic method and graphical method.

**Sequencing:** Introduction to Job shop Scheduling and flow shop scheduling, Solution of Sequencing Problem, Processing of n Jobs through two machines, Processing of n Jobs through m machines, graphical method.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Identify strategic situations and represent them as games. (13)
- Solve simple games using various techniques. (16)
- Solve problems of production scheduling and develop inventory policies. (16)

### UNIT IV

**Queuing Theory:** Introduction – Terminology, Arrival Pattern, Service Channel, Population, Departure Pattern, Queue Discipline, Birth & Death Process, Single Channel Models with Poisson Arrivals, Exponential Service Times with finite queue length and non-finite queue length; Multichannel Models with Poisson Arrivals, Exponential Service Times with finite queue length and non finite queue length.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Model a dynamic system as a queuing model to compute performance measures. (13)
- Apply optimality conditions for single- and multiple-variable constrained and unconstrained nonlinear optimization problems. (13)

### UNIT V

**Replacement and Maintenance Analysis:** Introduction – Types of Maintenance, Make or buy decision. Types of Replacement Problems, Determination of Economic Life of an Asset, and Simple Probabilistic Model for Items which completely fail-Individual Replacement Model, Group Replacement Model.

**Dynamic Programming (DP):** Introduction –Bellman’s Principle of Optimality – Applications of Dynamic Programming – Capital Budgeting Problem – Shortest Path Problem – Solution of Linear Programming Problem by DP.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Solve problems using dynamic programming. (13)
- Apply the concept of replacement model. (13)

**Course Outcomes:**

At the end of the course, the student will be able to

- Develop mathematical models for practical problems. (13)
- Apply linear programming to transportation problems. (13)
- Solve games using various techniques. (13)
- Solve production scheduling and develop inventory policies. (16)
- Apply optimality conditions for constrained and unconstrained nonlinear problems. (13)
- apply dynamic programming methods. (L3)

**Text books:**

1. Sharma S.D., “Operations Research: Theory, Methods and Applications”, 15<sup>th</sup> Edition, Kedar Nath Ram Nath, 2010
2. Taha H.A., “Operations Research”, 9<sup>th</sup> Edition, Prentice Hall of India, New Delhi, 2010.

**Reference books:**

1. Hiller F.S., and Liberman G.J., “Introduction to Operations Research”, 7<sup>th</sup> Edition, Tata McGraw Hill, 2010.
2. Sharma J.K., :Operations Research: Theory and Applications”, 4<sup>th</sup> Edition, Laxmi Publications, 2009.
3. Prem kumar Gupta and Hira, “Operations Research”, 3<sup>rd</sup> Edition, S Chand Company Ltd., New Delhi, 2003.
4. Pannerselvam R., “Operations Research”, 2<sup>nd</sup> Edition, Pentice Hall of India, New Delhi, 2006.
5. Sundaresan.V, and Ganapathy Subramanian.K.S, “Resource Management Techniques: Operations Research”, A.R Publications, 2015.

**Web References:**

- <http://www2.informs.org/Resources/>
- <http://www.mit.edu/~orc/>
- <http://www.ieor.columbia.edu/>
- <http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm>
- <http://www.wolfram.com/solutions/OperationsResearch/>
- <http://nptel.iitm.ac.in/video.php?subjectId=112106134>
- [http://www.youtube.com/watch?feature=player\\_detailpage&v=ug7O1ISZyg0](http://www.youtube.com/watch?feature=player_detailpage&v=ug7O1ISZyg0)
- <http://www2.ensc.sfu.ca/undergrad/courses/ENSC201/Unit09/lecture9.html>
- <http://pakaccountants.com/what-is-depreciated-replacement-cost/>
- [http://www.youtube.com/watch?feature=player\\_detailpage&v=H58TPQNr2kM](http://www.youtube.com/watch?feature=player_detailpage&v=H58TPQNr2kM)
- [http://www.youtube.com/watch?feature=player\\_detailpage&v=h0bdo06qNVw](http://www.youtube.com/watch?feature=player_detailpage&v=h0bdo06qNVw)
- [http://www.youtube.com/watch?feature=player\\_detailpage&v=xGkpXk-AnWU#t=104s](http://www.youtube.com/watch?feature=player_detailpage&v=xGkpXk-AnWU#t=104s)
- [http://nptel.iitm.ac.in/video.php?subjectId=112106134,](http://nptel.iitm.ac.in/video.php?subjectId=112106134)
- [http://www. Math.harvard.edu/archive/20\\_spring\\_05/handouts](http://www.Math.harvard.edu/archive/20_spring_05/handouts)

(19A03702T) METROLOGY AND MEASUREMENTS

Course Objectives:

- Introduce the basic concepts of metrology and measurement methods.
- Demonstrate the importance of metrology in manufacturing
- Explain the concepts of transducers and its practical applications.
- Expose with various measuring instruments
- Familiarize calibration methods of various measuring instruments.

UNIT I

10 hrs

**Concept of Measurement:** General concept-generalized measurement system, units and standards, measuring instruments, sensitivity, readability, range of accuracy, precision, static and dynamic response, repeatability, systematic and random errors, correction, calibration, terminology and limits fits and tolerances, hole basis and shaft basis system, interchangeability.

**Linear and Angular Measurement:** Linear measuring instruments: Vernier instruments, micrometers, slip gauges, tool makers microscope. Comparators: Mechanical, pneumatic and electrical. Angular measurements: Sine bar, bevel protractor and angle dekkor, rollers and spheres used to determine the tapers.

Learning Outcomes:

At the end of this unit the student will be able to

- Identify important parameters in metrology. (13).
- Differentiate interchangeability and selective assembly. (14).
- Select limits and tolerances for different assemblies. (11)
- Explain the principles of measurement of various comparators. (12).
- Discuss about the principles of slip gauges, micrometers and vernier height gauges. (12)

UNIT II

8 hrs

**Flatness Measurement:** Measurement of flatness – straight edges – surface plates, optical flat and autocollimators, interferometers and their applications.

**Surface Roughness Measurement:** Terminology systems, differences between surface roughness and surface waviness- Numerical assessment of surface finish - CLA, R,M,S Values- Ra , Rz values, Methods of measurement of surface finish-profilograph, talysurf, BIS symbols for indication of surface roughness, classification of automatic inspections systems, co-ordinate- measuring machines, non-contact inspection techniques-machine vision, laser scanning systems.

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Inspect the flatness of surfaces. (14)
- Recall the terms used in surface roughness measurement. (11)
- Explain the factors affecting the surface finish in machining. (12)
- Demonstrate the application of different surface measuring instruments. (12)

### **UNIT III**

**8 hrs**

Metrology of Screw Threads:

Screw thread measurements: Elements of threads, errors in screw threads, various methods for measuring external and internal screw threads, screw thread gauges.

Gear Measurement: Gear tooth terminology, measurement of gear elements-runout, lead, pitch backlash, profile, pressure angle, tooth thickness, diameter of gear, constant chord and base tangent method.

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Identify the errors in screw threads. (13)
- Explain the principles of gear measuring instruments. (12)
- Select the tools and methods for measuring screw thread, gear profiles. (11)

### **UNIT IV**

**8**

**hrs**

**Measurement of Displacement:** Theory and construction of various transducers to measure displacement - Piezo electric, inductive, capacitance, resistance, ionization and photoelectric transducers, calibration procedures.

**Measurement of Speed:** Mechanical tachometers - Electrical tachometers - Stroboscope, Noncontact type of tachometer.

**Measurements of Strain:** Various types of electrical strain gauges, gauge factor, method of usage of resistance strain gauge for bending, compressive and tensile strains, usage for measuring torque, strain gauge rosettes.

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- List various types of transducers used for the measurement of displacement and speed. (L1)

- Explain the static and dynamic characteristics of transducers. (L3)
- Classify the transducers with respect to change in resistance, capacitance and inductance. (L4)
- experiment with measurement of strain (L3)

## UNIT V

8

hrs

**Measurement of Force:** Direct method - analytical balance, platform balance; elastic members – load cells, cantilever beams and proving rings.

**Measurement of Torque:** Torsion bar dynamometer, servo controlled dynamometer and absorption dynamometer.

**Measurement of Temperature:** Standards and calibration, thermal expansion methods, thermo electric sensors (thermocouples), Electrical Resistance sensors, Junction semiconductor sensors, Digital thermometers, Radiation methods.

**Measurement of Pressure and Sound:** Standards and calibration, basic methods of pressure measurement, dead weight gauges and manometers, Elastic transducers, vibrating cylinder, resonant transducers, High and low pressure measurement.

### Learning Outcomes:

At the end of this unit, the student will be able to

- Identify various types of transducers used for the measurement of force, torque, temperature, pressure and sound. (L3)
- Explain methods of measurement of force, torque, temperature, pressure and sound. (L2)
- Develop the techniques for calibration of force, torque, temperature, pressure and sound measuring devices. (L3)

### Course Outcomes:

- List various measuring instruments used in metrology. (L4)
- Examine geometry of screw threads and gear profiles. (L4)
- Measure force, torque, temperature, pressure and sound. (L5)
- Calibrate various measuring instruments. (L4)

### Textbooks:

1. Thomas G.Beckwith, Marangoni, Linehard, “Mechanical Measurements”, 6<sup>th</sup> edition,



- PHI, 2013.
2. R.K. Jain, “Engineering Metrology”, 20<sup>th</sup> edition, Khanna Publishers, 2013.

**Reference Books:**

1. Mahajan, “Engineering Metrology”, 2<sup>nd</sup> edition, Dhanpat Rai, 2013.
2. S.Bhaskar, Basic Principles - Measurements and Control Systems, Anuradha Publications, 2014.
3. Anand K Bewoor & Vinay A Kulkarni, “Metrology & Measurement”, 15<sup>th</sup> edition, McGrawHill, 2015

(19A03703a) AUTOMOTIVE TRANSMISSION SYSTEM  
PROFESSIONAL ELECTIVE - III

**Course Objectives:**

- Explain operation and performance of various clutches and gear boxes.
- Familiarize hydrodynamic drives.
- Teach various types of gear boxes used for automotive transmission
- Impart principle of operation and performance of various hydrostatic and electric drives provide.
- Identify the applications of automatic transmission

**UNIT – I**

**Clutch & gear box:** Requirements of transmission system and role of clutch in driving system, Types of Clutches, Construction and Working of Single Plate, Multi Plate, Cone Clutch, Centrifugal and Semi Centrifugal clutch and its operating characteristics, Equation for torque capacity of a single plate clutch. Need for a gear box in an automobile and types of Gear boxes – Construction and working of Sliding mesh, Constant mesh gear box, Synchromesh gear box and principle of synchronizers.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Identify the requirements of transmission system (L2)
- Recognize the role of clutch in driving system (L1)
- List various types of clutches. (L1)
- Explain the need of gear box in an automobile (L2)
- Discuss the construction and working principles of gear boxes (L3)

**UNIT II:**

**Gear trains:** Construction and working Principle of Epi-cyclic gear train, Planetary gear box, Ford T Model gear box, Wilson gear box, Cotal electromagnetic transmission and Automatic over drive. Gear ratios for Wilson gear box and Automatic Over drive. Hydraulic control system for Automatic transmission.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Illustrate working of epic cyclic and planetary gear boxes. (I2)
- Explain electromagnetic transmission.(I2)

- Demonstrate hydraulic control system for automatic transmission. (12)

### UNIT – III

**Hydrostatic drives:** Introduction to hydrostatic drives, Working principle, types, Advantages and limitations of Hydrostatic drives, Comparison of hydrostatic drive with hydro dynamic drive, Construction and working of Janny Hydrostatic drive.

**Hydrodynamic and hydrokinetic drives:** Introduction to fluid coupling, Fluid coupling – Construction, Principle of operation and Performance characteristics, Drag torque and various drag reducing devices of fluid coupling, Problems on design and torque capacity of fluid coupling, Construction and working of Torque converter, converter coupling, Multistage torque converter, and Poly phase torque converter - Performance characteristic of multistage and poly phase torque converters.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Explain hydrostatic drives. (12)
- Differentiate hydrostatic and hydrodynamic drives. (12)
- Summarize construction and working of janny hydrostatic drive. (12)
- Give the advantages and limitations of hydrostatic drives.
- Solve the problems on fluid coupling and will be able to predict the torque capacity.

### UNIT IV:

**Automatic transmission:** Layout of Automatic transmission system, construction and working of Turbo glide transmission, Power glide transmission, ECT- intelligent transmission , Automatic transmission with intelligent electronic control systems, Hydraulic clutch actuation for Automatic transmission.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Draw layout of automatic transmission system. (13)
- Compare construction and working different types of transmission. (14)
- Explain the working of turbo glide transmission and power glide transmission(13)
- Identify the importance of intelligent electronic control systems in automatic transmission.(12)
- Demonstrate hydraulic clutch activation for automatic transmission. (12)

### UNIT V:

**ELECTRIC DRIVES:** Introduction to Electric drive: Layout Advantages, limitations and performance characteristics of Electric drive, Principle of Early Ward Leonard control system of electric drive. Principle of Modified Ward Leonard control system of electric drive.

**Course Outcomes:**

At the end of this course, the student will be able to

- Understand the working principles of clutches and gearboxes
- Analyze the working of planetary gear box systems.
- Identify the differences between the hydrostatic and hydrodynamic drives.
- Discuss various types of automatic transmission systems
- Design the automatic transmission system.

**Text books**

1. Harald Naunheimer , Bernd Bertsche , Joachim Ryborz , Wolfgang Novak "Automotive Transmission: Fundamentals, Selection, Design and Application", 2nd Edition, Springer, 2011.

**Reference books**

1. Heldt P.M, "Torque converters", Chilton Book Co., 1992.
2. Newton Steeds & Garrot, "Motor Vehicles", SAE International and Butterworth Heinemann, 2001.
3. CDX Automotive, "Fundamentals of Automotive Technology, Principles and practice", Jones & Barlett Publishers, 2013.
4. SAE Transactions 900550 & 930910.
5. Crouse W.H, Anglin D.L, "Automotive Transmission and Power Train construction", McGraw Hill, 1976.

**(19A03703b) SIMULATION AND MODELLING OF MANUFACTURING SYSTEMS  
PROFESSIONAL ELECTIVE - III**

**Course Objectives:**

- Explain the concept of modeling and simulation of manufacturing systems.
- Familiarize manufacturing simulation languages.
- Describe the various approaches to analyze the output data.
- Impart knowledge applications of simulation.
- Expose the students G P S S, SIMAN and SIMSCRIPT.

**UNIT – I**

System – ways to analyze the system – Model – types of models – Simulation – Definition – Types of simulation models – steps involved in simulation – Advantages & Disadvantages. Parameter estimation – estimator – properties – estimate – point estimate – confidence interval estimates – independent – dependent – hypothesis – types of hypothesis- steps – types 1& 2 errors – Framing – strong law of large numbers.

**Learning Outcomes:**

At the end of this Unit the student will be able to

- Implement various steps involved in simulation process.(15)
- Illustrate the advantages and disadvantages of simulation process.(12)
- List the various types of hypothesis. (11).
- Apply simulation models to manufacturing systems. (12)

**UNIT – II**

Building of Simulation model – validation – verification – credibility – their timing – principles of valid simulation Modeling – Techniques for verification – statistical procedures for developing credible model. Modeling of stochastic input elements – importance – various procedures – theoretical distribution – continuous – discrete – their suitability in modeling.

**Learning Outcomes:**

At the end of this Unit the student will be able to

- Build the simulation model for manufacturing systems. (16)
- Apply statistical procedures for developing credible model.(12)
- Describe modeling of stochastic input elements.(12)

- Appraise the importance of stochastic input elements. ((15)
- Illustrate the principles of valid simulation modeling. (12)

### **UNIT – III**

Generation of random variates – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables – exponential – uniform – weibull – normal Bernoullie – Binomial – uniform – poisson. Simulation languages – comparison of simulation languages with general purpose languages – Simulation languages vs Simulators – software features – statistical capabilities – G P S S – SIMAN- SIMSCRIPT –Simulation of M/M/1 queue – comparison of simulation languages.

#### **Learning Outcomes:**

At the end of this Unit the student will be able to

- List the various factors for selection of random variates.(11)
- Explain how random variables can be generate. (12)
- Compare various simulation languages used for generation of random varients.(12)
- Select appropriate simulation software's like., gpss, siman-simscript etc.,(13)

### **UNIT – IV**

Output data analysis – Types of Simulation w.r.t output data analysis – warmup period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons

#### **Learning Outcomes:**

At the end of this Unit the student will be able to

- Analyze the output data in manufacturing system.(14)
- Illustrate the types of simulation w.r.t output data analysis.(12)
- List the approaches for steady of output data.(11)
- Explain Welch algorithm for analyze the output data. (L2)

### **UNIT –V**

Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinite and finite capacities – Simple fixed period inventory system – Newboy paper problem.

#### **Learning Outcomes:**

At the end of this Unit the student will be able to

- Illustrate the applications of simulation in manufacturing systems. (12)
- Explain simple fixed period inventory system. (12)
- Describe flow shop and job shop systems. (12)
- Solve the manufacturing problems using newboy paper method. (13)

**Course outcomes:**

After successful completion of the course, the student will be able to

- Summarizes the various approaches to modelling and simulation of manufacturing systems. (12)
- Outline the concepts of output data analysis.(12)
- Identify various software languages for simulation of manufacturing systems.(13)

**TEXT BOOKS:**

1. Banks J. & Carson J.S., PH, “Discrete Event System Simulation”, Englewood Cliffs, NJ, 1984
2. Law, A.M. & Kelton, “Simulation Modelling and Analysis”, McGraw Hill, 2nd Edition, New York, 1991.
3. Narahari and M. Vishwanathan Prentice hall England wood Cliffs, “Performance modelling of automated manufacturing systems”. NJ USA 1992.

**REFERENCES:**

1. Carrie A. / Wiley, NY, “Simulation of Manufacturing Systems”, 1990.
2. Ross, S.M., McMillan, NY, “A Course in Simulation”, 1990. Simulation Modelling and SIMNET / Taha H.A / PH, Englewood Cliffs, NJ, 1987.

(19A03703c) **MECHANICAL BEHAVIOUR OF MATERIALS**  
**PROFESSIONAL ELECTIVE - III**

**Course objectives:**

The objectives of the course are to

- Explain the structure of material over the effects of mechanical properties.
- Familiarize the defects inside the structure and their effects on the mechanical properties.
- Train the methods for characterization of the mechanical behavior of materials.
- Impart knowledge about strengthening mechanisms of materials.
- Teach mechanisms of failures of materials (fracture, fatigue and creep) and their relationship with the different types of stress.

**UNIT – I**

**Elastic and plastic behavior:** Elastic behavior of materials – Hooke’s law, plastic behavior: dislocation theory – Burger’s vectors and dislocation loops, dislocations in FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, slip and twinning.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain the elastic behavior of engineering materials.(12)
- Recall Hooke’s law. (11)
- Explain the dislocation theory. (12)
- Identify the dislocations in fcc, hcp and bcc lattice (13)
- Determine the forces on and between dislocations.(13)

**UNIT – II**

**Strengthening mechanisms:** Cold Working, Grain Size Strengthening, Solid Solution Strengthening, Martensitic Strengthening, Precipitation Strengthening, Dispersion Strengthening, Fibre Strengthening, Examples. Yield Point Phenomenon, Strain aging and Dynamic strain aging.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Describe various strengthening mechanisms.(12)



- Discuss grain size strengthening and solid solution strengthening.(16)
- Apply dispersion strengthening and fibre strengthening.(12)
- Differentiate strain aging and dynamic strain aging.(13)

### UNIT – III

**Fracture and fracture mechanics:** Types of Fracture, Basic Mechanism of Ductile and Brittle Fracture, Griffith's Theory of Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT), Factors Affecting DBTT, Determination of DBTT. Fracture Mechanics-Introduction, Modes of Fracture, Stress Intensity Factor, Strain Energy Release Rate, Fracture Toughness and Determination of  $K_{IC}$ .

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the basic mechanism of ductile and brittle fracture. (12)
- Identify importance of Griffith's theory.(13)
- Predict factors affecting on DBTT.(16)
- Classify various modes of fracture.(11)

### UNIT - IV

**Fatigue behaviour and testing:** Stress Cycles, S-N Curves, Effect of Mean Stress, Factors Affecting Fatigue, Structural Changes Accompanying Fatigue, Cumulative Damage, HCF / LCF, Thermo-mechanical Fatigue, Application of Fracture Mechanics to Fatigue Crack Propagation-Paris law- Fatigue Testing Machines.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Explain fatigue behavior and testing. (12)
- Draw the s-n curves for different materials. (11)
- Discuss the factors affecting fatigue. (16)
- Apply fracture mechanics in design. (12)

### UNIT - V

**Creep behavior and testing:** Creep Curve, Stages in Creep Curve and Explanation, Structural Changes during Creep, Creep Mechanisms, Metallurgical Factors Affecting Creep, High Temperature Alloys, Stress Rupture Testing, Creep Testing Machines.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Identify various stages in creep curve.(13)

- Determine various structural changes during creep.(14)
- Predict the metallurgical factors affecting creep.(16)
- Demonstrate various creep testing machines.(12)

**Course outcomes:**

After successful completion of this course, the student will be able to

- Apply materials based on their structure and failure modes.(12)
- Characterize materials using different machines.(13)
- Summarize the various strengthening mechanisms with suitable examples.(12)
- Identify the creep in different materials and its influence in selection of materials.(13)

**Text books:**

1. Dieter, G.E., “Mechanical Metallurgy”, McGraw-Hill, SI Edition, 1995.
2. Davis. H. E., Troxell G.E., Hauck.G. E. W., “The Testing Of Engineering Materials”, McGraw-Hill, 1982.

**References:**

1. Wulff, The Structure and Properties of Materials, Vol. III “Mechanical Behavior of Materials”, John Wiley and Sons, 1983.
2. Honey Combe R. W. K., “Plastic Deformation of Materials”, Edward Arnold Publishers, 1984.
3. Suryanarayana, A. V. K., “Testing of Metallic Materials”, Prentice Hall India, 1979.

(19A03703d) SOLAR AND WIND ENERGY  
PROFESSIONAL ELECTIVE - III

**Course Objectives:**

The main objectives of this course are to make the student

- Familiarize with basics of solar radiation, available solar energy and its measurement.
- Familiarize with solar collectors, construction and operation of solar collectors.
- Understand solar energy conversion systems, applications and power generation.
- Familiarize the wind energy sources assessment
- Explain basics of designing aerofoil

**UNIT – I:**

**Solar radiation and collectors:** Solar angles – Sun path diagrams – Radiation - extra terrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - testing methods-evacuated tubular collectors - concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors.

**Solar thermal technologies:** Principle of working, types, design and operation of - Solar heating and cooling systems - Thermal Energy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond – Solar drying.

**Learning Outcomes:**

At the end of this course, the student will be able to

- Explain the basic concepts of solar radiation and solar collectors (L2)
- Develop sun path diagrams (L3)
- Explain the concepts of tracking systems (L2)
- Discuss the working principles of solar thermal technologies (L6)
- Develop design and operation of solar heating and cooling systems (L3)
- Explain the principles of thermal storage systems (L2)

**UNIT – II**

**Solar PV fundamentals:** Semiconductor – properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetro junctions - metal-semiconductor interface - dark and illumination characteristics - figure of merits of solar cell -

efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells – Solar thermo-photovoltaics.

**SPV system design and applications:** Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - stand alone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

### **Learning Outcomes:**

At the end of this course, the student will be able to

- Explain the properties of a semiconductor (L2)
- Apply the principles of solar thermo photovoltaics (L3)
- Outline the applications of SPV system (L2)
- Analyze the performance of a solar cell array system (L4)
- Utilize centralized and decentralized SPV systems (L3)

## **UNIT III**

**Introduction:** Historical Perspectives on Wind Turbines- Indian Energy Scenario - Global Energy Scenario - Introduction to Indian Wind Industry - Wind Energy potential of India and Global Wind Installations.

**Basics of Wind Resource Assessment:** Power in the wind –Wind Characteristics - Measurement of wind using anemometers (cup anemometer, propeller anemometer, pressure plate anemometer, pressure tube anemometer, sonic anemometer and other remote wind speed sensing techniques) –Turbulence-Wind Power Density –Average wind speed calculation - Statistical models for wind data analysis (Weibull and Rayleigh distribution). Energy estimation of wind regimes – Wind Rose, Wind Monitoring Station Siting and Instrumentation.

### **Learning Outcomes:**

After completion of this unit, students will be able to

- Recall historical perspective of wind turbines(L1)
- Relate Indian and globalenergy requirements(L1)
- Interpret power in the wind (L2)
- Classify different wind speed measuring instruments(L2)
- Apply different statistical models for wind data analysis (L3)

## **UNIT - IV**

**Wind Energy Conversion Systems:** Types - Components of Modern Wind Turbine (HAWT

and VAWT) - Fixed and Variable Speed operations - Power Control (Passive stall, Active pitch, Passive pitch and Active stall) - Electrical aspects of wind turbine, Safety of wind turbines.

### **Learning Outcomes:**

After completion of this unit, students will be able to

- Utilize different wind parameters for design of rotor (L3)
- Make use of power curve for energy estimation (L3)
- List different components of modern wind turbine (L1)
- Explain how to control the power of a wind turbine (L2)
- Name different safety measures of wind turbine (L1)

**Wind Farm Design and Health (Condition) Monitoring:** Planning of wind farm, Site selection, Micro siting, Grid Integration, Power evacuation, Wind Farm Feasibility Studies, Preparation of DPR, Environmental Benefits and Impacts.

**Small Wind Turbines:** Water pumping wind mills, offshore wind energy, Wind turbine testing, future developments.

### **Learning Outcomes:**

After completion of this unit, students will be able to

- Plan the wind farm(L3)
- Analyze the feasibility of wind farm(L4)
- List the environmental benefits and impacts (L1)
- Explain about small wind turbines(L2)

### **Text Book(s)**

1. Goswami D.Y., Kreider, J. F. and Francis., “Principles of Solar Engineering’, Taylor and Francis, 2000.
2. Chetan Singh Solanki, “Solar Photovoltaics – Fundamentals, Technologies and Applications”, PHI Learning Private limited, 2011.
3. Sukhatme S.P.,. Nayak.J.P, ‘Solar Energy – Principle of Thermal Storage and collection”, Tata McGraw Hill, 2008.
4. Sathyajith Mathew, “Wind Energy Fundamentals, Resource Analysis and Economics”, Springer Publications, (2006).
5. Wei Tong, “Wind Power Generation and Wind Turbine Design”, WIT Press, (2010).

### **References:**

1. Farm, and Business, Paul Gipe, “Wind Power, Revised Edition: Renewable Energy for Home”, Chelsea Green Publishing, 2004,.
2. A. R. Jha, “Wind Turbine Technology”, CRC Press, (2010).

**(19A01704a) AIR POLLUTION AND CONTROL**  
**OPEN ELECTIVE-III**

**Course Objectives:**

- To identify the sources of air pollution
- To know the composition and structure of atmosphere
- To know the pollutants dispersion models
- To understand the working of air pollution control equipments
- To identify the sources of noise pollution and their controlling methods

**UNIT I**

Introduction: sources, effects on – ecosystems, characterization of atmospheric pollutants, air pollution episodes of environmental importance. Indoor Air Pollution– sources, effects.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To understand the character of atmospheric pollutants and their effects

**UNIT II**

Meteorology - composition and structure of the atmosphere, wind circulation, solar radiation, lapse rates, atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature Inversions, Wind rose diagram.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Understand the composition and structure and structure of atmosphere
- To understand the maximum mixing depth and windrose diagram

**UNIT III**

General characteristics of stack emissions, plume behaviour, heat island effect. Pollutants dispersion models – description and application of point, line and areal sources. Monitoring of particulate matter and gaseous pollutants –respirable, non-respirable and nano - particulate matter. CO, CO<sub>2</sub>, Hydrocarbons (HC), SOX and NOX, photochemical oxidants.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the general characteristics of stack emissions and their behavior
- To understand the monitoring of particulate matter and gaseous pollutants

**UNIT IV**

Air Pollution Control equipment for particulate matter & gaseous pollutants– gravity settling chambers, centrifugal collectors, wet collectors, fabric filters, electrostatic precipitator (ESP).  
– Adsorption, Absorption, Scrubbers, Condensation and Combustion.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the various air pollution control equipments

**UNIT V**

Noise - sources, measurements, effects and occupational hazards. Standards, Noise mapping, Noise attenuation equations and methods, prediction equations, control measures, Legal aspects of noise.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the noise sources, mapping, prediction equations etc.,

**Course Outcomes:**

Upon the successful completion of this course, the students will be able to:

- Identify the sources of air pollution
- Understand the composition and structure and structure of atmosphere.
- Know about the general characteristics of stack emissions and their behavior
- Know about the general characteristics of stake emission and their behavior
- Know about the noise sources, mapping, prediction equations etc.,



## **REFERENCES:**

1. WarkK ., Warner C.F., and Davis W.T., “Air Pollution - Its Origin and Control”, Harper & Row Publishers, New York.
2. Lee C.C., and Lin S.D., “Handbook of Environmental Engineering Calculations”, McGraw Hill, New York.
3. Perkins H.C., “Air Pollution”, McGraw Hill.
4. Crawford M., “Air Pollution Control Theory”, TATA McGraw Hill.
5. Stern A.C., “Air Pollution”, Vol I, II, III.
6. Seinfeld N.J., “Air Pollution”, McGraw Hill.
7. Stern A.C. Vol. V, “Air Quality Management”.
8. M N Rao and HVN Rao, Air Pollution” Tata McGraw Hill publication

**(19A01704b) BASICS OF CIVIL ENGINEERING**  
**OPEN ELECTIVE-III**

**Course Objectives:**

- To identify the traditional materials that are used for building constructions
- To know the principles of building planning
- To know the causes of dampness in structures and its preventive measures
- To know about the low cost housing techniques
- To know the basic principles of surveying

**UNIT I**

Traditional materials: Stones- Types of stone masonry -Brick-types of brick masonry- lime Cement – Timber – Seasoning of timber - their uses in building works

**Learning Outcomes:**

After completing this Unit, students will be able to

- To understand the characteristics of different building materials.

**UNIT II**

Elements of building planning- basic requirements-orientation-planning for energy efficiency-planning based on utility-other requirements.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To understand the principles of planning in buildings

**UNIT III**

Dampness and its prevention: Causes of dampness- ill effects of dampness-requirements of an ideal material for damp proofing-materials for damp proofing –methods of damp proofing.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the causes of dampness in buildings and its ill effects
- To know about the general characteristics of ideal material for damp proofing

## UNIT IV

Cost effective construction techniques in mass housing schemes: Minimum standards – Approach to cost effective mass housing schemes- cost effective construction techniques.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the various cost effective techniques in mass housing schemes.

## UNIT V

Introduction to Surveying: Object and uses of surveying- Primary divisions in surveying- Fundamental principles of surveying- Classification of surveying-plans and maps-scales-types of graphical scales- units and measurements

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the objects of surveying and its classification.

### **Course Outcomes:**

Upon the successful completion of this course, the students will be able to:

- Identify the traditional building materials that are used in building construction.
- Plan the buildings based on principles of planning.
- Identify the sources of dampness and its ill effects on buildings and its prevention.
- Know the cost effective construction in mass housing schemes.
- Know the importance of surveying in planning of the buildings.

### **Text books:**

1. S.S.Bhavikatti, “Basic civil engineering”, New age international publishers.
2. S.S.Bhavikatti, “Building Construction:”, Vikas Publishing house, New Delhi.
3. G.C.Sahu and Joygopal jena, “Building materials and Construction”, McGraw Hill Education.

### **Reference books:**

1. N.Subramanian, “Building Materials testing and sustainability”, Oxford university press.

**(19A02704a) RENEWABLE ENERGY SYSTEMS**

**OPEN ELECTIVE-III**

**Course Objectives:**

At the end of the course the student will be able to

- Identify various sources of Energy and the need of Renewable Energy Systems.
- Understand the concepts of Solar Radiation, Wind energy and its applications.
- Distinguish between solar thermal and solar PV systems
- Interpret the concept of geo thermal energy and its applications.
- Understand the use of biomass energy and the concept of Ocean energy and fuel cells.

**UNIT -I**

**Solar Energy**

Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.

**Learning Outcomes:**

At the end of the course the student will be able to

- To understand about solar thermal parameters
- To distinguish between flat plate and concentrated solar collectors
- To know about thermal storage requirements
- To know about measurement of solar radiation

**UNIT – II**

**PV Energy Systems**

Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Electrical characteristics of silicon PV cells and modules, PV systems for remote power, Grid connected PV systems.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Understand the concept of PV effect in crystalline silicon and their characteristics
- Understand other PV technologies
- To know about electrical characteristics of PV cells & modules
- To know about grid connected PV systems

## UNIT - III

### Wind Energy

Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.

#### Learning Outcomes:

After completing this Unit, students will be able to

- To understand basics of wind energy conversion and system
- To distinguish between VAWT and HAWT systems
- To understand about design considerations
- To know about site selection considerations of WECS

## UNIT - IV

### Geothermal Energy

Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

#### Learning Outcomes:

After completing this Unit, students will be able to

- Understand the Geothermal energy and its mechanism of production and its applications
- Analyze the concept of producing Geothermal energies
- To learn about disadvantages and advantages of Geo Thermal Energy Systems
- To know about various applications of GTES

## UNIT -V

### Miscellaneous Energy Technologies

**Ocean Energy:** Tidal Energy-Principle of working, performance and limitations. Wave Energy-Principle of working, performance and limitations.

**Bio mass Energy:** Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration

**Fuel cell:** Principle of working of various types of fuel cells and their working, performance and limitations.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Analyze the operation of tidal energy
- Analyze the operation of wave energy
- Analyze the operation of bio mass energy
- Understand the principle, working and performance of fuel cell technology
- Apply these technologies to generate power for usage at remote centres

**Course Outcomes:**

Upon the successful completion of this course, the students will be able to:

- To distinguish between various alternate sources of energy for different suitable application requirements
- To differentiate between solar thermal and PV system energy generation strategies
- To understand about wind energy system
- To get exposed to the basics of Geo Thermal Energy Systems
- To know about various diversified energy scenarios of ocean, biomass and fuel cells

**Text Books:**

1. Stephen Peake, “Renewable Energy Power for a Sustainable Future”, Oxford International Edition, 2018.
2. G. D. Rai, “Non-Conventional Energy Sources”, 4<sup>th</sup> Edition, Khanna Publishers, 2000.

**References:**

1. S. P. Sukhatme, “Solar Energy”, 3<sup>rd</sup> Edition, Tata Mc Graw Hill Education Pvt. Ltd, 2008.
2. B H Khan , “ Non-Conventional Energy Resources”, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.
3. S. Hasan Saeed and D.K.Sharma, “Non-Conventional Energy Resources”, 3<sup>rd</sup> Edition, S.K.Kataria & Sons, 2012.
4. G. N. Tiwari and M.K.Ghosal, “Renewable Energy Resource: Basic Principles and Applications”, Narosa Publishing House, 2004.

**(19A02704b) ELECTRIC VEHICLE ENGINEERING  
OPEN ELECTIVE-III**

**Course Objectives:**

After completing this Unit, students will be able to

- To get exposed to new technologies of battery electric vehicles, fuel cell electric vehicles
- To get exposed to EV system configuration and parameters
- To know about electro mobility and environmental issues of EVs
- To understand about basic EV propulsion and dynamics
- To understand about fuel cell technologies for EV and HVEs
- To know about basic battery charging and control strategies used in electric vehicles

**UNIT-I**

**Introduction to EV Systems and Parameters**

Past, Present and Future EV, EV Concept, EV Technology, State-of-the Art EVs, EV configuration, EV system, Fixed and Variable gearing, single and multiple motor drive, in-wheel drives, EV parameters: Weight, size, force and energy, performance parameters.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about past, present and latest technologies of EV
- To understand about configurations of EV systems
- To distinguish between EV parameters and performance parameters of EV systems
- To distinguish between single and multiple motor drive EVs
- To understand about in-wheel EV

**UNIT-II**

**EV and Energy Sources**

Electro mobility and the environment, history of Electric power trains, carbon emissions from fuels, green houses and pollutants, comparison of conventional, battery, hybrid and fuel cell electric systems

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about various types of EV sources
- To understand about e-mobility
- To know about environmental aspects of EV
- To distinguish between conventional and recent technology developments in EV systems

### **UNIT-III**

#### **EV Propulsion and Dynamics**

Choice of electric propulsion system, block diagram, concept of EV Motors, single and multi motor configurations, fixed and variable geared transmission, In-wheel motor configuration, classification, Electric motors used in current vehicle applications, Recent EV Motors, Vehicle load factors, vehicle acceleration.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about what is meant by propulsion system
- To understand about single and multi motor EV configurations
- To get exposed to current and recent applications of EV
- To understand about load factors in vehicle dynamics
- To know what is meant acceleration in EV

### **UNIT-IV**

#### **Fuel Cells**

Introduction of fuel cells, basic operation, model, voltage, power and efficiency, power plant system – characteristics, sizing, Example of fuel cell electric vehicle.

Introduction to HEV, brake specific fuel consumption, comparison of series, series-parallel hybrid systems, examples

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about fuel cell technology of EV
- To know about basic operation of FCEV
- To know about characteristics and sizing of EV with suitable example
- To get exposed to concept of Hybrid Electric Vehicle using fuel cells
- To know about the comparison of various hybrid EV systems

### **UNIT-V**

#### **Battery Charging and Control**



**Battery charging:** Basic requirements, charger architecture, charger functions, wireless charging, power factor correction.

**Control:** Introduction, modelling of electro mechanical system, feedback controller design approach, PI controllers designing, torque-loop, speed control loop compensation, acceleration of battery electric vehicle

**Learning Outcomes:**

After completing this Unit, students will be able to

- To understand about basic requirements of battery charging and its architecture
- To know about charger functions
- To get exposed to wireless charging principle
- To understand about block diagram, modelling of electro mechanical systems of EV
- To be able to design various compensation requirements

**Course Outcomes:**

Upon the successful completion of this course, the students will be able to:

- To understand and differentiate between conventional and latest trends in Electric Vehicles
- To know about various configurations in parameters of EV system
- To know about propulsion and dynamic aspects of EV
- To understand about fuel cell technologies in EV and HEV systems
- To understand about battery charging and controls required of EVs

**TEXT BOOKS:**

1. C.C Chan, K.T Chau: “Modern Electric Vehicle Technology”, Oxford University Press Inc., New York 2001.
2. James Larminie, John Lowry, “Electric Vehicle Technology Explained”, Wiley, 2003.

**REFERENCE BOOKS:**

1. Iqbal Husain,, “Electric and Hybrid Vehicles Design Fundamentals”, CRC Press 2005.
2. Ali Emadi, “Advanced Electric Drive Vehicles”, CRC Press, 2015.

**(19A04704a) INTRODUCTION TO MICROCONTROLLERS & APPLICATIONS**  
**OPEN ELECTIVE-III**

**Course Objectives:**

This course will enable students to:

- Describe the Architecture of 8051 Microcontroller and Interfacing of 8051 to external memory.
- Write 8051 Assembly level programs using 8051 instruction set.
- Describe the Interrupt system, operation of Timers/Counters and Serial port of 8051.
- Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to 8051.

**UNIT – I**

**8051 Microcontroller:**

Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.

**Learning Outcomes:**

At the end of this student, the student will be able to

- Understand the importance of Microcontroller and acquire the knowledge of Architecture of 8051 Microcontroller. (L1)
- Analyze interface required memory of RAM & ROM. (L3)

**UNIT – II**

Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples to use these instructions.

**Learning Outcomes:**

At the end of this student, the student will be able to

- Explain different types instruction set of 8051. (L1)
- Develop the 8051 Assembly level programs using 8051 instruction set. (L3)

### UNIT – III

**8051 Stack, Stack and Subroutine instructions.** Simple Assembly language program examples to use subroutine instructions. 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin.

#### Learning Outcomes:

At the end of this student, the student will be able to

- Describe Stack and Subroutine of 8051. (L1)
- Design Timer /counters using of 8051. (L4)

### UNIT –IV

**8051 Serial Communication-** Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.**8051 Interrupts.** 8051 Assembly language programming to generate an external interrupt using a switch.

#### Learning Outcomes:

At the end of this student, the student will be able to

- Acquire knowledge of Serial Communication and develop serial port programming. (L1)
- Develop an ALP to generate an external interrupt using a switch. (L3)

### UNIT – V

8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to ADC-0804, DAC, LCD and Interfacing with relays and opto isolators, Stepper Motor Interfacing, DC motor interfacing, PWM generation using 8051.

#### Learning Outcomes:

At the end of this student, the student will be able to

- Apply and Interface simple switches, simple LEDs, ADC 0804 and LCD to using 8051 I/O ports. (L2)
- Design Stepper Motor and f motor interfacing of 8051. (L4)

#### Course outcomes:

- Understand the importance of Microcontroller and Acquire the knowledge of Architecture of 8051 Microcontroller.
- Apply and Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to using 8051 I/O ports.

- Develop the 8051 Assembly level programs using 8051 instruction set.
- Design the Interrupt system, operation of Timers/Counters and Serial port of 8051.

#### **TEXT BOOKS:**

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; “The 8051 Microcontroller and Embedded Systems – using assembly and C”, PHI, 2006 / Pearson, 2006.
2. Kenneth J. Ayala, “The 8051 Microcontroller”, 3rd Edition, Thomson/Cengage Learning.

#### **REFERENCE BOOKS:**

1. Manish K Patel, “The 8051 Microcontroller Based Embedded Systems”, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
2. Raj Kamal, “Microcontrollers: Architecture, Programming, Interfacing and System Design”, Pearson Education, 2005.

**(19A04704b) PRINCIPLES OF DIGITAL SIGNAL PROCESSING**  
**OPEN ELECTIVE-III**

**Course Objectives:**

- To explain about signals and perform various operations on it.
- To understand discrete time signals and systems.
- To solve Laplace transforms and z-transforms for various signals.
- To find Discrete Fourier Transform of a sequence by using Fast Fourier Transform.
- To design and realize IIR and FIR filters.

**UNIT- I:**

**INTRODUCTION TO SIGNALS**

Classification of Signals: Analog, Discrete, Digital, Deterministic & Random, Periodic & Aperiodic, Even & Odd, Energy & Power signals. Basic operations on signals: Time shifting, Time scaling, Time reversal, Amplitude scaling and Signal addition. Elementary Signals: Unit step, Unit ramp, Unit parabolic, Impulse, Sinusoidal function, Exponential function, Gate function, Triangular function, Sinc function and Signum function.

**Learning Outcomes:**

At the end of this student, the student will be able to

- Define basic signals and its operations, Classify discrete time signals and systems. (L1)
- Understand various basic operations on signals (L1)

**UNIT – II:**

**DISCRETE TIME SIGNALS AND SYSTEMS**

**Discrete Time Signals:** Elementary discrete time signals, Classification of discrete time signals: power and energy signals, even and odd signals. Simple manipulations of discrete time signals: Shifting and scaling of discrete-time signals.

**Discrete Time Systems:** Input-Output description of systems, Block diagram representation of discrete time systems, Linear Constant Coefficient Difference Equations, Classification of discrete time systems: linear and nonlinear, time-invariant and variant systems, causal and non causal, stable and unstable systems.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Define basic signals and its operations, Classify discrete time signals and systems. (L1)
- Understand various basic operations on signals (L1)

### **UNIT- III:**

#### **LAPLACE TRANSFORMS AND Z- TRANSFORMS**

**Laplace Transforms:** Laplace transforms, Partial fraction expansion, Inverse Laplace transform, Concept of Region of Convergence (ROC), Constraints on ROC for various classes of signals, Properties of Laplace transforms.

**Z-Transforms:** Concept of Z-transform of a discrete sequence, Region of convergence in Z-Transform, constraints on ROC for various classes of signals, inverse Z-transform, properties of Z-Transforms.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Understand the basic concepts of Laplace and Z transforms (L1)
- Apply the transform techniques to solve the problems (L2)

### **UNIT – IV:**

#### **FAST FOURIER TRANSFORMS**

Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), Radix-2 Fast Fourier Transforms (FFT), Decimation in Time and Decimation in Frequency FFT Algorithms: radix-2 DIT-FFT, DIF-FFT, and Inverse FFT: IDFT-FFT.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Understand the importance of DTFT, DFT, FFT and their inverse transforms with respect to signals and systems (L1)
- Analyze the Decimation in time and frequency algorithms (L3)

### **UNIT – V:**

#### **IIR AND FIR DIGITAL FILTERS**

**IIR DIGITAL FILTERS:** Analog filters approximations: Butterworth and Chebyshev, Design of IIR digital filters from analog filters. Realization of IIR filters: Direct form-I, Direct form-II, cascade form and parallel form.

**FIR DIGITAL FILTERS:** Characteristics of FIR digital filters, frequency response. Design of FIR digital filters using window techniques: Rectangular window, Triangular or Bartlett window, Hamming window, Hanning window, Blackman window. Realization of FIR filters: Linear phase and Lattice structures.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Understand the importance of IIR and FIR digital Filters (L1)
- Realize IIR filters and analyze various windowing techniques in FIR filters (L2)
- Design IIR and FIR filters (L4)

### **Course outcomes:**

- Define basic signals and its operations, Classify discrete time signals and systems.
- Solve Laplace Transform and z-Transform for various signals, Calculate DFT of a given sequence by using Fast Fourier Transform.
- Analyze the continuous and discrete signals and systems
- Design and realize IIR and FIR filters from the given specifications.

### **TEXT BOOKS:**

1. B. P. Lathi, "Signals, Systems and Communications", BS Publications, 2008.
2. John G. Proakis, Dimitris G. Manolakis, "Digital signal processing, principles, Algorithms and applications", 4<sup>th</sup> edition, Pearson Education/PHI, 2007.
3. A.V. Oppenheim and R.W. Schaffer, "Discrete Time Signal Processing", 2<sup>nd</sup> edition., PHI.

### **REFERENCES:**

1. A.V. Oppenheim, A.S. Will sky and S.H. Nawab, "Signals and Systems", PHI, 2<sup>nd</sup> Edition, 2013.
2. A. Anand Kumar, "Signals and Systems", PHI Publications, Third Edition, 2013
3. P. Ramesh Babu. "Digital Signal Processing".
4. Andreas Antoniou, "Digital signal processing", Tata McGraw Hill, 2006.
5. R S Kaler, M Kulkarni,, Umesh Gupta, "A Text book on Digital Signal processing" –I K International Publishing House Pvt. Ltd.
6. M H Hayes, Schaum's Outlines, "Digital Signal Processing", Tata Mc-Graw Hill, 2007.

**(19A05704a) FUNDAMENTALS OF GAME DEVELOPMENT**

**(Common to CSE & IT)**

**Course Objectives:**

This course is designed to:

- Get familiarized with the various components in a game and game engine.
- Explore the leading open source game engine components.
- Elaborate on game physics.
- Introduce to the game animation.
- Expose to network-based gaming issues.

**Unit – 1: Introduction to Game**

What is a Game? The Birth of Games, The Rise of Arcade Games, The Crash and Recovery, The Console Wars, Online Games and Beyond.

**The Game Industry:** Game Industry Overview, Game Concept Basics, Pitch Documentation, pitching a Game to a Publisher, Managing the developer-Publisher Relationship, Legal Agreements, Licenses, Console Manufacturers Approval.

**Roles on the Team:** Production, Art, Engineering, Design, Quality Assurance Testing, Team Organization, Corporate.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Demonstrate online games and beyond. [L2]
- Outline the process carried out in the Game Industry [L2]
- Inspect the roles on the Team[L4]

**Unit – 2: Teams**

Project Leadership, Picking Leads, Team Building, Team Buy-in and Motivation.

**Effective Communication:** Written Communication, Oral Communication, Nonverbal Communication, Establishing Communication Norms, Communication Challenges.

**Game Production Overview:** Production Cycle, Preproduction, Production, Testing, Postproduction.

**Learning Outcomes:**



After completing this Unit, students will be able to

- Build a team and pick a leader. [L6]
- Develop Effective communication. [L3]
- Outline the Game Production cycle [L2]

### **Unit – 3: Game Concept**

Introduction, Beginning the Process, Defining the Concept, Game Programming Basics, Prototyping, Risk Analysis, Pitch Idea, Project Kickoff.

**Characters, setting, and Story:** Story Development, Gameplay, Characters, Setting, Dialogue, Cinematics, Story Documentation.

**Game Requirements:** Define Game Features, Define Milestones and Deliverables, Evaluate Technology, Define Tools and Pipeline, Documentation, Approval, Game Requirements Outline

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Design a game. [L6]
- Demonstrate the game play. [L2]
- Identify the Game requirements [L3]

### **Unit – 4 : Game Plan**

Dependencies, Schedules, Budgets, Staffing, Outsourcing, Middleware, Game Plan Outline.

**Production Cycle:** Design Production Cycle, Art Production Cycle, Engineering Production Cycle, Working Together.

**Voiceover and Music:** Planning for Voiceover, choosing a Sound Studio, Casting Actors, Recording Voiceover, Voiceover Checklist, Planning for Music, Working with a Composer, Licensing Music.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Outline the Game plan. [L2]
- Define the production cycle. [L1]
- Make use of voiceover and music in game development. [L3]

### **Unit – 5 :Localization**

Creating International Content, Localization-Friendly Code, Level of Localization, Localization Plan, Testing, Localization Checklist.

**Testing and Code Releasing:** Testing Schedule, Test Plans, Testing Pipeline, Testing Cycle, External Testing, Determining Code Release, Code Release Checklist, Gold Masters, Postmortems.

**Marketing and Public Relations:** Software Age Ratings, Working with Marketing, Packaging, Demos, Marketing Assets, Game Builds, Working with Public Relations, Asset Deliverable Checklist.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Explain the importance of localization. [L2]
- Summarize Testing and code releasing [L2]
- Illustrate Marketing and public relations. [L2]

**Course Outcomes:**

Upon completion of the course, the students should be able to:

- Design games for commercialization (L6)
- Predict the trends in game development (L5)
- Design Game Plan and production cycle (L6)
- Dramatize the game playing environment (L4)

**Text Book:**

1. Heather Maxwell Chandler, and Rafael Chandler, “Fundamentals of Game Development”, Jones& Bartlett Learning, 2011.

**References:**

1. Flint Dille and John Zuur Platten, The Ultimate guide to Video Game Writing, Loan Eagle publisher, 2008.
2. Adams, Fundamentals of Game Design, 3<sup>rd</sup> edition, Pearson Education India, 2015.

**(19A05704b) CYBER SECURITY**  
**(Common to CSE & IT)**

**Course Objectives:**

This course is designed to:

- Understand essential building blocks and basic concepts of cyber security
- Explore Web security and Network security
- Explain the measures for securing the networks and cloud
- Understand privacy principles and policies
- Describe the legal issues and ethics in computer security

**UNIT I**

Introduction: Introduction to Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control, and Cryptography, Authentication, Access Control, Cryptography.

Programs and Programming: Unintentional (Non-malicious) Programming Oversights, Malicious Code—Malware, Countermeasures.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Explain Vulnerabilities, threats and. Counter measures for computer security[L2]
- Interpret the design of the malicious code [L2]

**UNIT II**

Web Security: User Side, Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks.

Operating Systems Security: Security in Operating Systems, Security in the Design of Operating Systems, Rootkit.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Outline the attacks on browser, Web and email. [L2]
- Explain the security aspects of Operating Systems. [L3]

### **UNIT III**

Network Security: Network Concepts, Threats to Network Communications, Wireless Network Security, Denial of Service, Distributed Denial-of-Service Strategic Defenses: Security Countermeasures, Cryptography in Network Security, Firewalls, Intrusion Detection and Prevention Systems, Network Management .

Cloud Computing and Security: Cloud Computing Concepts, Moving to the Cloud, Cloud Security Tools and Techniques, Cloud Identity Management, Securing IaaS.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Identify the network security threats and attacks. [L3]
- Design the Counter measures to defend the network security attacks. [L6]
- Analyze the security tools and techniques for Cloud computing [L4]

### **UNIT IV**

Privacy: Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, Data Mining, Privacy on the Web, Email Security, Privacy Impacts of Emerging Technologies, Where the Field Is Headed.

Management and Incidents: Security Planning, Business Continuity Planning, Handling Incidents, Risk Analysis, Dealing with Disaster.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Interpret the need for Privacy and its impacts of Emerging Technologies. [L2]
- Explain how to handle incidents and deal with Disaster. [L2]

### **UNIT V**

Legal Issues and Ethics: Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, Incident Analysis with Ethics, Emerging Topics: The Internet of Things, Economics, Computerized Elections, Cyber Warfare.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Adapt legal issues and ethics in computer security. [L6]
- Elaborate on the Emerging topics. [L6]

**Course Outcomes:**

Upon completion of the course, the students should be able to:

- Illustrate the broad set of technical, social & political aspects of Cyber Security and security management methods to maintain security protection (L2)
- Assess the vulnerabilities and threats posed by criminals, terrorist and nation states to national infrastructure (L5)
- Identify the nature of secure software development and operating systems (L3)
- Demonstrate the role security management in cyber security defense (L2)
- Adapt the legal and social issues at play in developing solutions.(L6)

**Text Books:**

- 1) Pfleeger, C.P., Security in Computing, Prentice Hall, 2010, 5th edition.
- 2) Schneier, Bruce. Applied Cryptography, Second Edition, John Wiley & Sons, 1996

**Reference Books:**

- 1) Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition, Information Security Management: Concepts and Practice, McGraw-Hill, 2013.
- 2) Whitman, Michael E. and Herbert J. Mattord. Roadmap to Information Security for IT and Infosec Managers. Boston, MA: Course Technology, 2011.

**(19A27704a) CORPORATE GOVERNANCE IN FOOD INDUSTRIES**  
**OPEN ELECTIVE III**

**PREAMBLE**

This text focuses on corporate governance, business ethics and emerging trends in food industries.

**Course Objectives**

- To understand the concepts of corporate governance in view of food industry

**UNIT – I**

Corporate Governance- A Conceptual Foundation: Concept, nature, issues and importance of corporate governance, origin and development of corporate governance, concept of corporate management, Different models of corporate governance, corporate governance in family business, corporate governance failure with examples.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Concept, nature, issues and importance of corporate governance
- origin and development of corporate governance, concept of corporate management
- Different models of corporate governance
- corporate governance in family business, corporate governance failure with examples

**UNIT – II**

Role Players: Role of various players viz. Role of shareholders their rights and responsibilities, Role of board of directors in corporate governance- executive and non executive directors, independent and nominee directors, Role of Auditors, audit committee, media.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Role of shareholders their rights and responsibilities

- Role of board of directors in corporate governance- executive and non executive directors, independent and nominee directors
- Role of Auditors, audit committee, media.

### **UNIT – III**

Corporate governance in India and the Global Scenario: Corporate Governance practices /codes in India, UK, Japan, USA. Contributions of CII-recommendations on corporate governance by different committees in India, SEBI guidelines, Kumar Manglam Birla Committee, Naresh Chandra committee Report, OECD Principles, Cadbury Committee

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Corporate Governance practices /codes in India, UK, Japan, USA.
- Contributions of CII-recommendations on corporate governance by different committees in India, SEBI guidelines,
- Have detail study of committees like Kumar Manglam Birla Committee, Naresh Chandra committee Report, OECD Principles, Cadbury Committee

### **UNIT – IV**

Emerging trends: Emerging Trends and latest developments in Corporate Governance. Corporate Governance initiative in India and Abroad, Corporate Governance Rating- Role of rating agencies in corporate governance. ICRA Corporate governance rating method for examining the quality and effectiveness of corporate governance.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Emerging Trends and latest developments in Corporate Governance.
- Corporate Governance initiative in India and Abroad,
- Corporate Governance Rating- Role of rating agencies in corporate governance
- ICRA Corporate governance rating method for examining the quality and effectiveness of corporate governance.

### **UNIT – V**

Business ethics and corporate governance. Social responsibility and corporate governance. Corporate governance and value creation. Political economy of corporate governance.

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Business ethics and corporate governance.
- Social responsibility and corporate governance.
- Corporate governance and value creation.
- Political economy of corporate governance.

### **Course Outcomes:**

By the end of the course, the students will

- Attain knowledge on system of corporate governance in food industries.
- Get to know about business ethics and values.

### **TEXT BOOKS**

1. Subhash Chandra Das, “Corporate Governance in India”, PHI Pvt. Ltd., New Delhi(2008),
2. Dennis Campbell, “Susan Woodley Trends and Developments In Corporate Governance”. (2004)

### **REFERENCES**

1. Jayati Sarkar. “Corporate Governance in India”. Sage Publications, New Delhi,2012.
2. Vasudha, Joshi “Corporate Governance The Indian Scenario”. Foundations Books Pvt. Ltd. New Delhi. 2012,



**(19A27704b) PROCESS TECHNOLOGY FOR CONVENIENCE & RTE FOODS**  
**OPEN ELECTIVE III**

**PREAMBLE**

This text focuses on various aspects and technologies involved in processing of convenience and Read-to-eat foods.

**Course Objectives:**

- To understand the importance and demand for convenience foods in present day scenario
- To learn the various technical aspects of convenience and Read-to-eat foods.

**UNIT – I**

Overview of grain-based snacks: whole grains – roasted, toasted, puffed, popped and flakes  
Coated grains-salted, spiced and sweetened Flour based snack– batter and dough based products; savoury and farsans; formulated chips and wafers, papads.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Role of cereal based ingredients in snacks industries.
- Various technologies and equipments involved in Snacks industries

**UNIT – II**

Technology for fruit and vegetable based snacks: chips, wafers, papads etc. Technology of ready to eat fruits and vegetable based food products like, sauces, fruit bars, glazed candy etc. Technology of ready to eat canned value added fruits/vegetables and mixes and ready to serve beverages etc.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Role of Fruits and vegetables in convenience products.
- Processing of various Fruit and vegetable based products.

### **UNIT – III**

Technology of ready- to- eat baked food products, drying, toasting roasting and flaking, coating, chipping. Extruded snack foods: Formulation and processing technology, colouring, flavouring and packaging. Technology for coated nuts – salted, spiced and sweetened products- chikkis, Sing bhujia.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Various methods involved in processing of ready to eat baked products
- Various methods involved in processing of extruded snack foods
- Technology involved in processing different coated nuts

### **UNIT IV**

Technology for ready-to-cook food products- different puddings and curried vegetables etc. Technology for ready-to-cook and ready to eat meat and meat food products. Technology for preparation of instant cooked rice, carrot and other cereals based food products.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Technology involved in processing different ready to cook food products
- Technology involved in processing different ready to cook and ready to eat meat and meat products
- Technology involved in processing different instant cooked cereal products

### **UNIT – V**

Technology of ready to eat instant premixes based on cereals, pulses etc. Technology for RTE puffed snack- sand puffing, hot air puffing, explosion puffing, gun puffing etc. Technology for preparation of traditional Indian dairy products.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Technology involved in processing different ready to eat instant premixes based on cereals and pulses and etc.
- Technology involved in processing different RTE puffed snacks
- Technology involved in processing different traditional dairy products

## **Course Outcomes:**

By end of the course students will understand

- Technology for processing ready to eat and ready cook different products and equipment used for manufacturing of RTE products

## **TEXT BOOKS**

1. Edmund WL. "Snack Foods Processing". AVI Publ.
2. Kamaliya M.K and Kamaliya K.B. 2001. Vol.1 and 2, "Baking Science and Industries", M.K.Kamaliya Publisher, Anand.

## **REFERENCES**

1. Frame ND . "Technology of Extrusion Cooking". Blackie Academic1994. .
2. Gordon BR. "Snack Food", AVI Publ, 1997.
3. Samuel AM. "Snack Food Technology", AVI Publ. 1976.

**(19A54704a) NUMERICAL METHODS FOR ENGINEERS**  
**OPEN ELECTIVE-III**  
**(ECE , CSE, IT & CIVIL)**

**Course objectives:**

This course aims at providing the student with the knowledge on various numerical methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations.

**UNIT-I:**

**Solution of Algebraic & Transcendental Equations:**

Introduction-Bisection method-Iterative method-Regula falsi method-Newton Raphson method. System of Algebraic equations: Gauss Jordan method-Gauss Siedal method.

**Learning Outcomes:**

Students will be able to

- Calculate the roots of equation using Bisection method and Iterative method.
- Calculate the roots of equation using Regula falsi method and Newton Raphson method.
- Solve the system of algebraic equations using Gauss Jordan method and Gauss Siedal method.

**UNIT-II:**

**Curve Fitting**

Principle of Least squares- Fitting of curves- Fitting of linear, quadratic and exponential curves.

**Learning Outcomes:**

Students will be able to

- understand curve fitting
- understand fitting of several types of curves

**UNIT-III:**

**Interpolation**

Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae. Gauss forward and backward formula, Stirling's formula, Bessel's formula.

### **Learning Outcomes:**

Students will be able to

- Understand the concept of interpolation.
- Derive interpolating polynomial using Newton's forward and backward formulae.
- Derive interpolating polynomial using Lagrange's formulae.
- Derive interpolating polynomial using Gauss forward and backward formulae.

### **UNIT-IV:**

#### **Numerical Integration**

Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule

### **Learning Outcomes:**

Students will be able to

- Solve integral equations using Simpson's 1/3 and Simpson's 3/8 rule.
- Solve integral equations using Trapezoidal rule.

### **UNIT-V:**

#### **Solution of Initial value problems to Ordinary differential equations**

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method-Runge-Kutta Methods.

### **Learning Outcomes:**

Students will be able to

- Solve initial value problems to ordinary differential equations using Taylor's method.
- Solve initial value problems to ordinary differential equations using Euler's method and Runge Kutta methods.

### **Course Outcomes:**

After the completion of course, students will be able to

- Apply numerical methods to solve algebraic and transcendental equations.
- Understand fitting of several kinds of curves.
- Derive interpolating polynomials using interpolation formulae.
- Solve differential and integral equations numerically.

**Text Books:**

3. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers.
4. Ronald E. "Probability and Statistics for Engineers and Scientists", Walpole, PNIE.
5. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India

**Reference Books:**

3. B.V.Ramana, "Higher Engineering Mathematics", Mc Graw Hill publishers.
4. Alan Jeffrey, "Advanced Engineering Mathematics", Elsevier.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– IV-I** **L T P C**  
**3 0 0 3**  
**(19A51704a) CHEMISTRY OF NANOMATERIALS AND APPLICATIONS**

Course Objectives:

- To understand synthetic principles of Nanomaterials by various methods
- And also characterise the synthetic nanomaterials by various instrumental methods
- To enumerate the applications of nanomaterials in engineering

**Unit I:**

**Introduction:** Scope of nanoscience and nanotechnology, nanoscience in nature, classification of nanostructured materials, importance of nano materials.

**Synthetic Methods: Bottom-Up approach:-** Sol-gel synthesis, microemulsions or reverse micelles, co-precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and sonochemical synthesis.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Classify the nanostructure materials (L2)
- Describe scope of nano science and technology (L2)
- Explain different synthetic methods of nano materials (L2)
- Identify the synthetic methods of nanomaterial which is suitable for preparation of particular material (L3)

**UNIT-II**

**Top-Down approach:-** Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapour deposition method, electrodeposition method, high energy ball milling.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Describe the top down approach (L2)
- Explain aerosol synthesis and plasma arc technique (L2)
- Differentiate chemical vapour deposition method and electrodeposition method (L2)
- Discuss about high energy ball milling (L3)

### UNIT-III

**Techniques for characterization:** Diffraction technique, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterials, BET method for surface area analysis, dynamic light scattering for particle size determination.

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Discuss different techniques for characterization of nanomaterial (L3)
- Explain electron microscopy techniques for characterization of nanomaterial (L3)
- Describe BET method for surface area analysis (L2)
- Apply different spectroscopic techniques for characterization (L3)

### UNIT-IV

**Studies of Nano-structured Materials:** Synthesis, properties and applications of the following nanomaterials, fullerenes, carbon nanotubes, core-shell nanoparticles, nanoshells, self-assembled monolayers, and monolayer protected metal nanoparticles, nanocrystalline materials, magnetic nanoparticles and important properties in relation to nanomagnetic materials, thermoelectric materials, non-linear optical materials, liquid crystals.

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Explain synthesis and properties and applications of nanomaterials (L2)
- Discuss about fullerenes and carbon nanotubes (L3)
- Differentiate nanomagnetic materials and thermoelectric materials (L2)
- Describe liquid crystals (L2)

### UNIT.V

Engineering Applications of Nanomaterials

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Illustrate applications of nanomaterials (L2)
- Discuss the magnetic applications of nanomaterials (L3)
- List the applications of non-linear optical materials (L1)
- Describe the applications of fullerenes, carbon nanotubes (L2)

#### **Course Outcome**



At the end of the course, the student will be able to:

- Understand the state of art synthesis of nano materials
- Characterize nano materials using ion beam, scanning probe methodologies, position sensitive atom probe and spectroscopic ellipsometry.
- Analyze nanoscale structure in metals, polymers and ceramics
- Analyze structure-property relationship in coarser scale structures
- Understand structures of carbon nano tubes

#### **TEXT BOOKS:**

1. **NANO: The Essentials** : T Pradeep, MaGraw-Hill, 2007.
2. **Textbook of Nanoscience and nanotechnology**: B S Murty, P Shankar, Baldev Rai, BB Rath and James Murday, Univ. Press, 2012.

#### **REFERENCE BOOKS:**

1. Concepts of Nanochemistry; Ludovico Cademrtiri and Geoffrey A. Ozin & Geoffrey A. Ozin, Wiley-VCH, 2011.
2. **Nanostructures & Nanomaterials; Synthesis, Properties & Applications**: Guozhong Cao, Imperial College Press, 2007.
3. **Nanomaterials Chemistry**, C. N. R. Rao, Achim Muller, K.Cheetham, Wiley-VCH, 2007.

**HUMANITIES ELECTIVE-II**

**(19A52701a) ORGANISATIONAL BEHAVIOUR**

**Course Objectives :**

The objectives of this course are

- To make the student understand about the organizational behavior
- To enable them to develop self motivation, leadership and management
- To facilitate them to become powerful leaders
- Impart knowledge about group dynamics
- To make them understand the importance of change and development

**Syllabus**

**UNIT-I**

Organizational Behavior - Introduction to OB - Meaning and definition, scope - Organizing Process – Making organizing effective - Understanding Individual Behavior – Attitude - Perception - Learning - Personality Types

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of Organizational Behavior
- Contrast and compare Individual & Group Behavior and attitude
- Analyze Perceptions
- Evaluate personality types

**UNIT-II**

Motivation and Leading - Theories of Motivation - Maslow's Hierarchy of Needs - Herzberg's Two Factor Theory - Leading - Leading Vs Managing

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of Motivation
- Understand the Theories of motivation
- Explain how employees are motivated according to Maslow's Needs Hierarchy
- Compare and contrast leading and managing

### **UNIT-III**

Leadership and Organizational Culture and Climate - Leadership - Traits Theory–Managerial Grid - Transactional Vs Transformational Leadership - Qualities of good Leader - Conflict Management - Evaluating Leader - Women and Corporate leadership.

#### **Learning Outcomes:**

After completion of this unit student will

- Know the concept of Leadership
- Contrast and compare Traits theory and Managerial Grid
- Know the difference between Transactional and Transformational Leadership
- Evaluate the qualities of good leaders
- Emerge as the good leader

### **UNIT – IV**

Group Dynamics - Types of groups - Determinants of group behavior - Group process – Group Development - Group norms - Group cohesiveness - Small Groups - Group decision making - Team building - Conflict in the organization – Conflict resolution

#### **Learning Outcomes:**

After completion of this unit student will

- Know the concept of Group Dynamics
- Contrast and compare Group behavior and group development
- Analyze Group decision making
- Know how to resolve conflicts in the organization

### **UNIT - V**

Organizational Change and Development - Organizational Culture - Changing the Culture – Change Management – Work Stress Management - Organizational management – Managerial implications of organization’s change and development

#### **Learning Outcomes:**

- After completion of this unit student will
- Know the importance of organizational change and development
- Apply change management in the organization
- Analyze work stress management
- Evaluate Managerial implications of organization

**Course outcomes:**

At the end of the course, students will be able to

- Understand the nature and concept of Organizational behavior
- Apply theories of motivation to analyze the performance problems
- Analyze the different theories of leadership
- Evaluate group dynamics
- Develop as powerful leader

**TEXT BOOKS:**

1. Luthans, Fred, “Organisational Behaviour” , McGraw-Hill, 12 Th edition 2011
2. P Subba Rao, Organisational Behaviour, Himalya Publishing House 2017

**REFERENCES BOOKS:**

1. McShane, “Organizational Behaviour”, TMH 2009
2. Nelson, “Organisational Behaviour”, Thomson, 2009.
3. Robbins, P.Stephen, Timothy A. Judge, “Organisational Behaviour”, Pearson 2009.
4. Aswathappa, “Organisational Behaviour”, Himalaya, 2009

**Course objectives :**

The objectives of this course are

- To provide fundamental knowledge on Management, Administration, Organization & its concepts.
- To make the students understand the role of management in Production
- To impart the concept of HRM in order to have an idea on Recruitment, Selection, Training & Development, job evaluation and Merit rating concepts
- To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management
- To make the students aware of the contemporary issues in management

**Syllabus**

**UNIT- I**

**INTRODUCTION TO MANAGEMENT**

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor's Scientific Theory-Henry Fayol's principles - Eltan Mayo's Human relations - Systems Theory - **Organisational Designs** - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

**Learning Outcomes:**

At the end if the Unit, the learners will be able to

- Understand the concept of management and organization
- Apply the concepts & principles of management in real life industry.
- Analyze the organization chart & structure for an enterprise.
- Evaluate and interpret the theories and the modern organization theory.

**UNIT II**

**OPERATIONS MANAGEMENT**

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control - Deming's contribution to Quality. **Material Management** - Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - Purchase Procedure and Stores Management - **Marketing Management** - Concept - Meaning - Nature- Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Understand the core concepts of Management Science and Operations Management
- Apply the knowledge of Quality Control, Work-study principles in real life industry.
- Evaluate Materials departments & Determine EOQ
- Analyze Marketing Mix Strategies for an enterprise.
- Create and design advertising and sales promotion

## **UNIT III**

### **HUMAN RESOURCES MANAGEMENT (HRM)**

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Evolution of HRM - Job Analysis - Human Resource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process and Tests in Employee Selection - Employee Training and Development - On-the- job & Off-the-job training methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration

### **Learning Outcomes:**

At the end if the Unit, the learners will

- Understand the concepts of HRM in Recruitment, Selection, Training & Development
- Apply Managerial and operative Functions
- Analyze the need of training
- Evaluate performance appraisal
- Design the basic structure of salaries and wages

## **UNIT IV STRATEGIC & PROJECT MANAGEMENT**

Definition& Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis - **Project Management** - Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Understand Mission, Objectives, Goals & strategies for an enterprise
- Apply SWOT Analysis to strengthen the project
- Analyze Strategy formulation and implementation
- Evaluate PERT and CPM Techniques
- Creative in completing the projects within given time

## **UNIT V**

### **CONTEMPORARY ISSUES IN MANAGEMENT**

The concept of Management Information System(MIS) - Materials Requirement Planning (MRP) - Customer Relations Management(CRM) - Total Quality Management (TQM) - Six Sigma Concept - Supply Chain Management(SCM) - Enterprise Resource Planning (ERP) - Performance Management - Business Process Outsourcing (BPO) - Business Process Re-engineering and Bench Marking - Balanced Score Card - Knowledge Management.

### **Learning Outcomes:**

At the end if the Unit, the learners will be able to

- Understand modern management techniques
- Apply Knowledge in Understanding in modern
- Analyze CRM, MRP, TQM
- Evaluate Six Sigma concept and SCM

### **Course Outcomes:**

At the end of the course, students will be able to

- Understand the concepts & principles of management and designs of organization in a practical world
- Apply the knowledge of Work-study principles & Quality Control techniques in industry
- Analyze the concepts of HRM in Recruitment, Selection and Training & Development.
- Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyze the business through SWOT.
- Create Modern technology in management science.

**TEXT BOOKS:**

1. A.R Aryasri, "Management Science", TMH, 2013
2. Stoner, Freeman, Gilbert, Management, Pearson Education, New Delhi, 2012.

**REFERENCES:**

1. Koontz & Weihrich, "Essentials of Management", 6<sup>th</sup> edition, TMH, 2005.
2. Thomas N.Duening & John M.Ivancevich, "Management Principles and Guidelines", Biztantra.
3. Kanishka Bedi, "Production and Operations Management", Oxford University Press, 2004.
4. Samuel C.Certo, "Modern Management", 9<sup>th</sup> edition, PHI, 2005



**(19A52701c) BUSINESS ENVIRONMENT**

**Course Objectives :**

The objectives of this course are

- To make the student understand about the business environment
- To enable them in knowing the importance of fiscal and monetary policy
- To facilitate them in understanding the export policy of the country
- Impart knowledge about the functioning and role of WTO
- Encourage the student in knowing the structure of stock markets

**Syllabus**

**UNIT – I**

**An Overview of Business Environment** – Types of Environment - Internal & External - Micro and Macro environment - Competitive structure of industries - Environmental analysis - Scope of business - Characteristics of business - Process & limitations of environmental analysis.

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of Business environment
- Explain various types of business environment
- Know about the environmental analysis of business
- Understand the business process

**UNIT – II**

**FISCAL POLICY** - Public Revenues - Public Expenditure - Public debt - Development activities financed by public expenditure - Evaluation of recent fiscal policy of Government of India - Highlights of Budget - **MONETARY POLICY** - Demand and Supply of Money – RBI - Objectives of monetary and credit policy - Recent trends - Role of Finance Commission.

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of public revenue and public Expenditure
- Explain the functions of RBI and its role
- Analyze the Monetary policy in India

- Know the recent trends and the role of Finance Commission in the development of our country
- Differentiate between Fiscal and Monetary Policy

### **UNIT – III**

**INDIA'S TRADE POLICY** - Magnitude and direction of Indian International Trade - Bilateral and Multilateral Trade Agreements - EXIM policy and role of EXIM bank - **BALANCE OF PAYMENTS** – Structure & Major components - Causes for Disequilibrium in Balance of Payments - Correction measures.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the role of Indian international trade
- Understand and explain the need for Export and EXIM Policies
- Analyze causes for Disequilibrium and correction measure
- Differentiate between Bilateral and Multilateral Trade Agreements

### **UNIT – IV**

**WORLD TRADE ORGANIZATION** - Nature and Scope - Organization and Structure - Role and functions of WTO in promoting world trade - Agreements in the Uruguay Round – TRIPS, TRIMS, and GATT - Dispute Settlement Mechanism - Dumping and Anti-dumping Measures.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the role of WTO in trade
- Analyze Agreements on trade by WTO
- Understand the Dispute Settlement Mechanism
- Compare and contrast the Dumping and Anti-dumping Measures.

### **UNIT – V**

**MONEY MARKETS AND CAPITAL MARKETS** - Features and components of Indian financial systems - Objectives, features and structure of money markets and capital markets - Reforms and recent development – SEBI - Stock Exchanges - Investor protection and role of SEBI.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the components of Indian financial system
- Know the structure of Money markets and Capital markets
- Analyze the Stock Markets
- Apply the knowledge in future investments
- Understand the role of SEBI in investor protection.

### **Course Outcomes:**

At the end of the course, students will be able to

- Understand various types of business environment.
- Understand the role of WTO
- Apply the knowledge of Money markets in future investment
- Analyze India's Trade Policy
- Evaluate fiscal and monetary policy
- Develop a personal synthesis and approach for identifying business opportunities

### **TEXT BOOKS:**

1. Francis Cherunilam (2009), "International Business": Text and Cases, Prentice Hall of India.
2. K. Aswathappa, "Essentials of Business Environment": Texts and Cases & Exercises 13th Revised Edition.HPH2016.

### **REFERENCE BOOKS:**

1. K. V. Sivayya, V. B. M Das (2009), Indian Industrial Economy, Sultan Chand Publishers, New Delhi, India.
2. Sundaram, Black (2009), International Business Environment Text and Cases, Prentice Hall of India, New Delhi, India.
3. Chari. S. N (2009), International Business, Wiley India.
4. E. Bhattacharya (2009), International Business, Excel Publications, New Delhi.

**Course objectives :**

The objectives of this course are

- To introduce the concepts of strategic management and understand its nature in
- competitive and organizational landscape
- To provide an understanding of internal and external analysis of a firm/individual
- To provide understanding of strategy formulation process and frame work
- Impart knowledge of Corporate culture
- Encourage the student in understanding SWOT analysis BCG Matrix

**Syllabus**

**UNIT: I**

**Introduction of Strategic Management:** meaning, nature, importance and relevance. The Strategic Management Process: – Corporate, Business and Functional Levels of strategy. Vision, mission and purpose –Business definition, objectives and goals – Stakeholders in business and their roles in strategic management. Balance scorecard.

**Learning Outcomes:**

After completion of this unit student will

- Understand the meaning and importance of strategic management
- Explain Strategic Management Process and Corporate, Business
- Know about the Business definition, objectives and goals
- Understand Stakeholders their roles in strategic management

**UNIT: II**

**External and Internal Analysis:** The Strategically relevant components of a Company's External Environment Analysis, Industry Analysis - Porter's Five Forces model – Industry driving forces – Key Success Factors. Analyzing a company's resources and competitive position

### **Learning Outcomes:**

After completion of this unit student will

- Understand the components of a Company's environment
- Explain External Environment Analysis, Industry Analysis
- Know how to analyze industry competition through the Porter's Five Forces model
- Analyze Key Success Factors in a company's competitive position

### **UNIT: III**

**Competitive Strategies:** Generic Competitive Strategies: Low cost, Differentiation, Focus. Grand Strategies: Stability, Growth (Diversification Strategies, Vertical Integration Strategies, Mergers, Acquisition & Takeover Strategies, Strategic Alliances & Collaborative Partnerships), Retrenchment, Outsourcing Strategies. Tailoring strategy to fit specific industry – Life Cycle Analysis - Emerging, Growing, Mature & Declining Industries.

### **Learning Outcomes:**

After completion of this unit student will

- Understand the Competitive Strategies
- Explain Stability, Growth Mergers, Acquisition & Takeover Strategies
- Know about the Retrenchment, Outsourcing Strategies
- Differentiate Life Cycle Analysis, Mature & Declining Industries

### **UNIT: IV**

**Strategy Implementation and control -** Strategy implementation; Organization Structure – Matching structure and strategy. Behavioral issues in implementation – Corporate culture – Mc Kinsey's 7s Framework. Functional issues – Functional plans and policies – Financial, Marketing, Operations, Personnel, IT.

### **Learning Outcomes:**

After completion of this unit student will

- Understand the Organization Structure
- Explain Matching structure and strategy
- Know about the Corporate culture
- Analyze Functional plans and policies

### **Unit: V**

**Strategy Evaluation:** Strategy Evaluation – Operations Control and Strategic Control- Relationship between a Company’s Strategy and its Business Model.- SWOT analysis – Value Chain Analysis –Benchmarking- Portfolio Analysis: BCG Matrix – GE 9 Cell Model.

**Learning Outcomes:**

After completion of this unit student will

- Understand the Operations Control and Strategic Control
- Explain Company’s Strategy and its Business Model
- Know about the SWOT analysis
- Analyze BCG Matrix and GE 9 Cell Model

**Course Outcomes:**

At the end of the course, students will be able to

- Understand the relevance and importance of strategic management
- Explain industry driving forces
- Analyze the competitive strategy
  
- Evaluate strategy implementation and control
- Create SWOT Analysis

**Suggested Text Books and References**

**TEXT BOOKS:**

1. Arthur A. Thompson Jr., AJ Strickland III, John E Gamble, “Crafting and Executing Strategy”, 18th edition, Tata McGraw Hill, 2012.
2. Subba Rao P, “Business Policy and Strategic Management” –HPH

**REFERENCES:**

1. Robert A. Pitts & David Lei, “Strategic Management: Building and Sustaining Competitive Advantage” 4th edition, Cengage Learning.
2. Hunger, J. David, “Essentials of Strategic Management” 5<sup>th</sup> edition, Pearson.
3. Ashwathappa, “Business Environment for Strategic Management”, HPH.

**(19A52701e) E-BUSINESS**

**Course Objectives:**

- To provide knowledge on emerging concept on E-Business related aspect.
- To understand various electronic markets models which are trending in India
- To give detailed information about electronic payment systems net banking.
- To exact awareness on internet advertising, market research strategies and supply chain management.
- To understand about various internet protocols-security related concept.

**SYLLABUS**

**UNIT – I**

**Electronic Business:** Definition of Electronic Business - Functions of Electronic Commerce (EC) - Advantages of E-Commerce – E-Commerce and E-Business Internet Services Online Shopping-Commerce Opportunities for Industries.

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of E-Business
- Contrast and compare E-Commerce E-Business
- Analyze Advantages of E-Commerce
- Evaluate opportunities of E-commerce for industry

**UNIT – II**

**Electronic Markets and Business Models:**E-Shops-E-Malls E-Groceries - Portals - Vertical Portals-Horizontal Portals - Advantages of Portals - Business Models-Business to Business(B2B)-Business to Customers(B2C)-Business to Government(B2G)-Auctions-B2B Portals in India

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of business models

- Contrast and compare Vertical portal and Horizontal portals
- Analyze Advantages of portals
- Explain the B2B,B2C and B2G model

### **UNIT – III**

**Electronic Payment Systems:** Digital Payment Requirements-Designing E-payment System-Electronic Fund Transfer (EFT)-Electronic Data Interchange (EDT)-Credit Cards-Debit Cards-E-Cash-Electronic Cheques -Smart Cards-Net Banking-Digital Signature.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the Electronic payment system
- Contrast and compare EFT and EDT
- Analyze debit card and credit card
- Explain the on Digital signature

### **UNIT – IV**

**E-Security:** Internet Protocols - Security on the Internet –Network and Website Security – Firewalls –Encryption – Access Control – Secure Electronic transactions.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand E-Security
- Contrast and compare security and network
- Analyze Encryption
- Evaluate electronic transitions

### **UNIT – V**

**E-Marketing:** Online Marketing – Advantages of Online Marketing – Internet Advertisement – Advertisement Methods – Conducting Online Online Market Research– Data mining and Marketing Research Marketing Strategy On the Web – E-Customer Relationship Management(e-CRM) –E- Supply Chain Management.(e-SCM) –New Trends in Supply Chain Management.

#### **Learning Outcomes:**

After completion of this unit student will



- Understand the concept of online marketing
- Analyze advantages of online marketing
- Compare the e-CRM and e-SCM
- Explain the New trends in supply chain management

**Course Outcomes:**

- They will be able to identify the priority of E-Commerce in the present globalised world.
- Will be able to understand E-market-Models which are practicing by the organization
- Will be able to recognize various E-payment systems & importance of net banking.
- By knowing E-advertisement, market research strategies, they can identify the importance of customer role.
- By understanding about E-security, they can ensure better access control to secure the information.

**TEXT BOOKS:**

3. C.S.V Murthy “E-Commerce”, Himalaya publication house, 2002.
4. P.T.S Joseph, “E-Commerce” , 4<sup>th</sup> Edition, Prentice Hall of India 2011

**REFERENCES:**

5. KamaleshKBajaj,DebjaniNa, “E-Commerce”, 2<sup>nd</sup> Edition TataMcGrwHills 2005
6. Dave Chaffey – “E-Commerce E-Management”, 2<sup>nd</sup> Edition, Pearson, 2012.
7. Henry Chan, “E-Commerce Fundamentals and Application”, Raymond Lee,Tharm Wiley India 2007
8. S. Jaiswall “E-Commerce”, Galgotia Publication Pvt Ltd 2003.

**(19A03702P) METROLOGY AND MEASUREMENT LABORATORY**

**Course objectives:**

- To experiment with measuring equipments used for linear and angular measurements.
- To find common types of errors in measurement equipment.
- To experiment with different types of sensors, transducers and strain gauges equipment.
- To make use of instruments for measurement of temperature, speed and vibrations

Any 4 experiments from each section

**Section A:**

1. Measurement of bores by internal micrometers and dial bore indicators.
2. Use of gear teeth vernier calipers and checking the chordal addendum and chordal height of spur gear.
3. Alignment test on the lathe and milling machine using dial indicators
4. Study of Tool makers microscope and its application
5. Angle and taper measurements by Bevel protractor, Sine bars, spirit level etc.
6. Thread measurement by Two wire/ Three wire method.
7. Surface roughness measurement by Talysurf instrument.
8. Use of straight edge and spirit level in finding the flatness of surface plate.

**Section B:**

1. Calibration of Pressure Gauges
2. Study and calibration of Mcleod gauge for low pressure.
3. Calibration of transducer or thermocouple for temperature measurement.
4. Calibration of LVDT transducer for displacement measurement.
5. Calibration of capacitive transducer for angular measurement.
6. Calibration of photo and magnetic speed pickups for the measurement of speed.
7. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.

**Course outcomes:**

At the end of course the students will be able to:

- Apply different instruments to measure length, width, depth, bore diameters, internal and external tapers, tool angles, and surface roughness. (13)

- Measure effective diameter of thread profile. (15)
- Conduct different machine alignment tests.(16)
- Measure temperature, displacement, and pressure. (13)

**(19A03602P) INTRODUCTION TO CAD/CAM LAB**

**Course Objectives:**

- To write program for CAD modeling.
- To learn part programming and path generation from a CAD model.
- To train on machining of various parts in CNC machines.

**GEOMETRIC MODELING**

Introduction to 3D Modeling (4 or 5 exercises).

1. Write program for translation, scaling and rotation.
2. Write program for generating spline Bezier and B-spline.
3. Write program for sweep surfaces and surface of revolution.
4. Blend surfaces using any software.
5. Create wireframe, surface and solid models.
6. Introduction to CNC Machines and G-Code, M-Codes
7. CNC part programming for operations like turning, step turning, taper turning, threading.
8. CNC program for plane milling, drilling operations.
9. Generation of CNC part programming with CAM packages for a given 3D models.
10. Development of APT programming for 2D objects
11. Programming for Robot pick and place and continuous path.

**Course Outcomes:**

After successful completion of this lab the student will be able to

- Generate CAD models.
- Write CNC programs for various machining operations.

**(19A05406P) INTERNET OF THINGS LABORATORY**

**Practicals:**

1. Select any one development board (Eg., Arduino or Raspberry Pi) and control LED using the board.
2. Using the same board as in (1), read data from a sensor. Experiment with both analog and digital sensors.
3. Control any two actuators connected to the development board using Bluetooth.
4. Read data from sensor and send it to a requesting client. (using socket communication)  
Note: The client and server should be connected to same local area network.
5. Create any cloud platform account, explore IoT services and register a thing on the platform.
6. Push sensor data to cloud.
7. Control an actuator through cloud.
8. Access the data pushed from sensor to cloud and apply any data analytics or visualization services.
9. Create a mobile app to control an actuator.
10. Design an IoT based air pollution control system which monitors the air pollution by measuring carbon monoxide, ammonia, etc and gives alarm or sends message when the pollution level is more than permitted range.
11. Design an IoT based system which measures the physical and chemical properties of the water and displays the measured values.
12. Identify a problem in your local area or college which can be solved by integrating the things you learned and create a prototype to solve it (Mini Project).
13. Design a business model canvas for a digital display

**Course outcomes:**

At the end of the course, students will be able to

- Choose the sensors and actuators for an IoT application (L1)
- Select protocols for a specific IoT application (L2)
- Utilize the cloud platform and APIs for IoT application (L3)
- Experiment with embedded boards for creating IoT prototypes (L3)
- Design a solution for a given IoT application (L6)

**Text Book:**

1. Adrian McEwen, Hakim Cassimally – “Designing the Internet of Things”, Wiley Publications, 2012.
2. Alexander Osterwalder, and Yves Pigneur – “Business Model Generation” – Wiley, 2011

**Reference Books:**

1. Arshdeep Bahga, Vijay Madisetti – “Internet of Things”: A Hands-On Approach, Universities Press, 2014.
2. Pethuru Raj, Anupama C. Raman, “The Internet of Things, Enabling technologies and use cases” –CRC Press.

**Reference sites:**

<https://www.arduino.cc/>

<https://www.raspberrypi.org/>

**(19A03801a) AUTOTRONICS**  
**PROFESSIONAL ELECTIVE - IV**

**Course Objectives:**

- Familiarize automotive systems.
- Introduce role of Automotive Grade Microcontrollers in ECU design and choice of appropriate Hardware and Software.
- Explain sensors and sensor monitoring mechanisms aligned to automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.
- Facilitate design and model various automotive control systems using Model based development technique.
- Impart safety standards, advances in autonomous vehicles, and vehicle on board and off board diagnostics.
- Demonstrate the various display devices those are used in automobiles.

**UNIT I**

**Introduction to Automotive Systems:** Need for electronic control in automobiles; various sub-systems of automobile: Engine, Transmission System, Steering and Brake Systems; Classification and working of IC engine: Gasoline, Diesel engines, 2-stroke, 4-stroke engines; Engine Control methods: Air-fuel ratio control, Spark timing, Start of fuel injection, etc.

**Learning Outcomes:**

After completion of this unit, the students will be able to

- Classify working of various types of IC engines. (L2)
- Explain need for electronic controls in automobiles. (L2)
- Impart engine control methods. (L1)

**UNIT II**

**Introduction to microcomputer:** Microcomputer: Buses, memory, timing, CPU registers; Microprocessor architecture: Initialization, operation codes, program counter, branch and jump instructions, subroutine. Analog to digital converters and Digital to analog converters, sampling, polling and interrupts, digital filters, lookup table.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Explain role of automotive grade microcontrollers. (12)

- Identify various components of microcomputer. (11)
- Use different types of microcontrollers. (13)

### UNIT III

**Sensors and actuators:** Speed sensors, Pressure sensors: Manifold Absolute Pressure sensor, knock sensor, Temperature sensors: Coolant and Exhaust gas temperature, Exhaust Oxygen level sensors, Position sensors: Throttle position sensors, accelerator pedal position sensors and crankshaft position sensors, Air mass flow sensors. Solenoids, stepper motors and relays.

#### Learning Outcomes:

After completion of this unit, students will be able to

- Explain sensors, actuators and sensor monitoring mechanisms aligned to automotive systems. (13)
- Use different signal conditioning techniques, interfacing techniques and actuator mechanisms. (13)

### UNIT IV

**Electronic engine and vehicle management system:** Electronic engine control: Input, output and control strategies, electronic fuel control system, fuel control modes: open loop and closed loop control at various modes, EGR control, Electronic ignition systems–Spark advance correction schemes, fuel injection timing control. Cruise control system, Antilock braking system, electronic suspension system, electronic steering control, traction control system, Transmission control, Safety: Airbags, collision avoiding system, low tire pressure warning system.

#### Learning Outcomes:

After completion of this unit, the students will be able to

- Summarize the advancements in the fuel injection systems. (12)
- Illustrate the electronic engine control systems in automobile engines.(12)
- Explain the electronic fuel injection system in si and ci engines. (12)
- Contrast direct fuel injection and indirect fuel injection system. (12)
- Apply sensors in the management of the vehicle control (13)
- Outline active and passive safety systems in automobiles.(12)
- Compare various types of advanced braking systems.(L2)

### UNIT V

**Automotive instrumentation system:** Input and output signal conversion, multiplexing, fuel quantity measurement, coolant temperature and oil pressure measurement, display devices-LED, LCD, VFD and CRT, On-board diagnostics (OBD), OBD-II, off-board diagnostics.



### **Learning Outcomes:**

After completion of this unit, students will be able to

- Identify input and output signal conversion. (13)
- Explain the basic mechanism off board diagnostics. (13)
- Differentiate between led, lcd, vfd and crt, on-board diagnostics(obd). (13)

### **Course outcomes:**

After completion of this course the student can be able to:

- Explain need for automotive electronic systems. (12)
- Illustrate automotive components, like sensors, actuators, communication protocols and safety systems. (12)
- Interface automotive sensors and actuators with microcontrollers. (14)
- Model various automotive control systems. (14)
- Utilize various display devices that are used in automobiles. (13)
- Justify importance of safety standards and vehicle on board and off board diagnostics. (11)

### **Text Books:**

1. William BRibbens, "Understanding Automotive Electronics", NewneButterworth - Heinermann, 2003.
2. Crouse W H, "Automobile Electrical Equipment", McGraw Hill, New York 2005.

### **References:**

1. Bechhold "Understanding Automotive Electronics", SAE, 1998.
2. Robert Bosch "Automotive Hand Book", SAE 5/e, 2000.
3. Tom Denton, "Automobile Electrical and Electronic Systems" 3/e, Edward Arnold, London, 2004.
4. Eric Chowanietz, "Automotive Electronics", SAE International, USA, 1995.

(19A03801b) MECHANICAL VIBRATIONS  
PROFESSIONAL ELECTIVE - IV

**Course Objective:**

- Demonstrate basic concepts and definitions of mechanical vibrations. To write equation of motion for discrete spring-mass systems with different configuration using classical and energy methods.
- To train the students about basic concepts of forced vibrations, vibration transmissibility and isolation and seismic instruments. Further to understand about various vibration control methods.
- To familiarize the students about two degree freedom system and various types of vibration absorbers.
- To analyze the two degree and multi degree of freedom systems.

**UNIT I**

**Single Degree Freedom Systems:** Un-damped free vibration: Classical method, Energy method, equivalent systems, torsional systems. Damped free vibration- Viscous damping, under damping, critical damping, over damping. Coulomb damping, equivalent damping coefficient. Simple problems.

**Learning Outcomes:**

After completion of this unit student will able to

- Find natural frequency of un-damped single degree freedom systems.(14)
- Find the behavior of single degree freedom systems with damping.(14)

**UNIT II**

**Forced vibrations of Single Degree Freedom Systems :** Steady state forced vibration, sources of excitation, impressed harmonic force, resonance impressed force due to unbalance, motion excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Solve vibration problems with forcing function.(14)
- Calculate transmissibility and isolation.(14)
- Explain different types of isolators and power absorbers.(13)

### UNIT III

**Two Degree Freedom Systems:** Formulation of Equation of motion, Natural frequencies and modes of vibration by classical method, coupled pendulum, forced vibration, dynamic vibration absorber.

#### Learning Outcomes:

After completion of this unit the students will be able to

- Analyze the two degree freedom systems with and without damping.(14)
- Solve problems on vibration absorber.(15)

### UNIT IV

**Multi Degree Freedom Systems:** Lagrangian method for formulation of equation of motion Influence co- efficient method, Lumped mass and distributed mass systems, Stodola method, Holzer's method, model analysis of free and forced vibrations.

**Whirling of shafts:** Critical speed of shafts, Rayleigh's upper bound approximation, Dunkerley's lower bound approximation, critical speed of shafts with damping.

#### Learning Outcomes:

After completion of this unit the student will be able to

- Analyze the multi degree freedom systems using Stodola method, Holzer's method and Matrix iteration method.(L5)
- Calculate natural frequencies with Rayleigh's method and Dunkerley's method.(L4)

### UNIT V

**Vibration measurement and Applications:** Transducers: variable resistance transducers, Piezoelectric transducers, electrodynamic transducers and linear variable differential transformer transducer; Vibration pickups: vibrometer, accelerometer, velometer and phase distortion; Frequency-measuring instruments; Vibration exciters- Mechanical exciters and electrodynamic shaker.

#### Learning Outcomes:

After completion of this unit the students will be able to

- Identify various transducers.(13)
- Use different vibration pickups.(14)
- Explain mechanical exciters and electrodynamic shaker.(12)

#### Course outcomes:

after successful completion of the course, the student will be able to

- Find natural frequency of un-damped single degree freedom systems(L4)

- Analyze the two degree freedom systems with and without damping.(L4)
- Calculate transmissibility and isolation.(L4)
- Solve problems on vibration absorber.(L5)
- Calculate natural frequencies of multi degree freedom system.(L4)
- Measure vibration parameters.(L4)
- Use mechanical exciters and electrodynamic shaker.(L5)

**Text books:**

1. Singrasu S. Rao, “Mechanical Vibrations”, 6<sup>th</sup> edition, Pearson Education, 2018.
2. William Thomson, “Theory of Vibrations with Applications”, 5<sup>th</sup> edition, Pearson, 2008

**Reference books:**

1. L. Meirovich, “Elements of Vibrations Analysis”, Tata McGraw Hill, 1986
2. S. Graham Kelly, “Mechanical Vibrations”, Tata McGraw Hill, 1996
3. William Weaver, “Timeoshenko, and Young, Vibration Problems in Engineering”, 5<sup>th</sup> edition, John Wiley, 2013.
4. C. Nataraj, “Vibration of Mechanical Systems”, 1<sup>st</sup> edition, Cenage Learning, 2012.
5. G.K.Groover, “Mechanical Vibrations”, 1<sup>st</sup> edition, Nem Chand 1977

**(19A03801c) REFRIGERATION AND AIR CONDITIONING**  
**PROFESSIONAL ELECTIVE - IV**

**Course Objective:**

- Provides insights in how thermodynamic principles are applied within the refrigeration and air conditioning industry.
- Introduce the students how real systems used in commercial, industrial refrigeration and air conditioning industries are built-up.
- Expose the students on various refrigeration methods like vcr, var and latest developments.
- Know the various air conditioning methods like summer, winter and year round air conditioning and to make the student to understand the practical applications of refrigeration and air conditioning systems.

**UNIT I**

**INTRODUCTION TO REFRIGERATION:** Necessity and Applications, Carnot Refrigerator, First and Second Law Applied to Refrigerating Machines, Unit of Refrigeration, COP, EER, Different Refrigeration Methods.

**AIR REFRIGERATION:** Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems - Numerical Problems - Refrigeration Needs of Air Crafts.

**Learning Outcomes:**

At the end of this unit the student will be able to

- Explain the terminologies associated with refrigeration. (12)
- Describe the first and second law applied to refrigerating machines.(12)
- Demonstrate the bell-coleman cycle in air refrigeration. (12)
- Identify the various refrigeration cycles.

**UNIT II**

Vapour Compression Refrigeration ( VCR ) System - Basic Cycle - Working Principle and Essential Components of The Plant - COP - Representation of Cycle On T-S and P-h Charts - Expander Vs. Throttling, Effect of Sub Cooling and Super Heating - Cycle Analysis - Actual Cycle- Influence of Various Parameters on System Performance - Construction and Use of P-h Charts - Numerical Problems. Refrigerants - Desirable Properties - Classification of Refrigerants Used - Nomenclature- Secondary Refrigerants- Lubricants - Ozone Depletion - Global Warming- Newer Refrigerants.

### **Learning Outcomes:**

At the end of this unit the student will be able to

- Appraise the importance of vapour compression refrigeration system. (15)
- Draw the t-s and p-h charts for representation of cycle.(11)
- Classify various refrigerants used in vapour compression refrigeration systems. (11)
- Model the numerical problems on refrigeration cycles. (13)
- Demonstrate the influence of various parameters on system performance. (12)

### **UNIT - III**

**VAPOR ABSORPTION REFRIGERATION ( VAR ) SYSTEM-** Description and Working of NH<sub>3</sub> - Water System and Li Br -Water ( Two Shell & Four Shell) System -Calculation of Max COP, Principle of Operation of Three Fluid Absorption System

**STEAM JET REFRIGERATION SYSTEM:** Working Principle and Basic Components- Estimation of Motive Steam Unconventional refrigeration systems - Principle and Operation of: (I) Thermo-Electric Refrigerator (Ii) Vortex Tube OrHilsch Tube (iii) Acoustic refrigeration system.

### **Learning Outcomes:**

At the end of this unit the student will be able to

- Appraise the importance of vapour absorption refrigeration system. (15)
- Identify the latest developments of electrolux, thermo electric vortex tube methods.. (13)
- Illustrate the working of various components of steam jet refrigeration system.(12)
- Estimate the motive steam required for steam jet refrigeration system.(16)
- Describe the working principle of thermo- electric refrigerator and vortex tube refrigerator.(12)

### **UNIT IV**

**INTRODUCTION TO AIR CONDITIONING:** Psychrometric Properties & Processes - Characterization of Sensible and Latent Heat Loads -- Need For Ventilation, Consideration of Infiltrated Air - Heat Load Concepts.

**AIR CONDITIONING SYSTEMS:** Air Cooler (Evaporative Cooling) ,Window, Split, Summer , Winter, Year Round, Central Air Conditioning Systems.

### **Learning Outcomes:**

At the end of this unit the student will be able to

- Illustrate the psychrometric properties & processes. (12)

- Select the air conditioning systems for different realistic situations. (16)
- Define the terms sensible heat load and latent heat load. (11)
- Draw the psychrometric charts for various air conditioning environments.(11)

## UNIT V

Air Conditioning Equipment - Humidifiers - Dehumidifiers - Air Filters, Fans and Blowers.

**HUMAN COMFORT:** Requirements of Temperature, Humidity And Concept of Effective Temperature, Comfort Chart. Heat Pump - Heat Sources - Different Heat Pump Circuits.

### Learning Outcomes:

At the end of this unit the student will be able to

- Appraise the importance of humidifiers and dehumidifiers. (15)
- Select the requirements of temperature and humidity for human comfort. (16)
- Demonstrate the heat pump working and its components. (12)
- List the various air conditioning equipments. (11)

### Course Outcomes

After completing the course, the student will be able to

- Summarize the various refrigeration and air conditioning equipments and it's working.
- Apply the basic knowledge to operate the refrigeration systems.
- Evaluate the cop for vapour absorption system.

### TEXT BOOKS:

1. CPArora, “Refrigeration and Air Conditioning”, TMH, 15<sup>th</sup> edition, 2013.
2. S.CArora&Domkundwar, “A Course in Refrigeration and Air conditioning”, Dhanpatrai

### REFERENCE BOOKS:

1. Manohar Prasad, “ Refrigeration and Air Conditioning”, New Age, 2<sup>nd</sup> edition, 2013
2. Dossat, “ Principles of Refrigeration”, Pearson Education, 4<sup>th</sup> edition, 2007
3. P.L.Ballaney, “Refrigeration and Air Conditioning”, 2<sup>nd</sup> edition, 2012.
4. P.N.Ananthanarayanan / TMH, “Basic Refrigeration and Air-Conditioning”, 4<sup>th</sup> edition, 2013.

**NOTE:** Tables/Codes: Thermal Engineering Data Book containing refrigerant and Psychrometric property Tables and charts are permitted in Exam

**(19A03801d) TOTAL QUALITY MANAGEMENT**  
**PROFESSIONAL ELECTIVE - IV**

**Course Objectives:**

The Objectives of this course are to

- Introduce the students, the basic concepts of Total Quality Management.
- Expose with various quality issues in Inspection.
- Gain Knowledge on quality control and its applications to real time.
- Know the extent of customer satisfaction by the application of various quality concepts.
- Understand the importance of Quality standards in Production.

**UNIT I**

**10 hrs**

Introduction: Definition of Quality, Dimensions of Quality, Definition of Total quality management, Quality Planning, Quality costs – Analysis, Techniques for Quality costs, Basic concepts of Total Quality Management.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Define what is quality. (12)
- Explain the principles of quality planning. (12)
- Explain the techniques of quality costs.(12)
- Interpret the concepts of total quality management. (12)
- Contrast the present quality issues with the past. (12)

**UNIT II**

**8 hrs**

**Historical Review:** Quality council, Quality statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of successful quality leader, Contributions of Gurus of TQM, Case studies.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain the importance of Quality council. (L2)
- Identify the barriers of TQM Implementation. (L3)
- Discuss the benefits of TQM. (L6)
- Summarize the essential characteristics of successful quality leader. (L2)
- Outline the contributions of TQM Gurus. (L2)

**UNIT III**

**8 hrs**



**TQM Principles:** Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment teams, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure Case studies

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain the importance of customer satisfaction, Service Quality and Customer Retention. (L2)
- Apply the principles of motivation and Empowerment. (L3)
- Compare the perfection and continuous improvement. (L2)
- Measure the Process improvement using Juran Trilogy.(L5)
- Demonstrate the concepts of performance measures using a case study. (L2)

**UNIT IV**

**8 hrs**

**TQM Tools:** Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, The seven tools of quality, Process capability, Concept of Six Sigma, New Seven management tools, Case studies.

**Learning Outcomes:**

At the end of this course, the student will be able to

- Infer the benefits of benchmarking. (L2)
- List the benefits of QFD Process. (L1)
- Identify various zones in House of Quality. (L3)
- Apply Six sigma towards quality improvement. (L3)
- List the seven tools of quality. (L1)

**UNIT V**

**8 hrs**

**Quality Systems:** Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits, Case Studies.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain the importance of ISO Standards. (L2)
- Discuss the need of ISO9000 and Other Quality systems. (L6)

- Build awareness on the services of ISO9000. (L6)
- Infer the process of documentation. (L2)
- Compare ISO 9000 and ISO 14000. (L2)

### **Course Outcomes:**

At the end of this course, the student will be able to

- Develop an understanding on quality Management philosophies and frameworks
- Adopt TQM methodologies for continuous improvement of quality
- Measure the cost of poor quality, process effectiveness and efficiency to identify areas for improvement
- Apply benchmarking and business process reengineering to improve management processes.
- Determine the set of indications to evaluate performance excellence of an organization.

### **Textbooks:**

1. Dale H Besterfield, “Total Quality Management”, 4<sup>th</sup> Edition, Pearson Education, 2015
2. Subburaj Ramaswamy, “Total Quality Management”, Tata Mcgraw Hill Publishing Company Ltd., 2005
3. Joel E.Ross , “Total Quality Management”, 3<sup>rd</sup> edition, CRC Press, 2017

### **Reference books:**

1. Narayana V and Sreenivasan N.S, “Quality Management – Concepts and Tasks”, NewAge International, 1996
2. Robert L.Flood, “Beyond TQM, First Edition”, John Wiley & Sons Ltd, 1993
3. Richard S. Leavenworth & Eugene Lodewick Grant, “Statistical Quality Control, Seventh Edition”, Tata Mcgraw Hill, 2015
4. Samuel Ho , TQM, “An Integrated Approach”, Kogan Page Ltd, USA, 1995.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– IV-II** **L T P C**  
**3 0 0 3**  
**(19A01802a) DISASTER MANGEMENT**

## OPEN ELECTIVE-IV

### Course Objectives:

The objective of this course is to:

- Develop an understanding of why and how the modern disaster manager is involved with pre-disaster and post-disaster activities.
- Develop an awareness of the chronological phases of natural disaster response and refugee relief operations. Understand how the phases of each are parallel and how they differ.
- Understand the ‘relief system’ and the ‘disaster victim.’
- Describe the three planning strategies useful in mitigation.
- Identify the regulatory controls used in hazard management.
- Describe public awareness and economic incentive possibilities.
- Understand the tools of post-disaster management.

### SYLLABUS

#### UNIT-I:

Natural Hazards And Disaster Management: Introduction of DM – Inter disciplinary -nature of the subject– Disaster Management cycle – Five priorities for action. Case study methods of the following: floods, draughts – Earthquakes – global warming, cyclones & Tsunamis – Post Tsunami hazards along the Indian coast – landslides.

#### Learning Outcomes:

After completing this Unit, students will be able to

- To know about the natural hazards and its management
- To understand about the global warming, cyclones and tsunamis

#### UNIT-II:

Man Made Disaster And Their Management Along With Case Study Methods Of The Following: Fire hazards – transport hazard dynamics – solid waste management – post disaster – bio terrorism -threat in mega cities, rail and air craft’s accidents, and Emerging infectious diseases & Aids and their management.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the fire hazards and solid waste management
- To understand about the emerging infectious diseases and aids their management.

### **UNIT-III:**

Risk and Vulnerability: Building codes and land use planning – social vulnerability – environmental vulnerability – Macroeconomic management and sustainable development, climate change risk rendition – financial management of disaster – related losses.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the regulations of building codes and land use planning related to risk and vulnerability.
- To understand about the financial management of disaster and related losses

### **UNIT-IV:**

Role Of Technology In Disaster Managements: Disaster management for infra structures, taxonomy of infra structure – treatment plants and process facilities-electrical substations-roads and bridges- mitigation programme for earth quakes –flowchart, geospatial information in agriculture drought assessment-multimedia technology in disaster risk management and training- transformable indigenous knowledge in disaster reduction.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the technological aspects of disaster management
- To understand about the factors for disaster reduction

### **UNIT-V:**

Education and Community Preparedness: Education in disaster risk reduction-Essentials of school disaster education-Community capacity and disaster resilience-Community based disaster recovery -Community based disaster management and social capital-Designing resilience- building community capacity for action.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To impart the education related to risk reduction in schools and communities

### **Course Outcomes:**

Upon the successful completion of this course, the students will be able to:

- Affirm the usefulness of integrating management principles in disaster mitigation work
- Distinguish between the different approaches needed to manage pre- during and post-disaster periods
- Explain the process of risk management
- Relate to risk transfer

### **TEXT BOOKS**

1. Rajib shah & R R Krishnamurthy “Disaster Management” – Global Challenges and Local Solutions’ Universities press. (2009),
2. Tushar Bhattacharya, “Disaster Science & Management” Tata McGraw Hill Education Pvt. Ltd., New Delhi.
3. Jagbir Singh “Disaster Management” – Future Challenges and Opportunities’ I K International Publishing House Pvt. Ltd. (2007),

### **REFERENCE BOOKS**

1. Harsh. K . Gupta “Disaster Management edited”, Universities press, 2003.

**(19A01802b) GLOBAL WARMING AND CLIMATE CHANGES**  
**OPEN ELECTIVE-IV**

**Course Objectives:**

The objective of this course is to:

- To know the basics, importance of global warming.
- To know the concepts of mitigation measures against global warming
- To know the impacts of climate changes

**UNIT I**

**EARTH'S CLIMATE SYSTEM:**

Introduction to environment, Ozone, ozone layer and its functions, Ozone depletion and ozone hole, Vienna convention and Montreal protocol, Green house gases and green house effect, Hydrological cycle and Carbon cycle, Global warming and its impacts

**Learning Outcomes:**

After completing this Unit, students will be able to

- To identify the importance of Ozone and effect of green house gases
- To know the effect of global warming

**UNIT II**

**ATMOSPHERE & ITS COMPONENTS:** Atmosphere and its layers-Characteristics of Atmosphere - Structure of Atmosphere - Composition of Atmosphere - Atmospheric stability - Temperature profile of the atmosphere - Temperature inversion and effects of inversion on pollution dispersion.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the layers of atmosphere and their characteristics

**UNIT III**

**IMPACTS OF CLIMATE CHANGE :** Causes of Climate change - Change of Temperature in the environment - Melting of ice and sea level rise - Impacts of Climate Change on various

sectors - Projected impacts for different regions, uncertainties in the projected impacts and risk of irreversible changes.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the causes of climate change and its effects on various sectors.

## **UNIT IV**

**OBSERVED CHANGES AND ITS CAUSES:** Climate change and Carbon credits-Clean Development Mechanism (CDM), CDM in India - Kyoto Protocol - Intergovernmental Panel on Climate Change (IPCC) - Climate Sensitivity - Montreal Protocol - United Nations Framework Convention on Climate Change (UNFCCC) - Global change in temperature and climate and changes within India

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the causes of climate change and carbon credits, effect of change in temperature and climate on india.

## **UNIT V**

**CLIMATE CHANGE AND MITIGATION MEASURES:** CDM and Carbon Trading - Clean Technology, biodiesel, compost, biodegradable plastics - Renewable energy usage as an alternative - Mitigation Technologies and Practices within India and around the world - Non-renewable energy supply to all sectors - Carbon sequestration - International and regional cooperation for waste disposal biomedical wastes, hazardous wastes, e-wastes, industrial wastes, etc.,

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the clean technology, use of renewable energy, mitigation technologies and their practices.

## **Course Outcomes**

Upon the successful completion of this course, the students will be able to:

- An ability to apply knowledge of mathematics, science, and engineering
- Design a system, component or process to meet desired needs with in realistic constraints such as economic ,environmental ,social ,political ,ethical ,health and safety , manufacturability and sustainability

- An ability to identify, formulate, and solve engineering problems

## **REFERENCE BOOKS**

1. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Private limited 2007.
2. Adaptation and mitigation of climate change-Scientific Technical Analysis. Cambridge University Press ,Cambridge,2006.
3. Atmospheric Science, J.M. Wallace and P.V. Hobbs, Elsevier / Academic Press 2006.
4. Jan C. van Dam, Impacts of “Climate Change and Climate Variability on Hydrological Regimes”, Cambridge university press ,2003.
5. David Archer, Global Warming: Understanding the Forecast, 2 nd ed. (Wiley, 2011
6. John Houghton, Global Warming: The Complete Briefing, 5th Edition, 2015, Cambridge Univ. Press. Useful



**(OE-IV)**

**Course Objectives:**

- To learn about a few applications of Internet of Things
- To distinguish between motion less and motion detectors as IoT applications
- To know about Micro Electro Mechanical Systems (MEMS) fundamentals in design and fabrication process
- To understand about applications of IoT in smart grid
- To introduce the new concept of Internet of Energy for various applications

**UNIT-I:**

**Sensors**

Definitions, Terminology, Classification, Temperature sensors, Thermoresistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflectometer, Pressure and Force sensors: Piezoresistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about basic principles of sensors and their classification
- To learn about various motion less sensors
- To understand about Piezoelectric sensor applications to detect temperature, pressure etc.
- To understand about Capacitive sensors to detect temperature, force and pressure etc.
- To know about concepts of tactile sensors, for a few applications

**UNIT-II:**

**Occupancy and Motion detectors**

Capacitive occupancy, Inductive and magnetic, potentiometric - Position, displacement and level sensors, Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, Capacitive, Piezoresistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors - Resistive microphones, Piezoelectric, Photo resistors

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about Capacitive occupancy
- To understand about Motion detectors
- To distinguish between Potentiometric, inductive and capacitive sensors for a few applications
- To learn about a few velocity and acceleration sensors
- To know about various flow sensors

### **UNIT-III:**

#### **MEMS**

Basic concepts of MEMS design, Beam/diaphragm mechanics, electrostatic actuation and fabrication, Process design of MEMS based sensors and actuators, Touch sensor, Pressure sensor, RF MEMS switches, Electric and Magnetic field sensors

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To understand about the basic concept of MEMS
- To know about electrostatic actuation
- To learn about process design of MEMS based sensors
- To learn about process design of MEMS based actuators
- To distinguish between RF switches with respect to electric and magnetic sensors

### **UNIT-IV:**

#### **IoT for Smart grid**

Driving factors, Generation level, Transmission level, Distribution level, Applications, Metering and monitoring applications, Standardization and interoperability, Smart home

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To get exposure fundamental applications of IoT to Smart grid
- To learn about driving factors of IoT in Generation level
- To learn about driving factors of IoT in Transmission level
- To learn about driving factors of IoT in Distribution level
- To distinguish between metering level and monitoring applications
- To get introduced to the concept of Smart home

### **UNIT-V:**

**IoE:** Concept of Internet of Energy, Evaluation of IoE concept, Vision and motivation of IoE, Architecture, Energy routines, information sensing and processing issues, Energy internet as smart grid

**Learning Outcomes:**

After completing this Unit, students will be able to

- To get exposed the new concept of internet of energy
- To learn about architecture of IoE
- To know about energy routines
- To learn about information sensing and processing issues
- To understand the use of energy internet as smart grid

**Course Outcomes:**

- To get exposed to recent trends in few applications of IoT in Electrical Engineering
- To understand about usage of various types of motionless sensors
- To understand about usage of various types of motion detectors
- To get exposed to various applications of IoT in smart grid
- To get exposed to future working environment with Energy internet

**TEXT BOOKS:**

1. Jon S. Wilson, “Sensor Technology Hand book”, Newnes Publisher, 2004
2. Tai Ran Hsu, “MEMS and Microsystems: Design and manufacture”, 1<sup>st</sup> Edition, Mc Grawhill Education, 2017
3. Ersan Kabalci and Yasin Kabalci, “From Smart grid to Internet of Energy”, 1<sup>st</sup> Edition, Academic Press, 2019

**REFERENCE BOOKS:**

1. Raj Kumar Buyya and Amir Vahid Dastjerdi, “Internet of Things: Principles and Paradigms”, Kindle Edition, Morgan Kaufmann Publisher, 2016
2. Yen Kheng Tan and Mark Wong, “Energy Harvesting Systems for IoT Applications”: Generation, Storage and Power Management, 1<sup>st</sup> Edition, CRC Press, 2019
3. RMD Sundaram Shriram, K. Vasudevan and Abhishek S. Nagarajan, “Internet of Things”, Wiley, 2019

**(19A02802b) SMART ELECTRIC GRID**

**(OE-IV)**

**Course Objectives:**

- To learn about recent trends in grids as smart grid
- To understand about smart grid architecture and technologies
- To know about smart substations
- To learn about smart transmission systems
- To learn about smart distribution systems

**UNIT-I:**

**Introduction to Smart Grid**

Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions – Traditional Power Grid and Smart Grid – New Technologies for Smart Grid – Advantages – Indian Smart Grid – Key Challenges for Smart Grid

**Smart Grid Architecture:** Components and Architecture of Smart Grid Design – Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs – Transmission Automation – Distribution Automation – Renewable Integration

**Learning Outcomes:**

After completing this Unit, students will be able to

- To understand basic definitions and architecture of Smart grid
- To learn about new technologies for smart grid
- To know about fundamental components of smart grid
- To understand key challenges of smart grid
- To understand the need for integration of Renewable energy sources

**UNIT-II:**

**Smart grid Technologies**

Characteristics of Smart grid, Micro grids, Definitions, Drives, benefits, types of Micro grid, building blocks, Renewable energy resources, needs in smart grid, integration impact, integration standards, Load frequency control, reactive power control, case studies and test beds

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about basic characteristic features of smart grid technologies
- To understand about definition, types, building blocks of Microgrids
- To know about integration requirements, standards of renewable energy sources in Microgrids
- To understand Load frequency and reactive power control of Microgrid
- To understand about Microgrid through a case study

### **UNIT-III:**

#### **Smart Substations**

Protection, Monitoring and control devices, sensors, SCADA, Master stations, Remote terminal unit, interoperability and IEC 61850, Process level, Bay level, Station level, Benefits, role of substations in smart grid, Volt/VAR control equipment inside substation

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about protection, monitor and control devices in Smart substations
- To know about the importance of SCADA in substations
- To understand about interoperability and IEC 61850
- To know about role of substations in Smart grid
- To understand about Volt/VAR control equipment inside substation

### **UNIT-IV:**

#### **Smart Transmission**

Energy Management systems, History, current technology, EMS for the smart grid, Wide Area Monitoring Systems (WAMS), protection & Control (WAMPC), needs in smart grid, Role of WAMPC smart grid, Drivers and benefits, Role of transmission systems in smart grid, Synchro Phasor Measurement Units (PMUs)

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about Energy Management Systems in smart transmission systems
- To understand about WAMPC
- To know about role of transmission systems in Smart grid
- To know about Synchro Phasor Measurement units

### **UNIT-V:**

## **Smart Distribution Systems**

DMS, DSCADA, trends in DSCADA and control, current and advanced DMSs, Voltage fluctuations, effect of voltage on customer load, Drivers, objectives and benefits, voltage-VAR control, VAR control equipment on distribution feeders, implementation and optimization, FDIR - Fault Detection Isolation and Service restoration (FDIR), faults, objectives and benefits, equipment, implementation

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about DSCADA in Smart Distribution Systems
- To distinguish between current and advanced DMSs
- To know about occurrence of voltage fluctuations
- To understand about VAR control and equipment on distribution feeders
- To know about FDIR objectives and benefits

### **Course Outcomes:**

- To be able to understand trends in Smart grids
- To understand the needs and roles of Smart substations
- To understand the needs and roles of Smart Transmission systems
- To understand the needs and roles of Smart Distribution systems
- To distinguish between SCADA and DSCADA systems in practical working environment

### **Text Books:**

1. Stuart Borlase, “Smart Grids - Infrastructure, Technology and Solutions”, 1<sup>st</sup> edition, CRC Press, 2013
2. Gil Masters, “Renewable and Efficient Electric Power System”, 2<sup>nd</sup> edition, Wiley–IEEE Press, 2013.

### **Reference Books:**

1. A.G. Phadke and J.S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer Edition, 2e, 2017.
2. T. Ackermann, “Wind Power in Power Systems”, Hoboken, NJ, USA, John Wiley, 2e, 2012.

**(19A04802a) INTRODUCTION TO IMAGE PROCESSING**

**OPEN ELECTIVE-IV**

**Course Objectives:**

- To interpret fundamental concepts of digital image processing.
- To exemplify image enhancement.
- To interpret fundamental concepts of color image processing.
- To assess image compression techniques for digital images.
- To summarize segmentation for digital images.

**UNIT-I:**

**INTRODUCTION TO DIGITAL IMAGE PROCESSING**

**Introduction:** Digital image representation, Fundamental steps in image processing, Elements of digital image processing, Elements of visual perception, Simple image model, Sampling and Quantization, Basic relationships between pixels, Image transformations.

**Applications:** Medical imaging, Robot vision, Character recognition, Remote sensing.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the fundamental concepts of image processing, Sampling process and basis relationships between pixels (L1)
- Explain the elements of Digital Image Processing (L2)

**UNIT-II:**

**IMAGE ENHANCEMENT**

Need for image enhancement, Point processing, Histogram processing, Spatial filtering- Smoothing and Sharpening.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the need for enhancement process (L1)
- Explain the terminology involved in enhancement process (L2)

### **UNIT-III:**

#### **COLOR IMAGE PROCESSING**

Colour fundamentals, Colour models, Color transformations, Pseudo colour image processing, Full colour image processing.

#### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the need for enhancement process (L1)
- Explain the terminology involved in enhancement process (L2)

### **UNIT-IV:**

#### **IMAGE COMPRESSION**

Redundancies, Fidelity criteria, Image compression model, Lossless compression: Huffman coding, Arithmetic coding. Lossy compression: Lossy Predictive Coding, JPEG Compression Standard.

#### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the need for image compression (L1)
- Explain the image compression and various types of compression techniques (L2)

### **UNIT-V:**

#### **IMAGE SEGMENTATION**

Detection of discontinuities: point, line and edge detection, Edge linking and Boundary detections: Local Processing, Global processing via Hough transform, Thresholding, Region oriented segmentation: Region growing, Region splitting and merging.

#### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the principle of image segmentation and its importance (L1)
- Explain the image compression and various types of compression techniques (L2)
- Analyze the various terminologies involved in image segmentation like edge, boundary detection etc. (L3)



**Course Outcomes:**

- Interpret fundamental concepts of digital and color image processing.
- Exemplify image enhancement.
- Analyze the various terminologies involved in image segmentation like edge, boundary detection etc. Assess image compression techniques for digital images.
- Summarize segmentation techniques for digital images.

**TEXT BOOKS:**

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, 3<sup>rd</sup> Edition, Pearson Education, 2011.

**REFERENCE BOOKS:**

1. S Jayaraman, S Esakkirajan and T Veerakumar, “Digital Image Processing”, TMH, 2011.
2. S. Sridhar, “Digital Image Processing”, 2<sup>nd</sup> Edition, Oxford Publishers, 2016.

**(19A04802b) PRINCIPLES OF CELLULAR AND MOBILE COMMUNICATIONS**  
**OPEN ELECTIVE-IV**

**Course Objectives:**

- To understand the concepts and operation of cellular systems.
- To apply the concepts of cellular systems to solve engineering problems.
- To analyse cellular systems for meaningful conclusions.
- To evaluate suitability of a cellular system in real time applications.
- To design cellular patterns based on frequency reuse factor.

**UNIT-I:**

**Introduction to Cellular Mobile Systems**

Why cellular mobile communication systems? A basic cellular system, Evolution of mobile radio communications, Performance criteria, Characteristics of mobile radio environment, Operation of cellular systems. Examples for analog and digital cellular systems.

**Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concepts and operation of cellular systems (L1).
- Analyze the characteristics of mobile radio environment (L3).

**UNIT-II:**

**Cellular Radio System Design**

General description of the problem, Concept of frequency reuse channels, Cochannel interference reduction, Desired C/I ratio, Cell splitting and sectoring.

**Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of frequency reuse and cochannel interference in cellular systems (L1).
- Apply the concept of cellular systems to solve engineering problems (L2).
- Analyze the design problems of cellular systems (L3).

- Design of cellular patterns based frequency reuse factor (L5).

### **UNIT-III:**

#### **Handoffs and Dropped Calls**

Why handoffs and types of handoffs, Initiation of handoff, Delaying a handoff, Forced handoffs, Queuing of handoffs, Power-difference handoffs, Mobile assisted handoff and soft handoff, Cell-site handoff, Intersystem handoff. Introduction to dropped call rate.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand why handoff is required (L1).
- Apply handoff techniques to solve engineering problems (L2).
- Compare various types of handoffs (L3).

### **UNIT-IV:**

#### **Multiple Access Techniques for Wireless Communications**

Introduction, Frequency Division Multiple Access, Time Division Multiple Access, Code Division Multiple Access and Space Division Multiple Access.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand various types of multiple access techniques (L1).
- Apply the concept of multiple access to solve engineering problems (L2).
- Compare various types of multiple access techniques (L3).

### **UNIT-V:**

#### **Digital Cellular Systems**

Global System for Mobile Systems, Time Division Multiple Access Systems, Code Division Multiple Access Systems. Examples for 2G, 3G and 4G systems. Introduction to 5G system.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand operation of various types of digital cellular systems (L1).
- Compare various types of digital cellular systems (L3).

- Evaluate suitability of a cellular system in real time applications (L4).

Note: The main emphasis is on qualitative treatment. Complex mathematical treatment may be avoided.

### **Course Outcomes:**

At the end of the course, the student should be able to

- Understand the concepts and operation of cellular systems (L1)
- Apply the concepts of cellular systems to solve engineering problems (L2).
- Analyse cellular systems for meaningful conclusions, Evaluate suitability of a cellular system in real time applications (L3).
- Design cellular patterns based on frequency reuse factor (L4).

### **TEXT BOOKS:**

2. William C. Y. Lee, “Mobile Cellular Telecommunications”, 2<sup>nd</sup>Edition, McGraw-Hill International, 1995.
3. Theodore S. Rappaport, “Wireless Communications – Principles and Practice”, 2<sup>nd</sup>Edition, PHI, 2004.

### **REFERENCES:**

3. Aditya K. Jagannatham “Principles of Modern Wireless Communications Systems – Theory and Practice”, McGraw-Hill International, 2015.

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### **Blooms’ Learning levels:**

L1: Remembering and Understanding

L2: Applying

L3: Analyzing, Evaluating

L4: Designing, Creating

**(19A04802c) INDUSTRIAL ELECTRONICS**  
**OPEN ELECTIVE-IV**

**Course Objectives:**

This course will enable students to:

- Describe semi-conductor devices (such as PN junction diode & Transistor) and their switching characteristics.
- Understand the characteristics of AC to DC converters.
- Understand about the practical applications Electronics in industries
- Describe the Ultrasonics and its application.

**UNIT I**

Scope of industrial Electronics, Semiconductors, Merits of semiconductors, crystalline structure, Intrinsic semiconductors, Extrinsic semiconductors, current flow in semiconductor, Open-circuited p-n junction, Diode resistance, Zener diode, Photoconductors and junction photo diodes, Photo voltaic effect, Light emitting diodes(LED).

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the importance of Electronics and semiconductor devices in industry, operation of semiconductor devices (L1)
- Describe the working of semiconductor diodes (L1)

**UNIT II**

Introduction, The junction transistor, Conventions for polarities of voltages and currents, Open circuited transistor, Transistor biased in the active region, Current components in transistors, Currents in a transistor, Emitter efficiency, Transport factor and transistor- $\alpha$ , Dynamic emitter resistance, Transistor as an amplifier, Transistor construction, Lettersymbols for semiconductor Devices, Characteristic curves of junction transistor in common configuration, static characteristic curves of PNP junction transistor in common emitter configuration, The transistor in common collector Configuration.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the working of Transistor and its different configurations (L1)

- Describe the working of CE, CC, CB configurations (L1)

### UNIT III

**AC to DC converters-** Introduction, Classification of Rectifiers, Half wave Rectifiers, Fullwave Rectifiers, Comparison of Half wave and full wave rectifiers, Bridge Rectifiers, Bridge Rectifier meter, Voltage multiplying Rectifier circuits, Capacitor filter, LC Filter, Metal Rectifiers, Regulated Power Supplies, Classification of Voltage Regulators, Short period Accuracy of Regulators, Long period Accuracy of Voltage Regulator, Principle of automatic voltage Regulator, Simple D.C. Voltage stabilizer using Zener diode, D.C. Voltage Regulators, Series Voltage Regulators, Complete series voltage regulator circuit, Simple series voltage regulator.

### UNIT IV

**Resistance welding controls:** Introduction, Resistance welding process, Basic Circuit for A.C. resistance welding, Types of Resistance welding, Electronic welding control used in Resistance welding, Energy storage welding. **Induction heating:** Principle of induction heating, Theory of Induction heating merits of induction heating, Application of induction heating, High frequency power source of induction heating. **Dielectric heating:** Principle of dielectric heating, theory of dielectric heating, dielectric properties of typical materials, electrodes used in dielectric heating, method of coupling of electrodes to the R.F. generator, Thermal losses in Dielectric heating, Applications.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the principle of operation of Resistance welding, Induction heating and Dielectric heating (L1)
- Apply the process of Resistance welding, Induction heating and Dielectric heating in the industry (L2)

### UNIT V:

**Ultrasonics:** Introduction, Generation of Ultrasonic waves, Application of Ultrasonic waves, Ultrasonic stroboscope, ultrasonic as means of communication, ultrasonic flaw detection, Optical image on non-homogeneities, ultrasonic study of structure of matter, Dispersive study of structure of matter, Dispersive and colloidal effect of Ultrasonic, Coagulating action of Ultrasonic, separation of mixtures by ultrasonic waves, cutting and machining of hard materials by ultrasonic vibrations, Degassing of liquids by ultrasonic waves, Physio-chemical

effects of ultrasonics, chemical effects of ultrasonics, Thermal effects of Ultrasonics, soldering and welding by ultrasonics, Ultrasonic Drying

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the principle of operation of Ultrasonics and its applications (L1)
- Analyze the thermal effects of Ultrasonics, soldering and welding by ultrasonics, Ultrasonic Drying in the industry (L3)

### **Course Outcome:**

- Understand the semi-conductor devices and their switching characteristics.
- Apply the Ultrasonic waves with different applications
- Analyze the thermal effects of Ultrasonics, soldering and welding by ultrasonics, Ultrasonic Drying in the industry, Interpret the characteristics of AC to DC converters,
- Develop the practical applications Electronics in industries.

### **TEXT BOOKS:**

1. G. K. Mithal, "Industrial Electronics", Khanna Publishers, Delhi, 2000.
2. J. Gnanavadivel, R. Dhanasekaran, P. Maruthupandi, "Industrial Electronics", Anuradha Publications, 2011.

### **REFERENCE BOOKS:**

1. F. D. Petruzulla, "Industrial Electronics", McGraw Hill, Singapore, 1996.
2. M. H. Rashid, "power Electronics Circuits, Devices and Application", PHI, 3<sup>rd</sup> edition, 2004.
3. G. M. Chute and R. D. Chute, "Electronics in Industry", McGraw Hill Ltd, Tokyo, 1995.

**(19A04802d) ELECTRONIC INSTRUMENTATION**  
**OPEN ELECTIVE-IV**

**Course Objectives:**

**This course will enable students to:**

- To introduce various measuring instruments and their functionality
- To teach various measurement metrics for performance analysis
- To explain principles of operation and working of different electronic instruments
- To familiarize the characteristics, operations, calibrations and applications of the different oscilloscopes and signal generators.
- To provide exposure to different types of transducers

**UNIT – I**

**Measurement and Error:** Definitions, Accuracy, Precision, Resolution and Significant Figures, Types of Errors, Measurement error combinations. (Text 2)

**Ammeters:** DC Ammeter, Multi-range Ammeter, The Ayrton Shunt or Universal Shunt, Requirements of Shunt, Extending of Ammeter Ranges, RF Ammeter (Thermocouple), Limitations of Thermocouple. (Text 1)

**Voltmeters and Multi-meters:** Introduction, Basic Meter as a DC Voltmeter, DC Voltmeter, Multi range Voltmeter, Extending Voltmeter Ranges, Loading, AC Voltmeter using Rectifiers. True RMS Voltmeter, Multi-meter. (Text 1)

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain the importance of measurement system (L1)
- Examine the characteristics of different Instruments (L2)
- Illustrate different types of errors that may occur in instruments during measurements (L2)

**UNIT – II**

**Digital Voltmeters:** Introduction, RAMP technique, Dual Slope Integrating Type DVM, Integrating Type DVM, Most Commonly used principles of ADC, Successive Approximations, -Digit, Resolution and Sensitivity of Digital Meters, General Specifications of DVM, (Text 1)



**Digital Instruments:** Introduction, Digital Multi-meters, Digital Frequency Meter, Digital Measurement of Time, Universal Counter, Digital Tachometer, Digital pH Meter, Digital Phase Meter, Digital Capacitance Meter, (Text 1)

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain working of digital measuring Instruments (L2)
- Compare the various measuring techniques for measuring voltage (L4)

**UNIT – III**

**Oscilloscopes:** Introduction, Basic principles, CRT features, Block diagram of Oscilloscope, Simple CRO, Vertical Amplifier, Horizontal Deflecting System, Sweep or Time Base Generator, Measurement of Frequency by Lissajous Method, Digital Storage Oscilloscope. (Text 1)

**Signal Generators:** Introduction, Fixed and Variable AF Oscillator, Standard Signal Generator, Laboratory Type Signal Generator, AF sine and Square Wave Generator, Function Generator, (Text 1)

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Describe functions of basic building of CRO (L1)
- Measure parameters viz. Amplitude, frequency and time period using CRO (L2)
- Classify signal generators and describe its characteristics (L2)

**UNIT – 4**

**Measuring Instruments:** Field Strength Meter, Stroboscope, Phase Meter, Q Meter, Megger. (Text 1)

**Bridges:** Introduction, Wheatstone's bridge, Kelvin's Bridge; AC bridges, Capacitance Comparison Bridge, Inductance Comparison Bridge, Maxwell's bridge, Wien's bridge. (Text 1)

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Describe function of various measuring Instruments. (L1)
- Describe how unknown capacitance and inductance can be measured using bridges (L1)
- Select appropriate bridge for measuring R, L and C parameters (L2)

## UNIT – 5

**Transducers:** Introduction, Electrical transducers, Selecting a transducer, Resistive transducer, Resistive position transducer, Strain gauges, Resistance thermometer, Thermistor, Inductive transducer, LVDT, Piezoelectric transducer, Photo cell, Photo voltaic cell, Semiconductor photo diode and transistor. (Text 1)

### Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the importance of transducer (L1)
- Illustrate different measuring techniques in transducers to measure physical quantities.(L2)
- Select the appropriate transducer for the measurement of physical parameters (L2)

### Course outcomes:

- Learn different types of errors in measurement, calibration process and standards, various methods for measurement of non-electrical quantities, Understand the different methods for measurement of various electrical quantities.
- Familiarize the dynamics of instrument systems, various passive and active transducers
- Compare the various measuring techniques for measuring voltage (L4)

### TEXT BOOKS:

- H. S. Kalsi, “Electronic Instrumentation”, McGraw Hill, 3rd Edition, 2012, ISBN:9780070702066.
- A. D. Helfrick and W.D. Cooper, “Modern Electronic Instrumentation and Measuring Techniques”, Pearson, 1st Edition, 2015, ISBN: 9789332556065.

### REFERENCE BOOKS:

- David A. Bell, “Electronic Instrumentation & Measurements”, Oxford University Press PHI 2nd Edition, 2006 ISBN 81-203-2360-2.
- A. K. Sawhney, “Electronics and Electrical Measurements”, Dhanpat Rai & Sons. ISBN -81-7700-016-0

**(19A05802a) BLOCKCHAIN TECHNOLOGY**

**Course Objectives:**

This course is designed to:

- Understand the philosophy of Blockchain and the cutting edge technology behind its functions
- Illustrate how to setup Ethereum tools
- Explain the key vocabulary and concepts used in Blockchain for Business

UNIT-I

**Blockchain concepts:** Blockchain, Blockchain application example: Escrow, Blockchain stack, from web 2.0 to the next generation decentralized web, domain specific Blockchain application, Blockchain benefits and challenges.

**Blockchain application templates:** Blockchain application components, design methodology for Blockchain applications, Blockchain applications templates

**Learning Outcomes:**

After completing this Unit, students will be able to

- Outline the benefits and challenges of Block chain(L2)
- Design the Blockchain applications(L6)

UNIT-II

**Setting up Ethereum development tools:** Ethereum clients,Ethereum languages, TestRPC, Mist Ethereumwalle, meta mask, web3 JavaScript API, truffle.

**Ethereum Accounts:** Ethereum Accounts, keypairs, working with EOA Accounts, working with contract accounts.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Illustrate the use of Ethereum development tools(L2)
- Create Ethereum accounts and work with them (L6)

UNIT-III

**Smart contracts:** Smart contract, structure of a contract, setting up and interacting with a contract using Geth client, setting up and interacting with a contract using Mist Wallet

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Make use of smart contracts(L3)
- Distinguish setting up and interacting with a contract using Geth client and Mist Wallet.(L4)

### UNIT-IV

**Smart contracts (continued):** Smart contract examples, Smart contract patterns.

**Decentralized Applications:** implementing Dapps, case studies,

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Illustrate the Smart contract examples and patterns(L2)
- Develop Decentralized applications.(L6)

### UNIT-V

**Mining:** Consensus on Blockchain network, mining, Block validation, state storage in Ethereum.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Define Consensus on Blockchain network(L1)
- Demonstrate State Storage in Ethereum(L2)

### **Course outcomes:**

Upon completion of the course, the students should be able to:

- Create customized blockchain solutions (L6)
- Make use of the specific mechanics of Ethereum(L3)
- Experiment with Smart contracts (L3)
- Develop Enterprise applications using Blockchain(L6)

### **Text book:**

1. Arshadeepbahga, Vijay madiseti, “Blockchain Applications A hands-on approach”, VPT 2017.

2. Chandramouli Subramanian, Asha A George, Abhilash K A and MeenaKarthikeyan, "Blockchain Technology", Universty Press, 2021

**References:**

1. Imran Bashir, "Mastering Blockchain" Packt Publishing Ltd, March 2017.
2. Melanie swan, "Blokchain blueprint for a new economy", O'REILLY

**(19A05802b) MEAN STACK TECHNOLOGIES**

**Course Objectives:**

This course is designed to:

- Translate user requirements into the overall architecture
- Implement new systems and manage the projects
- Write optimized front end code using HTML and JavaScript
- Monitor the performance of web applications & its infrastructure
- Design and implement Robust and Scalable Front End Applications

**UNIT I**

Introduction to Web: Internet and World Wide Web, Domain name service, Protocols: HTTP, FTP, SMTP. Html5 concepts, CSS3, Anatomy of a web page. XML: Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX Approaches.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Summarize the protocols related to Internet & WWW(L2)
- Compare and contrast XML and HTML(L5)

**UNIT II**

JavaScript: The Basic of JavaScript: Objects, Primitives Operations and Expressions, Control Statements, Arrays, Functions, Constructors, Pattern Matching using Regular Expressions. Angular Java Script Angular JS Expressions: ARRAY, Objects, \$eval, Strings, Angular JS Form Validation & Form Submission, Single Page Application development using Angular JS.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Illustrate the importance of JavaScript(L2)
- Develop applications using Angular JS(L6)

### **UNIT III**

Node.js: Introduction, Advantages, Node.js Process Model, Node JS Modules. Express.js: Introduction to Express Framework, Introduction to Nodejs , What is Nodejs, Getting Started with Express, Your first Express App, Express Routing, Implementing MVC in Express, Middleware, Using Template Engines, Error Handling , API Handling , Debugging, Developing Template Engines, Using Process Managers, Security & Deployment.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Explain the Node JS modules(L2)
- Make use of MVC in Express(L3)

### **UNIT IV**

RESTful Web Services: Using the Uniform Interface, Designing URIs, Web Linking, Conditional Requests. React Js: Welcome to React, Obstacles and Roadblocks, React's Future, Keeping Up with the Changes, Working with the Files, Pure React, Page Setup, The Virtual DOM, React Elements, ReactDOM, Children, Constructing Elements with Data, React Components, DOM Rendering, Factories.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Outline the RESTful Web Services(L2)
- Assess the future of React Js(L5)

### **UNIT V**

Mongo DB: Introduction, Architecture, Features, Examples, Database Creation & Collection in Mongo DB. Deploying Applications: Web hosting & Domains, Deployment Using Cloud Platforms.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Explain the features and architecture of Mongo DB (L2)
- Create and collect Database in MongDB(L6)

#### **Course Outcomes**

After the completion of the course, student will be able to

- List the Basic Concepts of Web & Markup Languages(L1)
- Develop web Applications using Scripting Languages & Frameworks(L6)
- Make use of Express JS and Node JS frameworks(L3)
- Illustrate the uses of web services concepts like restful, react js (L2)
- Deploying applications using Cloud Platforms (L6)

**Text Books:**

- 1) Programming the World Wide Web, Robert W Sebesta, 7ed, Pearson.
- 2) Web Technologies, Uttam K Roy, Oxford
- 3) Pro Mean Stack Development, ELadElrom, Apress
- 4) Restful Web Services Cookbook, Subbu Allamraju, O'Reilly
- 5) JavaScript & jQuery the missing manual, David sawyer mcfarland, O'Reilly
- 6) Web Hosting for Dummies, Peter Pollock, John Wiley Brand

**Reference Books:**

- 1) Ruby on Rails up and Running, Lightning fast Web development, Bruce Tate, Curt Hibbs, Oreilly (2006).
- 2) Programming Perl, 4ed, Tom Christiansen, Jonathan Orwant, Oreilly (2012).
- 3) Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, Dream Tech.
- 4) An Introduction to Web Design, Programming, Paul S Wang, Sanda S Katila, Cengage Learning.
- 5) Express.JS Guide, The Comprehensive Book on Express.js, Azat Mardan, Lean Publishing.

**e-Resources:**

- 1) <http://www.upriss.org.uk/perl/PerlCourse.html>



**(19A27802a) FOOD PLANT UTILITIES & SERVICES**  
**OPEN ELECTIVE - IV**

**PREAMBLE**

This subject focuses on different utilities like water, steam, electricity and its properties, production of consumption of these sources in the food plant.

**OBJECTIVES**

- To give brief idea about the utilities that are required/used in food industry and their sources and importance.

**UNIT – I**

Introduction Classification of various utilities and services in food industry. Water use in Food Processing Industry Water supply system: Pumps of different types, operational aspects, piping system for fresh water, chilled water etc., fittings and control, water requirement for cleaning and processing, water quality, water purification and softening Unit

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Water use in Food Processing Industry
- Water supply system: Pumps of different types, operational aspects, piping system for fresh water, chilled water etc.,
- fittings and control, water requirement for cleaning and processing,
- water quality, water purification and softening Unit

**UNIT – II**

Water use in food processing: Different types of water requirements in food processing plants, types of water use, waste water sources, water wastage minimization, water loadings per unit mass of raw material. Water conservation: Water and waste water management, economic use of water, water filtration and recirculation.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Different types of water requirements in food processing plants,

- types of water use, waste water sources, water wastage minimization,
- water loadings per unit mass of raw material
- Water and waste water management, economic use of water,
- water filtration and recirculation

### **UNIT – III**

Steam uses in Food Industry Steam uses in food industry: Food processing operations in which steam is used, temperature, pressure and quantity of steam required in various food processing operations Steam generation system: Components of a boiler system, fuels used in boilers, energy analysis for a steam generation system, heat loss from boiler system, boiler design consideration.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Food processing operations in which steam is used
- Temperature, pressure and quantity of steam required in various food processing operations
- Components of a boiler system, fuels used in boilers, energy analysis for a steam generation system
- Heat loss from boiler system, boiler design consideration.

### **UNIT – IV**

Waste-Heat Recovery in Food Processing Facilities Quantity and quality of waste heat in food processing facilities, waste heat utilization, heat exchangers for waste heat recovery, heat pumps for waste heat recovery. Waste Disposal and its Utilization Industrial waste, sewage, influent, effluent, sludge, dissolved oxygen, biological oxygen demand, chemical oxygen demand.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Waste-heat recovery in food processing facilities
- Quantity and quality of waste heat in food processing facilities,
- Waste heat utilization, heat exchangers for waste heat recovery, heat pumps for waste heat recovery.
- Waste disposal and its utilization industrial waste, sewage, influent, effluent, sludge,
- Dissolved oxygen, biological oxygen demand, chemical oxygen demand

## UNIT – V

Planning and Design of Service Facilities in Food Industry Estimation of utilities requirements: Lighting, ventilation, drainage, CIP system, dust removal, fire protection etc. Maintenance of facilities: Design and installation of piping system, codes for building, electricity, boiler room, plumbing and pipe colouring, maintenance of the service facilities. Services required in offices, laboratories, locker and toilet facilities, canteen, parking lots and roads, loading docks, garage, repair and maintenance shop, ware houses etc.

### Learning Outcomes:

At the end of unit, students will be able to understand the following

- Planning and Design of Service Facilities in Food Industry Estimation of utilities requirements: Lighting, ventilation, drainage, etc.
- Maintenance of facilities: Design and installation of piping system, codes for building, electricity, plumbing, maintenance of the service facilities.
- Services required in offices, laboratories, locker and toilet facilities, canteen, parking lots and roads, repair and maintenance shop, ware houses etc

### Course Outcomes

By end of the course, students will understand the following

- Various utilities and services used in food industry and its applications in food industry namely water, steam, electricity and etc.

### TEXT BOOKS

1. Lijun Wang. “Energy Efficiency and Management in Food Processing Facilities”. CRC Press. 2008,
2. M. E. Casper. “Energy-saving Techniques for the Food Industry”. Noyes Data Corporation. 1977,

### REFERENCES

1. P.L. Ballaney, “Thermal Engineering in SI Units”, 23<sup>rd</sup> Edition, Khanna Publishers, Delhi, 2003.
2. C.P. Arora. “Refrigeration and Air Conditioning”. 3<sup>rd</sup> Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi. 2008,
3. W. E. Whitman, “A Survey of Water Use in the Food Industry”, S. D. Holdsworth. Published by British Food Manufacturing Industries Research Association.
4. Chilton's Food Engineering. 1979, Chilton Co Publishers.

**(19A27802b) NUTRACEUTICALS AND FUNCTIONAL FOODS**

**OPEN ELECTIVE – IV**

**PREAMBLE**

This course will cover the classification, brief history and the impact of nutraceuticals and functional foods on health and disease prevention. Nutraceuticals to be covered in the course include isoprenoids, isoflavones, flavanoids, carotenoids, lycopene, garlic, omega 3 fatty acids, sphingolipids, vitamin E and antioxidants, herbal products in foods. Also marketing issues related to functional foods and nutraceuticals as well as stability testing will be reviewed.

**Course Objectives:**

- To understand the interrelationship between nutraceuticals and health maintenance.
- Cite the evidence supporting the efficacy and safety of nutraceutical and functional food products
- To explain the metabolic consequences of nutraceuticals and functional foods.
- Describe the physiologic and biochemical changes associated with consumption of nutraceuticals

**UNIT – I**

Introduction, definition, Modification in the definition of nutraceuticals. Classification of nutraceuticals, Nutraceuticals market scenario, formulation considerations. Challenges for Nutraceuticals.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Classification of nutraceuticals,
- Nutraceuticals market scenario and formulation considerations.
- Challenges for Nutraceuticals.

**UNIT – II**

Nutraceuticals value of spices and seasoning – Turmeric, Mustard, Chilli, Cumin, Fenugreek, Black Cumin, Fennel, Asafoetida, Garlic, Ginger, Onion, Clove, Cardamom etc.,

Nutraceuticals from Fruits And Vegetables – Mango, Apple, Grapes, Bel, Banana, Broccoli, Tomato, Bitter Melon, Bitter Orange etc.

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Nutraceuticals value of spices and seasoning – Turmeric, Mustard, Chilli, Etc.
- Nutraceuticals from Fruits and Vegetables – Mango, Apple, Grapes, Tomato etc.

### **UNIT – III**

Omega -3 fatty acids from fish- Typical properties, structural formula, functional category. CLA- typical properties, structural formula, functional category. Application in Nutraceuticals. Calcium, chromium, copper, iodine, iron, magnesium, Zn- mechanism of action, bioavailability, uses and deficiency, dietary sources.

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Properties of Omega -3 fatty acids from fish and structures
- Application in Nutraceuticals. Calcium, iodine, iron, Zn- mechanism of action, bioavailability, uses and deficiency, dietary sources.

### **UNIT – IV**

Definition, classification – Type of classification (Probiotics, probiotics and synbiotics: Taxonomy and important features of probiotic microorganisms. Health effects of probiotics including mechanism of action. Probiotics in various foods: fermented milk products, non-milk products etc. Prebiotics. Definition, chemistry, sources, metabolism and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases, perspective for food applications for the following: Non-digestible carbohydrates/oligosaccharides: Dietary fibre, Resistant starch, Gums.

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Probiotics, probiotics and synbiotics: important features of probiotic microorganisms.
- Non-digestible carbohydrates/oligosaccharides: Dietary fibre and etc.

### **UNIT – V**

Phytosterol, Fatty Acids, Carotenoids, Anthocyanins, Carotenoids, Amino Acids, Water Soluble Vitamins, Free radical biology and antioxidant activity of nutraceuticals. Regulations of Nutraceuticals and Functional Foods in India and rest of the world.

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Phytosterol, Fatty Acids, Carotenoids, Anthocyanins, Free radical biology and antioxidant activity of nutraceuticals.
- Regulations of Nutraceuticals and Functional Foods in India and rest of the world.

### **Course Outcomes**

- Students will get know the nutraceuticals and its active components in different foods, regulations on nutraceuticals in India.

### **TEXT BOOKS**

1. “Handbook of Nutraceuticals and Functional Foods. Yashwant Pathak, Vol. 1. (Ingredients, formulations, and applications)” CRC Press 2005.
2. “Handbook of Nutraceuticals and Functional Foods”. Robert Wildman, 2<sup>nd</sup> Edition. CRC Press 2001.

### **REFERENCES**

1. B. Shrilakshmi, “Dietetics”, 5<sup>th</sup> Edition, New Age International (P) Ltd., New Delhi, 2005.
2. A. E. Bender, “Nutrition and Dietetic Foods”, Chem. Pub. Co. New York, 2<sup>nd</sup> Edition, 2004.
3. P. S. Howe, “Basic Nutrition in Health and Disease”, 2<sup>nd</sup> Edition, W. B. Saunders Company, London, 2003.
4. Kramer, “Nutraceuticals in Health and Disease Prevention”, Hoppe and Packer, Marcel Dekker, Inc., NY 2001.
5. Bao and Fenwick, “Phytochemicals in Helath and Disease”, Marcel Decker, Inc. NY 2004.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– IV-II** **L T P C**  
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**(19A54802a) MATHEMATICAL MODELING & SIMULATION**

## OPEN ELECTIVE-IV

### Course Objective:

This course focuses on what is needed to build simulation software environments, and not just building simulations using preexisting packages.

### UNIT-I:

Simulation Basics-Handling Stepped and Event-based Time in Simulations-Discrete versus Continuous Modeling-Numerical Techniques-Sources and Propagation of Error

### Learning Outcomes:

Students will be able to

- Understand computer simulation technologies and techniques.

### UNIT-II

Dynamical, Finite State, and Complex Model Simulations-Graph or Network Transitions Based Simulations-Actor Based Simulations-Mesh Based Simulations-Hybrid Simulations

### Learning Outcomes:

Students will be able to

- implement and test a variety of simulation and data analysis.

### UNIT-III

Converting to Parallel and Distributed Simulations-Partitioning the Data-Partitioning the Algorithms-Handling Inter-partition Dependencies

### Learning Outcomes:

Students will be able to

- Understand concepts of modeling layers of society's critical infrastructure networks.
- Understand partitioning the data.

### UNIT-IV

Probability and Statistics for Simulations and Analysis-Introduction to Queues and Random Noise-Random Variates Generation-Sensitivity Analysis

**Learning Outcomes:**

Students will be able to

- Understand Queues and Random noise.
- Understand sensitivity analysis.

**UNIT-V**

Simulations Results Analysis and Viewing Tools-Display Forms: Tables, Graphs, and Multidimensional Visualization-Terminals, X and MS Windows, and Web Interfaces-Validation of Model Results

**Learning Outcomes:**

Students will be able to

- Build tools to view and control simulations and their results.

**Course Outcomes:**

After the completion of course, student will be able to

- Understand basic Model Forms.
- Understand basic Simulation Approaches.
- Evaluate handling Stepped and Event-based Time in Simulations.
- Distinguish Discrete versus Continuous Modeling.
- Apply Numerical Techniques.
- Calculate Sources and Propagation of Error.

**TEXT BOOKS:**

1. JN Kapur, "Mathematical modelling", Newage publishers
2. Kai Velten, "Mathematical Modeling and Simulation: Introduction for Scientists and Engineers" Wiley Publishers.



**(19A51802a) GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT**

**Course Objectives:**

- Learn an interdisciplinary approach to the scientific and societal issues arising from industrial chemical production, including the facets of chemistry and environmental health sciences that can be integrated to promote green chemistry and the redesign of chemicals, industrial processes and products.
- Understand the use of alternatives assessments that combine chemical, environmental health, regulatory, and business considerations to develop safer products.

**UNIT 1: PRINCIPLES AND CONCEPTS OF GREEN CHEMISTRY**

Introduction, Green chemistry Principles, sustainable development and green chemistry, atom economy, atom economic: Rearrangement and addition reactions and un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation, Polymer recycling.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Apply the Green chemistry Principles for day to day life as well as synthesis (L3)
- Describe the sustainable development and green chemistry (L2)
- Explain economic and un-economic reactions (L2)
- Demonstrate Polymer recycling (L2)

**UNIT 2: CATALYSIS AND GREEN CHEMISTRY**

Introduction to catalysis, Heterogeneous catalysts: Basics of Heterogeneous Catalysis, Zeolites and the Bulk Chemical Industry, Heterogeneous Catalysis in the Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Homogeneous catalysis: Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, Asymmetric Catalysis, Heterogenising the Homogenous catalysts, Phase transfer catalysis: Hazard Reduction, C–C Bond Formation, Oxidation Using Hydrogen Peroxide, Bio-catalysis and photo-catalysis with examples.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Explain Heterogeneous catalyst and its applications in Chemical and Pharmaceutical Industries (L2)
- Differentiate Homogeneous and Heterogeneous catalysis (L2)
- Identify the importance of Bio and Photo Catalysis (L3)
- Discuss Transition metal and Phase transfer Catalysis (L3)

### **UNIT 3: ORGANIC SOLVENTS: ENVIRONMENTALLY BENIGN SOLUTIONS**

Organic solvents and volatile organic compounds, solvent free systems, supercritical fluids: Super critical carbondioxide, super critical water and water as a reaction solvent: water based coatings, Ionic liquids as catalyst and solvent

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Demonstrate Organic solvents and importance of solvent free systems (L3)
- Discuss Super critical carbondioxide (L2)
- Explain Super critical water and water as a reaction solvent (L2)
- Interpret Ionic Liquids as Catalyst and Solvent (L2)

### **UNIT 4: EMERGING GREENER TECHNOLOGIES AND ALTERNATIVE ENERGY SOURCES**

Biomass as renewable resource, Energy: Fossil Fuels, Energy from Biomass, Solar Power, Other Forms of Renewable Energy, Fuel Cells, Chemicals from Renewable feedstocks: Chemicals from Renewable Feedstocks: Chemicals from Fatty Acids, Polymers from Renewable Resources, Some Other Chemicals from Natural Resources, Alternative Economies: The Syngas Economy, The Biorefinery, Design for energy efficiency: Photochemical Reactions: Advantages of and Challenges Faced by Photochemical Processes, Examples of Photochemical Reactions, Chemistry Using Microwaves: Microwave Heating, Microwave-assisted Reactions, Sonochemistry: Sonochemistry and Green Chemistry, Electrochemical Synthesis: Examples of Electrochemical Synthesis. Industrial applications of alternative environmentally benign catalytic systems for carrying out the important reactions such as selective oxidation, reduction and C-C bond formations (specific reactions).

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Describe importance of Biomass and Solar Power (L2)
- Illustrate Sonochemistry and Green Chemistry ((L2)
- Apply Green Chemistry for Sustainable Development (L3)
- Discuss the importance of Renewable resources (L3)

## **UNIT 5: GREEN PROCESSES FOR GREEN NANOSCIENCE**

Introduction and traditional methods in the nanomaterials synthesis, Translating green chemistry principles for practicing Green Nanoscience. Green Synthesis of Nanophase Inorganic Materials and Metal Oxide Nanoparticles: Hydrothermal Synthesis, Reflux Synthesis, Microwave-Assisted Synthesis, Other methods for Green synthesis of metal and metal oxide nanoparticles, Green chemistry applications of Inorganic nanomaterials

### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Discuss green Chemistry Principles for practicing Green nano synthesis (L3)
- Illustrate Microwave Assisted Synthesis (L2)
- Differentiate Hydrothermal and Reflux synthesis (L2)
- Demonstrate Green Chemistry applications of Inorganic nanomaterials (L2)

### **Course Outcomes:**

Upon completion of this course the students should recognize and acquire green chemistry concepts and apply these ideas to develop respect for the inter connectedness of our world and an ethic of environmental care and sustainability.

### **Text Books :**

1. M. Lancaster, Green Chemistry an introductory text, Royal Society of Chemistry, 2002.
2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, 4<sup>th</sup> Edition, Oxford University Press, USA

### **References :**

1. Green Chemistry for Environmental Sustainability, First Edition, Sanjay K. Sharma and Ackmez Mudhoo, CRC Press, 2010.
2. Edited by Alvis Perosa and Maurizio Selva , Hand Book of Green chemistry Volume 8: Green Nanoscience, wiley-VCH, 2013.

# HONOURS

**(19A03H01) ALTERNATIVE FUELS AND EMISSION CONTROL IN  
AUTOMOTIVES  
(Honors)**

**Course Objectives:**

The main objectives of this course are to make the student

- Explain various alcohol and gaseous fuels and their use in SI and CI engines.
- Discuss various vegetable oils and their use in CI engines.
- Determine the formation of various emissions from SI engine and control techniques.
- Identify various emission measuring instruments and test procedures.

**UNIT I**

**Alcohol fuels and gaseous fuels:** Properties of alcohols, alcohol – gasoline blends, fuel flexible vehicle, methanol reformed gas engine, dual fuel system, Spark assisted diesel engine, surface ignition engine, ignition accelerators, performance, combustion and emission characteristics in SI and CI engines, Properties of Hydrogen, production and storage methods, safety precautions, biogas production and its properties, properties of LPG and CNG, Performance, combustion and emission characteristics of hydrogen, biogas, LPG and CNG in SI and CI engines

**Learning Outcomes:**

At the end of this unit, the student will be able to

- The properties of alcohols and alcohol gasoline blends (L5)
- Explain the principles of spark assisted diesel engine and surface ignition engine.(13)
- Identify the performance, combustion and emission characteristics in si and ci engines.(13)
- Explain production, storage methods and emission characteristics of hydrogen. (13)

**UNIT II**

**Vegetable oils:** Various vegetable oils for diesel engines, structure and properties, problems in using vegetable oils in diesel engines, Methods to improve the engine performance using vegetable oils – preheating, Esterification , blending with good secondary fuels, Semi-adiabatic engine, surface ignition engine, ignition accelerators dual fuelling with gaseous and liquid fuels coils, Performance, combustion and emission characteristics of biodiesel fuelled diesel engines.

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- List various vegetable oils and its properties used for diesel engines (L1)
- Identify the problems in using vegetable oils in diesel engines.(L3)
- Explain the methods to improve the engine performance using vegetable oils.(L3)
- Explain the method of blending with good secondary fuels. (L3)
- Determine the performance, combustion and emission characteristics of biodiesel fuelled diesel engine (L3)

### **UNIT III**

**Emissions from SI engines and their control:** Emission formation in SI engines (CO, HC and NO<sub>x</sub>), Effect of design and operating variables on emission formation, Control techniques – Thermal reactor, exhaust gas recirculation, Three way catalytic convertor and Charcoal canister control for evaporative emission, Positive crank case ventilation for blow by gas control.

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain emission formation in SI engines. (L3)
- Practice the effect of design and operating variables on emission formation in SI engine.(L5)
- Classify various control techniques on SI engine emission formation.(L2)
- Choose a control technique for a given application (L1)
- Explain on positive crank case ventilation for blow by gas control. (L3)

### **UNIT IV**

**Emissions from CI engines and their control:** Emission formation in CI engines (HC, CO, NO<sub>x</sub>, Aldehydes, Peroxides, hydroxides smoke and particulates), Effect of design and operating variables on emission formation, Control techniques – Exhaust gas recirculation, NO<sub>x</sub> selective catalytic reduction, Diesel oxidation catalytic convertor, Diesel particulate filter, NO<sub>x</sub> versus particulates – Trade off

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain emission formation in CI engines (L3)
- Appraise the effect of design and operating variables on emission formation in CI engine.(L5)
- Explain various control techniques on CI engine emission formation. (L3)

- Choose a control technique for a given application (L1)

## UNIT V

**Emission measuring instruments and test procedures:** Principle of operation of emission measuring instruments used in SI and CI engines, Measurement of CO<sub>2</sub> and CO by NDIR, Hydrocarbon emission by FID, Chemiluminescent analyser for NO<sub>x</sub>, Liquid and Gas chromatograph Spot sampling and continuous indication type smoke meters (Bosch, AVL and Hartridge smoke meters) emission test procedures – FTP, Euro and Bharat norms

### Lerning Outcomes:

At the end of this unit, the student will be able to

- Classify various emission measuring instruments for SI and CI engines (L2)
- Apply the principle of operation of emission measuring instruments used in SI and CI engines (L3)
- Explain the method of measurement of CO<sub>2</sub> and CO by NDIR (L3)
- Identify the emission of hydrocarbons using FID (L3)

### Course Outcomes:

At the end of this course, the student will be able

- Identify various emissions from SI and CI engines (L3)
- Explain the properties of alcohol fuels and gaseous fuels. (L3)
- Predict the problems by using vegetable oils in diesel engines (L6)
- Choose the use of various emission measuring instruments (L3)

### Text book

1. Thipse.S.S, “Alternative Fuels: Concepts, Technologies and Developments”, Jaico Publishing House, 2010.
2. Ganesan V, “ Internal combustion engines”, 4<sup>th</sup> Edition, Tata McGraw Hill Education, 2012

### Reference books

1. Michael F. Hrdeski, “Alternative Fuels: The Future of Hydrogen”, The Fairmont Press, 2008
2. R.K.Rajput, “A textbook of Internal Combustion Engines”, 2<sup>nd</sup> Edition, Laxmi Publications, 2007
3. “Society of Automotive Engineers”, Alternative Fuels: Fuel Cells and Natural Gas, Society of Automotive Engineers, Incorporated, 2000

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)** **L T P C**  
**3 1 0 4**  
**(19A03H02) ROBOTICS AND APPLICATIONS IN MANUFACTURING**  
**(Honors)**

**Course Objectives:**

The objectives of this course are to

- Learn the fundamental concepts of industrial robotic technology.
- Apply the basic mathematics to calculate kinematic and dynamic forces in robot manipulator.
- Understand the robot controlling and programming methods.
- Describe concept of robot vision system .

**UNIT – I**

**10 hrs**

**Fundamentals of Robots:** Introduction, definition, classification and history of robotics, robot characteristics and precision of motion, advantages, disadvantages and applications of robots. Introduction to matrix representation of a point in a space a vector in space, a frame in space, Homogeneous transformation matrices, representation of a pure translation, pure rotation about an axis.

**Learning Outcomes:**

at the end of this unit the student will be able to

- Define a robot and homogeneous transformations.(L1)
- Compare the types of robot manipulators based on applications.(L2)
- List out the various advantages, disadvantages and applications of robot.(L1)
- Explain the robot characteristics.(L2)

**UNIT – II**

**8 hrs**

**Kinematics of robot:** Forward and inverse kinematics of robots- forward and inverse kinematic equations for position and orientation, Denavit-Hartenberg(D-H) representation of forward kinematic equations of robots, The inverse kinematic of robots, Degeneracy and Dexterity, simple problems with D-H representation.

**Differential motions and Velocities:** Introduction, differential relationship, Jacobian, differential motions of a frame-translations, rotation, rotating about a general axis, differential transformations of a frame. Differential changes between frames, differential motions of a robot and its hand frame, calculation of Jacobian, relation between Jacobian and the differential operator, Inverse Jacobian.

**Learning Outcomes:**



at the end of this unit the student will be able to

- Evaluate D-H notations for simple robot manipulator.(L4)
- Identify the position of robot gripper within work volume.(L3)
- Use the Jacobian, Lagrange-Euler and Newton- Euler formations to solve manipulator dynamic problems.(L5)
- Explain the concepts of manipulator kinematics and dynamics.(L2)

### UNIT – III

8 hrs

**Control of Manipulators:** Open- and Close-Loop Control, the manipulator control problem, linear control schemes, characteristics of second-order linear systems, linear second-order SISO model of a manipulator joint, joint actuators, partitioned PD control scheme, PID Control Scheme, computer Torque control, force control of robotic manipulators, description of force-control tasks, force control strategies, hybrid position/force control, impedance force/torque control.

#### Learning Outcomes:

at the end of this unit the student will be able to

- Understand the basic concepts of robot controlling systems.(L2)
- Describe PD and PID control schemes.(L2)
- Use the force control strategies to determine the forces in robot.(L5)
- Explain the force control and torque control techniques.(L2)

### UNIT – IV

8 hrs

**Robot Vision:** Introduction, architecture of robotic vision system, image processing, image acquisition camera, image enhancement, image segmentation, imaging transformation, Camera transformation and calibrations, industrial applications of robot vision.

#### Learning Outcomes:

at the end of this unit the student will be able to

- Identify the components of robot vision system.(L3)
- Understand the concept of image enhancement, segmentation and transformation.(L2)
- List the various components of robot vision system.(L1)
- Illustrate the industrial applications of robot vision system.(L2)

### UNIT – V

8 hrs

**Robot Applications In Manufacturing:** Material Transfer - Material handling, loading and unloading - Process - spot and continuous arc welding & spray painting - Assembly and Inspection.

## **Learning Outcomes:**

at the end of this unit the student will be able to

- Understand the use of robot for material transferring system.(L2)
- List the various industrial applications of robotics.(L1)

## **Course Outcomes:**

at the end of the course, the student will be able to

- Illustrate the industrial applications of robot vision system.(L3)
- Understand the basic concepts of robot controlling systems.(L2)
- Evaluate D-H notations for simple robot manipulator.(L4)
- Define a robot and homogeneous transformations.(L1)

## **TEXT BOOKS**

1. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robotics" — Mc Graw Hill, 1986.
2. John.J.Craig Addison, "Introduction to Robotics: Mechanics and Control", Wesley, 1999.
3. K.S. FU, R.C. Gonzalez and C.S.G Lee, "Robotics: Control, sensing, vision, and intelligence" . Mc Graw Hill, 1987.

## **REFERENCES**

1. Saeed B. Niku, "Introduction to Robotics – Analysis, System, Applications", 2<sup>nd</sup> Edition, John Wiley & Sons, 2010.
2. H. Asada and J.J.E. Slotine, "Robot Analysis and Control", 1<sup>st</sup> Edition Wiley-Interscience, 1986.
3. Robert J. Schilling, "Fundamentals of Robotics: Analysis and control", Prentice-Hall Of India Pvt. Limited, 1996.
4. Mohsen shahinpoor, "A robot Engineering text book", Harper & Row Publishers, 1987.
5. Richard D. Klafter, "Thomas Robotic Engineering an integrated approach", PHI publications 1988.
6. R K Mittal and I J Nagrath, "Robotics and control", Illustrated Edition, Tata McGraw Hill India 2003.
7. Ashitava Ghoshal, "Robotics, Fundamental concepts and analysis", Oxford University Press, 2006

**(19A03H03) PRODUCT MARKETING**  
**(Honors)**

**Course Objectives:**

- Introduce the basic concepts of Product marketing.
- Familiarize with market information systems and research
- Understand the nature and importance of industrial market
- Discuss the major stages in new product development
- Identify the factors affecting pricing decisions

**UNIT I:**

**Introduction (7 Hours)**

Historical development of marketing management, Definition of Marketing, Core marketing concepts, Marketing Management philosophies, Micro and Macro Environment, Characteristics affecting Consumer behaviour, Types of buying decisions, buying decision process, Classification of consumer products, Market Segmentation Concept of Marketing Myopia. Importance of marketing in the Indian Socio economic system.

**Learning Outcomes:**

At the end of this student, the student will be able to

- Define Marketing. (L1)
- Discuss marketing philosophies. (L2)
- Sketch the buying decision process. (L3)
- Understand the importance of marketing in the Indian socio economic system. (L2)

**UNIT II:**

**Marketing of Industrial Products (6 Hours)**

Components of marketing information system–benefits & uses marketing research system, marketing research procedure, Demand Estimation research, Test marketing, Segmentation Research - Cluster analysis, Discriminate analysis. Sales forecasting: objective and subjective methods. Nature and importance of the Industrial market, classification of industrial products, participants in the industrial buying process, major factors influencing industrial buying behavior, characteristics of industrial market demand. Determinants of industrial market

demand Buying power of Industrial users, buying motives of Industrials users, the industrial buying process, buying patterns of industrial users.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Identify the components of marketing information system. (L2)
- List the advantages and uses of marketing research system. (L1)
- Demonstrate sales forecasting. (L3)
- Explain the major factors influencing industrial buying behaviour. (L2)

### **UNIT III:**

#### **Product Management And Branding (7 Hours)**

The concept of a product, features of a product, classification of products, product policies – product planning and development, product line, product mix – factors influencing change in product mix, product mix strategies, meaning of “New – product; major stages in new – product development product life cycle. Branding: Reasons for branding, functions of branding features of types of brands, kinds of brand name.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Identify the factors influencing change in product mix. (L2)
- Sketch various stages in product life cycle. (L2)
- Recall the features of a product and product policies. (L1)
- Demonstrate on features, functions and reasons of branding. (L3)

### **UNIT IV:**

#### **Pricing and Packaging (7Hours)**

Importance of Price, pricing objectives, factors affecting pricing decisions, procedure for price determination, kinds of pricing, pricing strategies and decisions Labeling: Types, functions advantages and disadvantages, Packaging: Meaning, growth of packaging, function of packaging, kinds of packaging.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- List the factors affecting pricing decisions. (L1)
- Explain the procedure for price determination. (L2)

- Employ Pricing strategies and decisions. (L3)
- Understand the functions of labelling and packaging. (L2)

## **UNIT V:**

### **Product Promotion (6Hours)**

Importance of Price, pricing objectives, factors affecting pricing decisions, procedure for price determination, kinds of pricing, pricing strategies and decisions. Advertising and sales promotion: Objectives of advertisement function of advertising, classification of advertisement copy, advertisement media – kinds of media, advantages of advertising. Objectives of sales promotion, advantages sales promotion. Personal Selling : Objectives of personal selling, qualities of good salesman, types of salesman, major steps in effective selling

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Discuss the procedures for price determination. (L2)
- Explain the objectives of advertisement function of advertising. (L2)
- List the advantages and disadvantages of advertising. (L1)
- Describe the major steps in effecting selling. (L2)

### **Course Outcomes:**

At the end of the course, the student will be able to

- Understand basic marketing management concepts and their relevance to business development. (L2)
- Prepare a questionnaire for market research. (L5)
- Design marketing research plan for business organizations. (L5)
- Optimize marketing mix to get competitive advantage. (L4)

### **Text Books:**

1. Philip Kotler, “Principles of Marketing”, Prentice – Hall.
2. Philip Kotler, “Marketing Management”, Prentice – Hall.

### **Reference Books:**

1. Wiliam J Stanton, “Fundamentals of Marketing”, McGraw Hill
2. R.S.N. Pillai and Mrs.Bagavathi, “Marketing”, S. Chand & Co. Ltd
3. Rajagopal, “Marketing Management Text & Cases”, Vikas Publishing House

**(19A03H04) ADDITIVE MANUFACTURING**  
**(Honors)**

**Course Objectives:**

- Familiarize of additive manufacturing / rapid prototyping and its applications in various fields.
- Impart reverse engineering technologies.
- Explain different processes available in additive manufacturing.
- Bring awareness on 3d printing materials and geometric issues related to additive manufacturing applications.

**UNIT – I**

**10 Hours**

**Introduction to Additive Manufacturing (AM) Systems:** History and Development of AM, Need of AM, Difference between AM and CNC, Classification of AM Processes: Based on Layering Techniques, Raw Materials and Energy Sources, AM Process Chain, Benefits and Applications of AM, Representation of 3D model in STL format, RP data formats: SLC, CLI, RPI, LEAF, IGES, CT, STEP, HP/GL.

**Learning Outcomes:**

At the end of the unit, the student will be able to

- Identify the applications for additive manufacturing processes. (13)
- Explain the process of additive manufacturing. (12)
- Represent a 3d model in stl format and other rp data formats to store and retrieve the geometric data of the object. (13)

**UNIT – II**

**8 Hours**

**CAD & Reverse Engineering:** Basic Concept, Digitization techniques, Model Reconstruction, Data Processing for Additive Manufacturing Technology: CAD model preparation, Part Orientation and support generation, Model Slicing, Tool path Generation, Software's for Additive Manufacturing Technology: MIMICS, MAGICS. Reverse Engineering (RE) –Meaning, Use, RE – The Generic Process, Phase of RE Scanning, Contact Scanners, Noncontact Scanners, Point Processing, Application Geometric Model, Development.

**Learning Outcomes:**

At the end of the unit, the student will be able to

- Apply various digitalization techniques. (I3)
- Explain the concept of reverse engineering and scanning tools. (I2)

### UNIT – III

**8 Hours**

**Solid and Liquid Based AM Systems:** Stereolithography (SLA): Principle, Process, Materials, Advantages, Limitations and Applications. Solid Ground Curing (SGC): Principle, Process, Materials, Advantages, Limitations, Applications. Fusion Deposition Modeling (FDM): Principle, Process, Materials, Advantages, Limitations, Applications. Laminated Object Manufacturing (LOM): Principle, Process, Materials, Advantages, Limitations, Applications.

#### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Explain the principles, advantages, limitations and applications of solid and liquid based AM systems. (L2)
- Identify the materials for solid and liquid based AM systems. (L3)

### UNIT – IV

**8 Hours**

**Powder Based AM Systems:** Principle and Process of Selective Laser Sintering (SLS), Advantages, Limitations and Applications of SLS, Principle and Process of Laser Engineered Net Shaping (LENS), Advantages, Limitations and Applications of LENS, Principle and Process of Electron Beam Melting (EBM), Advantages, Limitations and Applications of EBM.

#### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Explain the principles, advantages, limitations and applications of powder based AM systems. (L2)
- Apply SLS, LENS and EBM 3D printing methods. (L3)

### UNIT – V

**8 Hours**

**Other Additive Manufacturing Systems:** Three Dimensional Printing (3DP): Principle, Process, Advantages, Limitations and Applications. Ballistic Particle Manufacturing (BPM): Principle, Process, Advantages, Limitations, Applications. Shape Deposition Manufacturing (SDM): Principle, Process, Advantages, Limitations, Applications.

#### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Explain principles and limitation of 3D printing using BPM and SDM. (L2)

- Use BPM and SDM 3D printing methods. (L3)

### **Course Outcomes:**

At the end of the course, the student will be able to

- Demonstrate various additive manufacturing and rapid prototyping techniques applications.
- Describe different additive manufacturing processes.
- Apply methods in rapid prototyping.
- Use powder based am system.
- Model 3d printing using sdm and bpm methods.

### **Text Books:**

1. Ian Gibson, David W. Rosen, Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 1<sup>st</sup> edition, Springer, 2010.
2. Chua C.K., Leong K.F. and Lim C.S., “Rapid Prototyping: Principles and Applications”, 2<sup>nd</sup> edition, World Scientific Publishers, 2003.
3. Liou W. Liou, Frank W., Liou, “Rapid Prototyping and Engineering Applications: A Tool Box for Prototype Development”, CRC Press, 2007.

### **Reference Books:**

1. Pham D.T. and Dimov S.S., “Rapid Manufacturing; The Technologies and Application of RPT and Rapid Tooling”, Springer, London 2001.
2. Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2003.
3. Hilton P.D. and Jacobs P.F., “Rapid Tooling: Technologies and Industrial Applications”, CRC Press, 2005.
4. RafiqNoorani, “Rapid Prototyping: Principles and Applications in Manufacturing”, John Wiley & Sons, 2006.



(19A03H05) MECHANICS OF COMPOSITE MATERIALS  
(Honors)

**Course Objectives:**

- Understand the properties of composite materials.
- Familiarize the manufacturing methods for composites.
- Teach the practical requirements associated with joining and manufacturing

**UNIT-1**

**Introduction To Composite Materials**

Introduction To Composite Materials: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites.

**Applications:** Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.

**Fiber Reinforced Plastic Processing:** Lay up and curing, fabricating process, open and closed mould process, hand layup techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.

**Learning Outcomes:**

At the end of this student, the student will be able to

- Define Composite Materials. (L1)
- List the applications of composite materials. (L1)
- Compare open and closed mould process. (L3)
- Demonstrate the processing methods of ceramic materials. (L3)

**UNIT-2**

**Micro Mechanical Analysis of a Lamina:**

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems.

**Macro Mechanics of a Lamina:** Hooke's law for different types of materials, Number of elastic constants, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.

**Learning Outcomes:**

At the end of this student, the student will be able to

- Solve numerical problems on evaluation of the four elastic moduli by rule of mixture.. (L4)
- Understand the hooke's law for different types of materials. (L2)
- Explain the two dimensional relationship of compliance and stiffness matrix. (L2)
- Discuss the stress strain relationship for lamina of arbitrary orientation. (L2)

### **UNIT-3**

#### **Biaxial Strength Theories**

Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems.

#### **Macro Mechanical Analysis of Laminate**

Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) , Special cases of laminates, Numerical problems.

#### **Learning Outcomes:**

At the end of this student, the student will be able to

- Discuss the maximum stress theory and maximum strain theory. (L2)
- Differentiate between CL, T, A, B and D matrices. (L4)
- List the special cases of macro mechanical analysis of laminates (L1)
- Solve problems on Kirchoff hypothesis. (L4)

### **UNIT-4**

**Metal Matrix Composites:** Metal Matrix Composites: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC's and its application.

**Fabrication Process For MMC's:** Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.

**Study Properties Of Mmc's:** Physical Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties.

#### **Learning Outcomes:**

At the end of this student, the student will be able to

- Identify the importance of metal matrix composites. (L2)
- Give the applications of metal matrix composites (L1)
- Recall the fabrication processes for MMC's. (L1)
- Demonstrate on the various properties of MMC's. (L2)

## UNIT-5

**Failure Theories:** Micromechanics of Failure of Unidirectional Lamina, Anisotropic Strength and Failure Theories, Importance of Shear Strength, Choice of Failure Criteria, Examples.

### Learning Outcomes:

At the end of this student, the student will be able to

- Discuss the failure theories of unidirectional lamina. (L2)
- Explain the anisotropic strength of unidirectional lamina . (L2)
- Understand the choice of failure criteria with help of examples. (L2)

### Course Outcomes:

At the end of the course, the student will be able to

- Design and manufacture composite materials for various applications. (L5)
- Conduct mechanical testing of composite structures and analyse failure modes. (L4)
- Synthesize structures for environmental effects. (L5)
- Analyse economic aspects of using composites. (L4)

### Text Books

1. K.K. Chawla, “Composite Materials”, Springer-Verlag, New York. (1998),
2. Madhujit Mukhopadhyaya, “Mechanics of composite materials and structures”, Universities Press 2004.

### References

1. B.T. Astrom “Manufacturing of Polymer Composites”, Chapman & Hall. , (1997),
1. Stuart M Lee, J. Ian Gray, Miltz, “Reference Book for Composites Technology”, CRC press. (1989),
2. Frank L Matthews and R D Rawlings, “Composite Materials: Engineering and Science”, Taylor and Francis. (2006),
3. D. Hull and T.W. Clyne, “Introduction to Composite Materials”, Cambridge University Press. (1996),
4. M.R. Piggott, “Load Bearing Fibre Composites”, Pergamon press, Oxford. (1998),
5. F. Ashby and D.R.H. Jones, (1999), Engineering Materials, Pergamon press.
6. R.W. Davidge and A. Kelly, (1999), Mechanical behavior of ceramics, Cambridge University press.
7. Andrew C. Marshall, (1998), Composite Basics, Marshall Consulting. Mode of Evaluation Quiz/Assignment/ Seminar/Written Examination.



# **Jawaharlal Nehru Technological University Anantapur**

*(Established by Govt. of A.P., Act. No. 30 of 2008)*

**Ananthapuramu–515 002 (A.P) India**

## **Four Year B.Tech. Course Structure and Syllabi under R20 Regulations**



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
 (Established by Govt. of A.P., ACT No.30 of 2008)  
 ANANTAPUR – 515 002 (A.P) INDIA

## Semester-0

### Induction Program: 3 weeks (Common for All Branches of Engineering)

S.No	Course Name	Category	L-T-P-C
1	Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counselling	MC	2-0-2-0
3	Orientation to all branches -- career options, tools, etc.	MC	3-0-0-0
4	Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
(Established by Govt. of A.P., ACT No.30 of 2008)  
ANANTAPUR – 515 002 (A.P) INDIA

**Mechanical Engineering**

**Semester - 1 (Theory - 5, Lab - 4)**

<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
1.	20A54101	Linear Algebra and Calculus	BS	3-0-0	3
2.	20A51201T	Engineering Chemistry	BS	3-0-0	3
3.	20A05201T	C-Programming & Data Structures	ES	3-0-0	3
4.	20A02101T	Basic Electrical & Electronics Engineering	ES	3-0-0	3
5.	20A03202	Engineering Workshop	ES	0-0-3	1.5
6.	20A05202	IT Workshop	ES	0-0-3	1.5
7.	20A51201P	Engineering Chemistry Lab	BS	0-0-3	1.5
8.	20A05201P	C-Programming & Data Structures Lab	ES	0-0-3	1.5
9.	20A02101P	Basic Electrical & Electronics Engineering Lab	ES	0-0-2	1.5
<b>Total</b>					<b>19.5</b>

**Semester – 2 (Theory – 5, Lab – 5)**

<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P/D</b>	<b>Credits</b>
1.	20A54201	Differential Equations and Vector Calculus	BS	3-0-0	3
2.	20A56101T	Engineering Physics	BS	3-0-0	3
3.	20A52101T	Communicative English	HS	3-0-0	3
4.	20A03201T	Material Science & Engineering	ES	3-0-0	3
5.	20A03101T	Engineering Drawing	ES	1-0-0/2	2
6.	20A03101P	Engineering Graphics Lab	ES	0-0-2	1
7.	20A52101P	Communicative English Lab	HS	0-0-3	1.5
8.	20A56101P	Engineering Physics Lab	BS	0-0-3	1.5
9.	20A03201P	Material Science Lab	ES	0-0-3	1.5
<b>Total</b>					<b>19.5</b>

Semester-III							
S.No.	Course Code	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	20A54303	Complex variables, Transforms and Application of PDE	BS	3	0	0	3
2.	20A01302T	Fluid Mechanics & Hydraulic Machines	PC	3	0	0	3
3.	20A03301T	Manufacturing Processes	PC	3	0	0	3
4.	20A03302	Thermodynamics	PC	3	0	0	3
5.	20A01305T	Mechanics of Materials	ES	3	0	0	3
6.	20A01302P	Fluid Mechanics & Hydraulic Machines Lab	PC	0	0	3	1.5
7.	20A03301P	Manufacturing Processes Lab	PC	0	0	3	1.5
8.	20A01305P	Mechanics of Materials Lab	ES	0	0	3	1.5
9.	20A52201	Universal Human Values	MC	3	0	0	3
10.	20A05305	<b>Skill oriented course – I</b> Application Development with Python	SC	1	0	2	2
<b>Total</b>							<b>24.5</b>
Semester-IV							
S.No.	Course Code	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	20A54402	Numerical Methods & Probability Theory	BS	3	0	0	3
2.	20A03401T	Applied Thermodynamics	PC	3	0	0	3
3.	20A03402	Kinematics of Machinery	PC	3	0	0	3
4.	20A03403T	Manufacturing Technology	PC	3	0	0	3
5.	20A52301 20A52302 20A52303	<b>Humanities Elective- I</b> Managerial Economics & Financial Analysis Organizational Behavior Business Environment	HS	3	0	0	3
6.	20A03401P	Applied Thermodynamics Lab	PC	0	0	3	1.5
7.	20A03403P	Manufacturing Technology Lab	PC	0	0	3	1.5
8.	20A03404	Computer Aided Machine Drawing	PC	0	0	3	1.5
9.	20A52401	<b>Skill oriented course – II</b> Soft skills	SC	1	0	2	2
10.	20A99401	<b>Mandatory noncredit course</b> Design Thinking for Innovation	MC	2	1	0	0
11.	20A99301	NSS/NCC/NSO Activities	-	0	0	2	0
<b>Total</b>							<b>21.5</b>
Community Service Internship/Project (Mandatory) for 6 weeks duration during summer vacation							

**Note:**

1. Eligible and interested students can register either for Honors or for a Minor in IV Semester as per the guidelines issued by the University
2. Students shall register for NCC/NSS/NSO activities and will be required to participate in an activity for two hours in a week during fourth semester.
3. Lateral entry students shall undergo a bridge course in Mathematics during third semester

<b>Semester-V</b>						
<b>S.No.</b>	<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1.	20A03501	CAD/CAM	3	0	0	3
2.	20A03502	Design of Machine Members	3	0	0	3
3.	20A03503T	Metrology and Measurements	3	0	0	3
4.	20A03504a 20A03504b 20A03504c	<b>Professional Elective - I</b> Automation & Robotics Tool Design Power Plant Engineering	3	0	0	3
5.		<b>Open Elective – I</b>	3	0	0	3
6.	20A03503P	Metrology and Measurements Laboratory	0	0	3	1.5
7.	20A03506	Computer Aided Modeling Laboratory	0	0	3	1.5
8.	20A03507	<b>Skill oriented course - III</b> Innovation through IoT	1	0	2	2
9.	20A03508	Evaluation of Community Service Project				1.5
10.	20A99201	<b>Mandatory noncredit course</b> Environmental Science	3	0	0	0
<b>Total</b>						<b>21.5</b>

**Open Elective Course – I**

<b>S.No.</b>	<b>Course Code</b>	<b>Course Name</b>	<b>Offered by the Dept.</b>
1	20A01505	Building Technology	CE
2	20A02505	Electric Vehicles	EEE
3	20A04505	Digital Electronics	ECE
4	20A05505a	Java Programming	CSE & Allied /IT
5	20A05502T	Artificial Intelligence	
6	20A12502	Mobile Application Development using Android	
7	20A27505	Computer Applications in Food Processing	FT
8	20A56501	Materials Characterization Techniques	Physics
9	20A51501	Chemistry of Energy Materials	Chemistry

**Note:**

1. A student is permitted to register for Honours or a Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to their Minor from V Semester onwards.
2. A student shall not be permitted to take courses as Open Electives/Minor/Honours with content substantially equivalent to the courses pursued in the student's primary major.
3. A student is permitted to select a Minor program only if the institution is already offering a Major degree program in that discipline



<b>Semester-VI</b>						
<b>S.No.</b>	<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1.	20A03601	Dynamics of Machinery	3	0	0	3
2.	20A03602	Finite Element Methods (FEM)	3	0	0	3
3.	20A03603T	Heat Transfer	3	0	0	3
4.	20A03604a 20A03604b 20A03604c	<b>Professional Elective – II</b> Non-Destructive Testing (NDT) Production and operations management Total Quality Management (TQM)	3	0	0	3
5.		<b>Open Elective Course – II</b>	3	0	0	3
6.	20A03606	Computer Aided Design Laboratory	0	0	3	1.5
7.	20A03607	Computer Aided Manufacturing Laboratory	0	0	3	1.5
8.	20A03603P	Heat Transfer Laboratory	0	0	3	1.5
9.	20A03608	<b>Skill oriented course - IV</b> 3D Printing practice	1	0	2	2
10.	20A99601	<b>Mandatory Non-credit Course</b> Intellectual Property Rights & Patents	2	0	0	0
<b>Total</b>						<b>21.5</b>
Industry Internship (Mandatory) for 6 - 8 weeks duration during summer vacation						

**Open Elective Course – II**

<b>S.No</b>	<b>Course Code</b>	<b>Course Name</b>	<b>Offered by the Dept.</b>
1	20A01605	Environmental Economics	CE
2	20A02605	Smart Electric Grid	EEE
3	20A04605	Signal Processing	ECE
4	20A04701b	Introduction to Internet of Things	ECE/CSE
5	20A05605a	Principles of Operating Systems	CSE & Allied /IT
6	20A05605b	Foundations of Machine Learning	
7	20A05605c	Data Analytics Using R	
8	20A27605	Food Refrigeration and Cold Chain Management	FT
9	20A54701	Wavelet Transforms & its applications	Mathematics
10	20A56701	Physics Of Electronic Materials and Devices	Physics
11	20A51701	Chemistry of Polymers and its Applications	Chemistry

<b>Semester-VII</b>						
<b>S.No.</b>	<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
<b>1.</b>	20A03701a 20A03701b 20A03701c	<b>Professional Elective Course- III</b> Modern manufacturing Methods Design for Manufacturing (DFM) Operations Research	3	0	0	3
<b>2.</b>	20A03702a 20A03702b 20A03702c	<b>Professional Elective Course- IV</b> Automobile Engineering Mechanical Vibrations Refrigeration & Air Conditioning	3	0	0	3
<b>3.</b>	20A03703a 20A03703b 20A03703c	<b>Professional Elective Course- V</b> Mechatronics & MEMS Design of Oil Hydraulics and Pneumatics Geometric dimensioning and tolerances	3	0	0	3
<b>4.</b>	20A52701a 20A52701b 20A52701c	<b>Humanities Elective – II</b> Entrepreneurship and Incubation Management Science Enterprise Resource Planning	3	0	0	3
<b>5.</b>		<b>Open Elective Course – III</b>	3	0	0	3
<b>6.</b>		<b>Open Elective Course – IV</b>	3	0	0	3
<b>7.</b>	20A03706	<b>Skill oriented course - V</b> Industrial Automation	1	0	2	2
<b>8.</b>	20A03707	Evaluation of Industry Internship				3
<b>Total</b>						<b>23</b>

**Open Elective Course – III**

<b>S.No</b>	<b>Course Code</b>	<b>Course Name</b>	<b>Offered by the Dept.</b>
1	20A01704	Cost Effective Housing Techniques	CE
2	20A02704	IOT Applications in Electrical Engineering	EEE
3	20A04704	Electronic Sensors	ECE
4	20A05704a	Web Technologies	CSE & Allied /IT
5	20A05704b	VR & AR for Engineers	
6	20A05704c	Software Engineering	
7	20A27704	Human Nutrition	FT
8	20A54702	Numerical Methods for Engineers	Mathematics
9	20A56702	Sensors And Actuators for Engineering Applications	Physics
10	20A51702	Chemistry of Nanomaterials and Applications	Chemistry

**Open Elective Course – IV**

<b>S.No</b>	<b>Course Code</b>	<b>Course Name</b>	<b>Offered by the Dept.</b>
1	20A01705	Health, Safety & Environmental management	CE
2	20A02705	Renewable Energy Systems	EEE
3	20A04705	Microcontrollers and Applications	ECE
4	20A05705a	Cyber Security	CSE & Allied /IT
5	20A05705b	Introduction to Full Stack Development	
6	20A05705c	Industrial IoT	
7	20A27705	Waste and Effluent Management	FT
8	20A54703	Number theory & its applications	Mathematics
9	20A56703	Smart Materials and Devices	Physics
10	20A51703	Green Chemistry and Catalysis for Sustainable Environment	Chemistry

Semester-VIII							
S.No.	Course Code	Course Name	Category	L	T	P	Credits
1.	20A03801	Full Internship & Project work	PR				12
<b>Total</b>							<b>12</b>

### COURSES OFFERED FOR HONOURS DEGREE IN MECHANICAL ENGINEERING

S.No.	Course Code	Course Title	Contact Hours per week		Credits
			L	T	
1	20A03H01	Mechanics and manufacturing of Composite materials	3	1	4
2	20A03H02	Application of Computational Fluid Dynamics	3	1	4
3	20A03H03	Advanced Automotive Electronics	3	1	4
4	20A03H04	Applications of Optimization Techniques	3	1	4
5	20A03H05	MOOC I: Design of Mechatronic Systems <a href="https://onlinecourses.nptel.ac.in/noc22_me128/preview">https://onlinecourses.nptel.ac.in/noc22_me128/preview</a>			2
6	20A03H06	MOOC II: Heat Exchangers: Fundamentals and Design Analysis <a href="https://onlinecourses.nptel.ac.in/noc22_me106/preview">https://onlinecourses.nptel.ac.in/noc22_me106/preview</a>			2

### LIST OF MINORS OFFERED TO MECHANICAL ENGINEERING

S.No.	Minor Title	Department offering the Minor
1.	Construction Technology	Civil Engineering
2.	Environmental Geotechnology	Civil Engineering
3.	Energy Systems	EEE
4.	Internet of Things	ECE
5.	Food Science	Food Technology
6.	Artificial Intelligence & Data Science	CSE& Allied/IT
7.	Virtual & Augmented Reality	
8.	Cyber Security &Blockchain Technologies	

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– I Sem**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**(20A54101) LINEAR ALGEBRA & CALCULUS**  
(Common to All Branches of Engineering)

**Course Objectives:**

- This course will illuminate the students in the concepts of calculus and linear algebra.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

**UNIT -1****Matrices**

Rank of a matrix by echelon form, normal form. Solving system of homogeneous and non-homogeneous equations linear equations. Eigen values and Eigenvectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalisation of a matrix.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Solving systems of linear equations, using technology to facilitate row reduction determine the rank, eigen values and eigenvectors (L3).
- Identify special properties of a matrix, such as positive definite, etc., and use this information to facilitate the calculation of matrix characteristics; (L3)

**UNIT -2****Mean Value Theorems**

Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof) related problems.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Translate the given function as series of Taylor's and Maclaurin's with remainders (L3)
- Analyze the behaviour of functions by using mean value theorems (L3)

**UNIT -3****Multivariable Calculus**

Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Find partial derivatives numerically and symbolically and use them to analyze and interpret the way a function varies. (L3)
- Acquire the Knowledge maxima and minima of functions of several variable (L1)
- Utilize Jacobian of a coordinate transformation to deal with the problems in change of variables (L3)

**UNIT -4**

**Multiple Integrals**

Double integrals, change of order of integration, change of variables. Evaluation of triple integrals, change of variables between Cartesian, cylindrical and spherical polar co-ordinates. Finding areas and volumes using double and triple integrals.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Evaluate double integrals of functions of several variables in two dimensions using Cartesian and polar coordinates (L5)
- Apply double integration techniques in evaluating areas bounded by region (L4)
- Evaluate multiple integrals in Cartesian, cylindrical and spherical geometries (L5)

**UNIT -5**

**Beta and Gamma functions**

Beta and Gamma functions and their properties, relation between beta and gamma functions, evaluation of definite integrals using beta and gamma functions.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand beta and gamma functions and its relations (L2)
- Conclude the use of special function in evaluating definite integrals (L4)

**Text Books:**

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.

**Reference Books:**

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011.
4. Micheael Greenberg, Advanced Engineering Mathematics, 9<sup>th</sup> edition, Pearson edn
5. Dean G. Duffy, Advanced Engineering Mathematics with MATLAB, CRC Press

6. Peter O'neil, Advanced Engineering Mathematics, Cengage Learning.
7. R.L. Garg Nishu Gupta, Engineering Mathematics Volumes-I &II, Pearson Education
8. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education
9. H. k Das, Er. RajnishVerma, Higher Engineering Mathematics, S. Chand.
10. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

**Course Outcomes:**

At the end of the course, the student will be able to

- Develop the use of matrix algebra techniques that is needed by engineers for practical applications (L6)
- Utilize mean value theorems to real life problems (L3)
- Familiarize with functions of several variables which is useful in optimization (L3)
- Students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional coordinate systems (L5)
- Students will become familiar with 3- dimensional coordinate systems and also learn the utilization of special functions

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– I Sem**

**L T P C**  
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**(20A51201T) ENGINEERING CHEMISTRY**  
(Civil and Mechanical)

**Course Objectives:**

- To familiarize engineering chemistry and its applications
- To impart the concept of soft and hard waters, softening methods of hard water
- To train the students on the principles and applications of electrochemistry, polymers, surface chemistry, and cement

**UNIT -1****Water Technology**

Introduction –Soft Water and hardness of water, Estimation of hardness of water by EDTA Method - Boiler troubles –Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment – specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electrodialysis.

**Learning outcomes:**

At the end of this unit, the students will be able to

- List the differences between temporary and permanent hardness of water (L1)
- Explain the principles of reverse osmosis and electrodialysis. (L2)
- Compare quality of drinking water with BIS and WHO standards. (L2)
- Illustrate problems associated with hard water - scale and sludge. (L2)
- Explain the working principles of different Industrial water treatment processes (L2)

**UNIT -2****Electrochemistry and Applications:**

Electrodes – concepts, electrochemical cell, Nernst equation, cell potential calculations.

Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad), and lithium ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen, methanol fuel cells – working of the cells.

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, **Factors affecting the corrosion**, cathodic and anodic protection, electroplating and electroless plating (Nickel and Copper).

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Apply Nernst equation for calculating electrode and cell potentials (L3)
- Apply Pilling Bedworth rule for corrosion and corrosion prevention (L3)
- Demonstrate the corrosion prevention methods and factors affecting corrosion (L2)
- Compare different batteries and their applications (L2)

### UNIT -3

#### **Polymers and Fuel Chemistry:**

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth and coordination polymerization.

Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of poly styrene. PVC and Bakelite

Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol

Fuels – Types of fuels, calorific value, numerical problems based on calorific value; Analysis of coal, Liquid Fuels refining of petroleum, fuels for IC engines, knocking and anti-knock agents, Octane and Cetane values, cracking of oils; alternative fuels- propane, methanol and ethanol, bio-fuels.

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Explain different types of polymers and their applications (L2)
- Solve the numerical problems based on Calorific value(L3)
- Select suitable fuels for IC engines (L3)
- Explain calorific values, octane number, refining of petroleum and cracking of oils (L2)

### UNIT-4

#### **Advanced Engineering Materials**

Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications

Refractories- Classification, Properties, Factors affecting the refractory materials and Applications.

Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils – Viscosity, Viscosity Index, Flash point, Fire point, Cloud point, saponification and Applications.

Building materials- Portland Cement, constituents, phases and reactivity of clinker, Setting and Hardening of cement.

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Explain the constituents of Composites and its classification (L2)
- Identify the factors affecting the refractory material(L3)
- Illustrate the functions and properties of lubricants (L2)
- Demonstrate the phases and reactivity of concrete formation (L2)
- Identify the constituents of Portland cement (L3)
- Enumerate the reactions at setting and hardening of the cement (L3)

### UNIT -5

#### **Surface Chemistry and Applications:**

Introduction to surface chemistry, colloids, micelle formation, synthesis of colloids (any two methods with examples), chemical and electrochemical methods (not more than two methods) of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, solid-gas interface, solid-liquid interface, adsorption isotherm, BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors.



### Learning Outcomes:

At the end of this unit, the students will be able to

- Summarize the concepts of colloids, micelle and nanomaterials (L2)
- Explain the synthesis of colloids with examples (L2)
- Outline the preparation of nanomaterials and metal oxides (L2)
- Identify the application of colloids and nanomaterials in medicine, sensors and catalysis (L2)

### Text Books:

1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

### Reference Books:

1. G.V.Subba Reddy, K.N.Jayaveera and C. Ramachandraiah, Engineering Chemistry, Mc Graw Hill, 2020.
2. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
3. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
4. D.J. Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heinemann, 1992.

### Course Outcomes:

At the end of the course, the students will be able to

- Demonstrate the corrosion prevention methods and factors affecting corrosion (L2)
- Explain the preparation, properties, and applications of thermoplastics & thermosetting, elastomers & conducting polymers. (L2)
- Explain calorific values, octane number, refining of petroleum and cracking of oils (L2)
- Explain the setting and hardening of cement and concrete phase (L2)
- Summarize the concepts of colloids, micelle and nanomaterials (L2).

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME)– I Sem**

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**(20A05201T) C-PROGRAMMING & DATA STRUCTURES**

(Common to All Branches of Engineering)

**Course Objectives:**

- To illustrate the basic concepts of C programming language.
- To discuss the concepts of Functions, Arrays, Pointers and Structures.
- To familiarize with Stack, Queue and Linked lists data structures.
- To explain the concepts of non-linear data structures like graphs and trees.
- To learn different types of searching and sorting techniques.

**UNIT-1**

**Introduction to C Language** - C language elements, variable declarations and data types, operators and expressions, decision statements - If and switch statements, loop control statements - while, for, do-while statements, arrays.

**Learning outcomes:**

At the end of this unit, the students will be able to

- Use C basic concepts to write simple C programs. (L3)
- Use iterative statements for writing the C programs (L3)
- Use arrays to process multiple homogeneous data. (L3)
- Test and execute the programs and correct syntax and logical errors. (L4)
- Translate algorithms into programs. (L4)
- Implement conditional branching, iteration and recursion. (L2)

**UNIT – 2**

Functions, types of functions, Recursion and argument passing, pointers, storage allocation, pointers to functions, expressions involving pointers, Storage classes – auto, register, static, extern, Structures, Unions, Strings, string handling functions, and Command line arguments.

**Learning outcomes:**

At the end of this unit, the students will be able to

- Writing structured programs using C Functions. (L5)
- Writing C programs using various storage classes to control variable access. (L5)
- Apply String handling functions and pointers. (L3)
- Use arrays, pointers and structures to formulate algorithms and write programs.(L3)

### UNIT-3

**Data Structures**, Overview of data structures, stacks and queues, representation of a stack, stack related terms, operations on a stack, implementation of a stack, evaluation of arithmetic expressions, infix, prefix, and postfix notations, evaluation of postfix expression, conversion of expression from infix to postfix, recursion, queues - various positions of queue, representation of queue, insertion, deletion, searching operations.

#### **Learning outcomes:**

At the end of this unit, the students will be able to

- Describe the operations of Stack. (L2)
- Explain the different notations of arithmetic expression. (L5)
- Develop various operations on Queues. (L6)

### UNIT – 4

**Linked Lists** – Singly linked list, dynamically linked stacks and queues, polynomials using singly linked lists, using circularly linked lists, insertion, deletion and searching operations, doubly linked lists and its operations, circular linked lists and its operations.

#### **Learning outcomes:**

At the end of this unit, the students will be able to

- Analyze various operations on singly linked list. (L4)
- Interpret operations of doubly linked lists. (L2)
- Apply various operations on Circular linked lists. (L6)

### UNIT-5

**Trees** - Tree terminology, representation, Binary trees, representation, binary tree traversals. binary tree operations, **Graphs** - graph terminology, graph representation, elementary graph operations, Breadth First Search (BFS) and Depth First Search (DFS), connected components, spanning trees. **Searching and Sorting** – sequential search, binary search, exchange (bubble) sort, selection sort, insertion sort.

#### **Learning outcomes:**

At the end of this unit, the students will be able to

- Develop the representation of Tress. (L3)
- Identify the various Binary tree traversals. (L3)
- Illustrate different Graph traversals like BFS and DFS. (L2)
- Design the different sorting techniques (L6)
- Apply programming to solve searching and sorting problems. (L3)

**Text Books:**

1. The C Programming Language, Brian W Kernighan and Dennis M Ritchie, Second Edition, Prentice Hall Publication.
2. Fundamentals of Data Structures in C, Ellis Horowitz, SartajSahni, Susan Anderson-Freed, Computer Science Press.
3. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A. AnandaRao, Pearson Education.
4. B.A. Forouzon and R.F. Gilberg, "COMPUTER SCIENCE: A Structured Programming Approach Using C", Third edition, CENGAGE Learning, 2016.
5. Richard F. Gilberg & Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", Second Edition, CENGAGE Learning, 2011.

**Reference Books:**

1. Pradip Dey and Manas Ghosh, Programming in C, Oxford University Press, 2nd Edition 2011.
2. E. Balaguruswamy, "C and Data Structures", 4<sup>th</sup> Edition, Tata Mc Graw Hill.
3. A.K. Sharma, Computer Fundamentals and Programming in C, 2nd Edition, University Press.
4. M.T. Somashekara, "Problem Solving Using C", PHI, 2<sup>nd</sup> Edition 2009.

**Course Outcomes:**

1. Analyse the basicconcepts of C Programming language. (L4)
2. Design applications in C, using functions, arrays, pointers and structures. (L6)
3. Apply the concepts of Stacks and Queues in solving the problems. (L3)
4. Explore various operations on Linked lists. (L5)
5. Demonstrate various tree traversals and graph traversal techniques. (L2)
6. Design searching and sorting methods (L3)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– I Sem**

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**(20A02101T) BASIC ELECTRICAL & ELECTRONICS ENGINEERING**

(Civil, Mechanical, CSE, AI & DS, CSE (AI), CSE(IoT), CSE (Data Science), CSE(AI & ML), IT and Food Technology)

**Part A: Basic Electrical Engineering**

**Course Objectives:**

- To introduce basics of electric circuits.
- To teach DC and AC electrical circuit analysis.
- To explain working principles of transformers and electrical machines.
- To impart knowledge on Power system generation, transmission and distribution

**UNIT -1**

**DC & AC Circuits:**

Electrical circuit elements (R - L and C) - Kirchhoff laws - Series and parallel connection of resistances with DC excitation. Superposition Theorem - Representation of sinusoidal waveforms - peak and rms values - phasor representation - real power - reactive power - apparent power - power factor - Analysis of single-phase ac circuits consisting of RL - RC - RLC series circuits, Resonance.

**Learning Outcomes**

At the end of this unit, the student will be able to

- Recall Kirchoff laws
- Analyze simple electric circuits with DC excitation
- Apply network theorems to simple circuits
- Analyze single phase AC circuits consisting of series RL - RC - RLC combinations

**UNIT -2**

**DC & AC Machines:**

Principle and operation of DC Generator - EMF equations - OCC characteristics of DC generator – principle and operation of DC Motor – Performance Characteristics of DC Motor - Speed control of DC Motor – Principle and operation of Single Phase Transformer - OC and SC tests on transformer - Principle and operation of 3-phase AC machines [ Elementary treatment only ]

**Learning Outcomes**

At the end of this unit, the student will be able to

- Explain principle and operation of DC Generator & Motor.
- Perform speed control of DC Motor
- Explain operation of transformer and induction motor.
- Explain construction & working of induction motor - DC motor

### UNIT -3

#### Basics of Power Systems:

Layout & operation of Hydro, Thermal, Nuclear Stations - Solar & wind generating stations – Typical AC Power Supply scheme – Elements of Transmission line – Types of Distribution systems: Primary & Secondary distribution systems.

#### Learning Outcomes

At the end of this unit, the student will be able to

- Understand working operation of various generating stations
- Explain the types of Transmission and Distribution systems

#### Text Books:

1. D. P. Kothari and I. J. Nagrath - “Basic Electrical Engineering” - Tata McGraw Hill - 2010.
2. V.K. Mehta & Rohit Mehta, “Principles of Power System” – S.Chand – 2018.

#### References:

1. L. S. Bobrow - “Fundamentals of Electrical Engineering” - Oxford University Press - 2011.
2. E. Hughes - “Electrical and Electronics Technology” - Pearson - 2010.
3. C.L. Wadhwa – “Generation Distribution and Utilization of Electrical Energy”, 3rd Edition, New Age International Publications.

#### Course Outcomes:

The student should be able to

- Apply concepts of KVL/KCL in solving DC circuits
- Understand and choose correct rating of a transformer for a specific application
- Illustrate working principles of DC Motor
- Identify type of electrical machine based on their operation
- Understand the basics of Power generation, Transmission and Distribution

## Part ‘B’- Electronics Engineering

#### Course Objectives

- Understand principles and terminology of electronics.
- Familiar with the theory, construction, and operation of electronic devices.
- Learn about biasing of BJTs and FETs.
- Design and construct amplifiers.
- Understand the concept & principles of logic devices.

#### Unit-1:

**Diodes and Applications:** Semiconductor Diode, Diode as a Switch & Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Operation and Applications of Zener Diode, LED, Photo Diode.

**Transistor Characteristics:** Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Biasing of Transistor Configuration; Field Effect Transistor (FET) – Construction, Characteristics of Junction FET, Concepts of Small Signal Amplifiers –CE & CC Amplifiers.

**Learning outcomes:**

At the end of this unit, the student will be able to

- Remember and understand the basic characteristics of semiconductor diode. (L1)
- Understand principle of operation of Zener diode and other special semiconductor diodes. (L1)
- Analyze BJT based biasing circuits. (L3)
- Design an amplifier using BJT based on the given specifications. (L4)

**Unit-2:**

**Operational Amplifiers and Applications:** Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal Op-Amp, Concept of Virtual Ground; Op-Amp Applications - Inverting, Non-Inverting, Summing and Difference Amplifiers, Voltage Follower, Comparator, Differentiator, Integrator.

**Learning outcomes:**

At the end of this unit, the student will be able to

- Describe operation of Op-Amp based linear application circuits, converters, amplifiers and non-linear circuits. (L2)
- Analyze Op-Amp based comparator, differentiator and integrator circuits. (L3)

**Unit-3:**

**Digital Electronics:** Logic Gates, Simple combinational circuits – Half and Full Adders, BCD Adder. Latches and Flip-Flops (S-R, JK and D), Shift Registers and Counters. Introduction to Microcontrollers and their applications (Block diagram approach only).

**Learning outcomes:**

At the end of this unit, the student will be able to

- Explain the functionality of logic gates. (L2)
- Apply basic laws and De Morgan's theorems to simplify Boolean expressions. (L3)
- Analyze standard combinational and sequential circuits. (L4)
- Distinguish between 8085 & 8086 microprocessors also summarize features of a microprocessor. (L5)

**Text Books:**

1. R.L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2007.
2. Ramakanth A. Gayakwad, Op-Amps & Linear ICs, 4<sup>th</sup> Edition, Pearson, 2017.
3. R. P. Jain, Modern Digital Electronics, 3<sup>rd</sup> Edition, Tata Mcgraw Hill, 2003.

4. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2<sup>nd</sup> Edition, Pearson, 2012.

**Reference Books:**

1. SantiramKal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India,2002.
2. R. S. Sedha, A Text Book of Electronic Devices and Circuits, S.Chand& Co,2010.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education,2009.

**Course Outcomes:**

After the completion of the course students will able to

- Explain the theory, construction, and operation of electronic devices.
- Apply the concept of science and mathematics to explain the working of diodes and its applications, working of transistor and to solve the simple problems based on the applications
- Analyze small signal amplifier circuits to find the amplifier parameters
- Design small signal amplifiers using proper biasing circuits to fix up proper Q point.
- Distinguish features of different active devices including Microprocessors.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– I Sem**

**L T P C**  
**0 0 3 1.5**

**(20A03202) ENGINEERING WORKSHOP**

(Common to All Branches of Engineering)

**Course Objective:**

To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills

**List of Topics**

**Wood Working:**

Familiarity with different types of woods and tools used in wood working and make following joints

- a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint

**Sheet Metal Working:**

Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets

- a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing

**Fitting:**

Familiarity with different types of tools used in fitting and do the following fitting exercises

- a) V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire puncture and change of two wheeler tyre

**Electrical Wiring:**

Familiarities with different types of basic electrical circuits and make the following connections

- a) Parallel and series b) Two way switch c) Godown lighting  
d) Tube light e) Three phase motor f) Soldering of wires

**Course Outcomes:**

After completion of this lab the student will be able to

- Apply wood working skills in real world applications. (13)
- Build different objects with metal sheets in real world applications. (13)
- Apply fitting operations in various applications. (13)
- Apply different types of basic electric circuit connections. (13)
- Use soldering and brazing techniques. (12)

**Note: In each section a minimum of three exercises are to be carried out.**

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**B.Tech (ME) – II Sem**

**L T P C**  
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**(20A05202) IT WORKSHOP**  
 (Common to All Branches of Engineering)

**Course Objectives:**

- To make the students know about the internal parts of a computer, assembling and disassembling a computer from the parts, preparing a computer for use by installing the operating system
- To provide Technical training to the students on Productivity tools like Word processors, Spreadsheets, Presentations and LAtEX
- To learn about Networking of computers and use Internet facility for Browsing and Searching

**Preparing your Computer**

**Task 1:**

**Learn about Computer:** Identify the internal parts of a computer, and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.

**Task 2:**

**Assembling a Computer:** Disassemble and assemble the PC back to working condition. Students should be able to trouble shoot the computer and identify working and non-working parts. Student should identify the problem correctly by various methods

**Task 3:**

**Install Operating system:** Student should install Linux on the computer. Student may install another operating system (including proprietary software) and make the system dual boot or multi boot. Students should record the entire installation process.

**Task 4:**

**Operating system features:** Students should record the various features that are supported by the operating system(s) installed. They have to submit a report on it. Students should be able to access CD/DVD drives, write CD/DVDs, access pen drives, print files, etc. Students should install new application software and record the installation process.

**Networking and Internet**

**Task 5:**

**Networking:** Students should connect two computers directly using a cable or wireless connectivity and share information. Students should connect two or more computers using switch/hub and share information. Crimping activity, logical configuration etc. should be done by the student. The entire process has to be documented.

**Task 6:**

**Browsing Internet:** Student should access the Internet for Browsing. Students should search the Internet for required information. Students should be able to create e-mail account and send email. They should get acquaintance with applications like Facebook, skype etc. If Intranet mailing facility is available in the organization, then students should share the information using it. If the operating system supports sending messages to multiple users (LINUX supports it) in the same network, then it should be done by the student. Students are expected to submit the information about different browsers available, their features, and search process using different natural languages, and creating e-mail account.

**Task 7:**

**Antivirus:** Students should download freely available Antivirus software, install it and use it to check for threats to the computer being used. Students should submit information about the features of the antivirus used, installation process, about virus definitions, virus engine etc.

**Productivity tools**

**Task 8:**

**Word Processor:** Students should be able to create documents using the word processor tool. Some of the tasks that are to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the colour, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Students should be able to prepare project cover pages, content sheet and chapter pages at the end of the task using the features studied. Students should submit a user manual of the word processor considered, Image Manipulation tools.

**Task 9:**

**Presentations:** creating, opening, saving and running the presentations, selecting the style for slides, formatting the slides with different fonts, colours, creating charts and tables, inserting and deleting text, graphics and animations, bulleting and numbering, hyperlinking, running the slide show, setting the timing for slide show.

**Task 10:**

**Spreadsheet:** Students should be able to create, open, save the application documents and format them as per the requirement. Some of the tasks that may be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells. Students should submit a user manual of the Spreadsheet

**Task 11:**

**LateX:** Introduction to Latex and its installation and different IDEs. Creating first document using Latex, using content into sections using article and book class of LaTeX. Styling Pages: reviewing and customizing different paper sizes and formats. Formatting text (styles, size, alignment, colors and adding bullets and numbered items, inserting mathematical symbols, and images, etc.). Creating basic tables, adding simple and dashed borders, merging rows and columns. Referencing and Indexing: cross-referencing (refer to sections, table, images), bibliography (references).

**References:**

1. Introduction to Computers, Peter Norton, McGraw Hill
2. MOS study guide for word, Excel, Powerpoint & Outlook Exams, Joan Lambert, Joyce Cox, PHI.
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
4. Networking your computers and devices, Rusen, PHI
5. Trouble shooting, Maintaining & Repairing PCs, Bigelows, TMH
6. Lamport L. LATEX: a document preparation system: user's guide and reference manual. Addison-wesley; 1994.

**Course Outcomes:**

- Disassemble and Assemble a Personal Computer and prepare the computer ready to use.
- Prepare the Documents using Word processors and Prepare spread sheets for calculations .using excel and also the documents using LAtEX.
- Prepare Slide presentations using the presentation tool.
- Interconnect two or more computers for information sharing.
- Access the Internet and Browse it to obtain the required information.

**Note:** Use open source tools for implementation of the above exercises.

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**B.Tech (ME)– I Sem**

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**(20A51201P) ENGINEERING CHEMISTRY LAB**  
**(Common to Civil and Mechanical)**

**Course Objectives:**

- To Verify the fundamental concepts with experiments

**List of Experiments:**

1. Determination of Hardness of a groundwater sample.
2. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base
3. Determination of cell constant and conductance of solutions
4. Potentiometry - determination of redox potentials and emfs
5. Determination of Strength of an acid in Pb-Acid battery
6. Preparation of a polymer
7. Determination of percentage of Iron in Cement sample by colorimetry
8. Estimation of Calcium in port land Cement
9. Preparation of nanomaterials by precipitation.
10. Adsorption of acetic acid by charcoal
11. Determination of percentage Moisture content in a coal sample
12. Determination of Viscosity of lubricating oil by Redwood Viscometer 1 &2
13. Determination of Calorific value of gases by Junker's gas Calorimeter

**Course Outcomes:**

At the end of the course, the students will be able to

- Determine the cell constant and conductance of solutions (L3)
- Prepare advanced polymer materials (L2)
- Determine the physical properties like surface tension, adsorption and viscosity (L3)
- Estimate the Iron and Calcium in cement (L3)
- Calculate the hardness of water (L4)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME)– I Sem**

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**(20A05201P) C-PROGRAMMING & DATA STRUCTURES LAB**

(Common to All Branches of Engineering)

**Course Objectives:**

- To get familiar with the basic concepts of C programming.
- To design programs using arrays, strings, pointers and structures.
- To illustrate the use of Stacks and Queues
- To apply different operations on linked lists.
- To demonstrate Binary search tree traversal techniques.
- To design searching and sorting techniques.

**Week 1**

Write C programs that use both recursive and non-recursive functions

- i) To find the factorial of a given integer.
- ii) To find the GCD (greatest common divisor) of two given integers.
- iii) To solve Towers of Hanoi problem.

**Week 2**

- a) Write a C program to find both the largest and smallest number in a list of integers.
- b) Write a C program that uses functions to perform the following:
  - i) Addition of Two Matrices
  - ii) Multiplication of Two Matrices

**Week 3**

- a) Write a C program that uses functions to perform the following operations:
  - i) To insert a sub-string in to a given main string from a given position.
  - ii) To delete n characters from a given position in a given string.

**Week 4**

- a) Write a C program that displays the position or index in the string S where the string T begins, or – 1 if S doesn't contain T.
- b) Write a C program to count the lines, words and characters in a given text.

**Week 5**

- a) Write a C Program to perform various arithmetic operations on pointer variables.
- b) Write a C Program to demonstrate the following parameter passing mechanisms:
  - i) call-by-value
  - ii) call-by-reference

**Week 6**

Write a C program that uses functions to perform the following operations:

- i) Reading a complex number
- ii) Writing a complex number

- iii) Addition of two complex numbers
- iv) Multiplication of two complex numbers

(Note: represent complex number using a structure.)

### **Week 7**

Write C programs that implement stack (its operations) using

- i) Arrays
- ii) Pointers

### **Week 8**

Write C programs that implement Queue (its operations) using

- i) Arrays
- ii) Pointers

### **Week 9**

Write a C program that uses Stack operations to perform the following:

- i) Converting infix expression into postfix expression
- ii) Evaluating the postfix expression

### **Week 10**

Write a C program that uses functions to perform the following operations on singly linked list.

- i) Creation
- ii) Insertion
- iii) Deletion
- iv) Traversal

### **Week 11**

Write a C program that uses functions to perform the following operations on Doubly linkedlist.

- i) Creation
- ii) Insertion
- iii) Deletion
- iv) Traversal

### **Week 12**

Write a C program that uses functions to perform the following operations on circular linkedlist.

- i) Creation
- ii) Insertion
- iii) Deletion
- iv) Traversal

### **Week 13**

Write a C program that uses functions to perform the following:

- i) Creating a Binary Tree of integers
- ii) Traversing the above binary tree in preorder, inorder and postorder.

### Week 14

Write C programs that use both recursive and non-recursive functions to perform the following searching operations for a key value in a given list of integers:

- i) Linear search
- ii) Binary search

### Week 15

Write a C program that implements the following sorting methods to sort a given list of integers in ascending order

- i) Bubble sort
- ii) Selection sort
- iii) Insertion sort

### Text Books:

1. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A. Ananda Rao, Pearson Education.
2. B.A. Forouzon and R.F. Gilberg, "COMPUTER SCIENCE: A Structured Programming Approach Using C", Third edition, CENGAGE Learning, 2016.
3. Richard F. Gilberg & Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", Second Edition, CENGAGE Learning, 2011.

### Reference Books:

1. PradipDey and ManasGhosh, Programming in C, Oxford University Press, 2nd Edition 2011.
2. E.Balaguruswamy, "C and Data Structures", 4<sup>th</sup> Edition, Tata Mc Graw Hill.
3. A.K.Sharma, Computer Fundamentals and Programming in C, 2nd Edition, University Press.
4. M.T.Somashekara, "Problem Solving Using C", PHI, 2<sup>nd</sup> Edition 2009.

### Course Outcomes

- Demonstrate basic concepts of C programming language. (L2)
- Develop C programs using functions, arrays, structures and pointers. (L6)
- Illustrate the concepts Stacks and Queues. (L2)
- Design operations on Linked lists. (L6)
- Apply various Binary tree traversal techniques. (L3)
- Develop searching and sorting methods. (L6)



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– I Sem**

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**(20A02101P) BASIC ELECTRICAL & ELECTRONICS ENGINEERING LAB**  
(Civil, Mechanical, CSE, AI & DS, CSE (AI), CSE(IoT), CSE (Data Science), CSE(AI & ML), IT and Food Technology)

**Part A: Electrical Engineering Lab**

**Course Objectives:**

- To Verify Kirchoff's laws and Superposition theorem
- To learn performance characteristics of DC Machines.
- To perform various tests on 1- Phase Transformer.
- To Study the I – V Characteristics of Solar PV Cell

**List of experiments: -**

1. Verification of Kirchhoff laws.
2. Verification of Superposition Theorem.
3. Magnetization characteristics of a DC Shunt Generator.
4. Speed control of DC Shunt Motor.
5. OC & SC test of 1 – Phase Transformer.
6. Load test on 1-Phase Transformer.
7. I – V Characteristics of Solar PV cell
8. Brake test on DC Shunt Motor.

**Course Outcomes:**

After completing the course, the student will be able to

- Understand Kirchoff's Laws & Superposition theorem.
- Analyze the various characteristics on DC Machines by conducting various tests.
- Analyze I – V Characteristics of PV Cell
- Apply the knowledge to perform various tests on 1-phase transformer

**Part B: Electronics Engineering Lab**

**Course Objectives:**

- To verify the theoretical concepts practically from all the experiments.
- To analyze the characteristics of Diodes, BJT, MOSFET, UJT.
- To design the amplifier circuits from the given specifications.
- Exposed to linear and digital integrated circuits.

**List Of Experiments:**

1. PN Junction diode characteristics A) Forward bias B) Reverse bias.
2. Zener diode characteristics and Zener as voltage Regulator.
3. Full Wave Rectifier with & without filter.

4. Wave Shaping Circuits. (Clippers & Clampers)
5. Input & Output characteristics of Transistor in CB / CE configuration.
6. Frequency response of CE amplifier.
7. Inverting and Non-inverting amplifiers using Op-AMPs.
8. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
9. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

**Tools / Equipment Required:** DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

**Course outcomes:**

- Learn the characteristics of basic electronic devices like PN junction diode, Zener diode & BJT.
- Construct the given circuit in the lab
- Analyze the application of diode as rectifiers, clippers and clampers and other circuits.
- Design simple electronic circuits and verify its functioning.

Note: Minimum Six Experiments to be performed in each section.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME)– II Sem****L T P C****3 0 0 3****(20A54201) DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS**

(Common to Civil, EEE, Mechanical, ECE and Food Technology)

**Course Objectives:**

- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.

**UNIT -1****Linear differential equations of higher order (Constant Coefficients)**

Definitions, homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskian, method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Mass spring system.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Identify the essential characteristics of linear differential equations with constant coefficients (L3)
- Solve the linear differential equations with constant coefficients by appropriate method (L3)
- Classify and interpret the solutions of linear differential equations (L3)
- Formulate and solve the higher order differential equation by analyzing physical situations (L3)

**UNIT 2:****Partial Differential Equations**

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order equations using Lagrange's method.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Apply a range of techniques to find solutions of standard pdes (L3)
- Outline the basic properties of standard PDEs (L2)

**UNIT -3****Applications of Partial Differential Equations**

Classification of PDE, method of separation of variables for second order equations. Applications of Partial Differential Equations: One dimensional Wave equation, One dimensional Heat equation.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Classify the PDE (L3)
- Learn the applications of PDEs (L2)

**UNIT-4****Vector differentiation**

Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Apply del to Scalar and vector point functions (L3)
- Illustrate the physical interpretation of Gradient, Divergence and Curl (L3)

**UNIT -5****Vector integration**

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Find the work done in moving a particle along the path over a force field (L4)
- Evaluate the rates of fluid flow along and across curves (L4)
- Apply Green's, Stokes and Divergence theorem in evaluation of double and triple integrals (L3)

**Text Books:**

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

**Reference Books:**

1. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2011.
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B.Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
4. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
5. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011.
6. Micheael Greenberg, Advanced Engineering Mathematics, 9<sup>th</sup> edition, Pearson edn
7. Dean G. Duffy, Advanced engineering mathematics with MATLAB, CRC Press
8. Peter O'neil, Advanced Engineering Mathematics, Cengage Learning.
9. R.L. GargNishu Gupta, Engineering Mathematics Volumes-I &II, Pearson Education
10. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education.
11. H. k Das, Er. RajnishVerma, Higher Engineering Mathematics, S. Chand.
12. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

**Course Outcomes:**

At the end of the course, the student will be able to

- Solve the differential equations related to various engineering fields (L6)
- Identify solution methods for partial differential equations that model physical processes (L3)
- Interpret the physical meaning of different operators such as gradient, curl and divergence (L5)
- Estimate the work done against a field, circulation and flux using vector calculus (L6)

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**B.Tech (ME)– II Sem**

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**(20A56101T) ENGINEERING PHYSICS**  
 (Common to Civil Mechanical and Food Technology)

**Course Objectives**

- To make a bridge between the physics in school and engineering courses.
- To identify the importance of the optical phenomenon i.e. interference, diffraction and polarization related to its Engineering applications.
- To understand the mechanisms of emission of light, the use of lasers as light sources for low and high energy applications, study of propagation of light wave through optical fibres along with engineering applications
- To open new avenues of knowledge in dielectric and magnetic materials which find potential in the emerging micro device applications.

Considering the significance of micro miniaturization of electronic devices and significance of low dimensional materials, the basic concepts of nano materials, their properties and applications in modern emerging technologies are elicited.

- To familiarize the concepts of theoretical acoustics to practical use in engineering field. To explain the significance of ultrasound and its application in NDT for diversified engineering application.
- To enlighten the periodic arrangement of atoms in crystals, Bragg's law and to provide fundamentals related to structural analysis through powder diffraction method.

**UNIT-I**

**Wave Optics**

**Interference-** Principle of superposition – Interference of light – Conditions for sustained interference – Interference in thin films (Reflection Geometry) – Colors in thin films – Newton's Rings- Determination of wavelength and refractive index.

**Diffraction-** Introduction – Fresnel and Fraunhofer diffraction – Fraunhofer diffraction due to single slit, double slit and N-slits (qualitative) – Grating spectrum.

**Polarization-** Introduction – Types of polarization – Polarization by reflection, refraction and double refraction – Nicol's Prism – Half wave and Quarter wave plates with applications.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain the need of coherent sources and the conditions for sustained interference (L2)
- Identify engineering applications of interference (L3)
- Analyze the differences between interference and diffraction with applications (L4)
- Illustrate the concept of polarization of light and its applications (L2)
- Classify ordinary polarized light and extraordinary polarized light (L2)

## UNIT-II

### Lasers and Fiber optics

**Lasers-** Introduction – Characteristics of laser – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion – Lasing action – Pumping mechanisms – Nd-YAG laser – He-Ne laser – Applications of lasers.

**Fiber optics-** Introduction – Principle of optical fiber – Acceptance Angle – Numerical Aperture – Classification of optical fibers based on refractive index profile and modes – Propagation of electromagnetic wave through optical fibers – Propagation Losses (Qualitative) – Applications.

### Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the basic concepts of LASER light Sources (L2)
- Apply the concepts to learn the types of lasers (L3)
- Identifies the Engineering applications of lasers (L2)
- Explain the working principle of optical fibers (L2)
- Classify optical fibers based on refractive index profile and mode of propagation (L2)
- Identify the applications of optical fibers in various fields (L2)

## UNIT III

### Engineering Materials

**Dielectric Materials-** Introduction – Dielectric polarization – Dielectric polarizability, Susceptibility and Dielectric constant – Types of polarizations: Electronic, Ionic and Orientation polarization (Qualitative) – Lorentz internal field – Clausius-Mossotti equation.

**Magnetic Materials-** Introduction – Magnetic dipole moment – Magnetization – Magnetic susceptibility and permeability – Origin of permanent magnetic moment – Classification of magnetic materials: Dia, para & Ferro – Domain concept of Ferromagnetism (Qualitative) – Hysteresis – Soft and Hard magnetic materials.

**Nanomaterials-** Introduction – Surface area and quantum confinement – Physical properties: electrical and magnetic properties – Synthesis of nanomaterials: Top-down: Ball Milling – Bottom-up: Chemical Vapour Deposition – Applications of nanomaterials.

### Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the concept of dielectric constant and polarization in dielectric materials (L2)
- Summarize various types of polarization of dielectrics (L2)
- Interpret Lorentz field and Clausius-Mosotti relation in dielectrics(L2)
- Classify the magnetic materials based on susceptibility and their temperature dependence (L2)
- Explain the applications of dielectric and magnetic materials (L2)
- Apply the concept of magnetism to magnetic devices (L3)
- Identify the nano size dependent properties of nanomaterials (L2)
- Illustrate the methods for the synthesis and characterization of nanomaterials (L2)
- Apply the basic properties of nanomaterials in various Engineering branches (L3).

## UNIT-IV

### Acoustics and Ultrasonics

**Acoustics-** Introduction – Requirements of acoustically good hall – Reverberation – Reverberation time – Sabine’s formula (Derivation using growth and decay method ) – Absorption coefficient and its determination – Factors affecting acoustics of buildings and their remedies.

**Ultrasonics-** Introduction – Properties – Production by magnetostriction and piezoelectric methods – Detection – Acoustic grating – Non Destructive Testing – Pulse echo system through transmission and reflection modes – Applications.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Explain how sound is propagated in buildings (L2)
- Analyze acoustic properties of typically used materials in buildings (L4)
- Recognize sound level disruptors and their use in architectural acoustics (L2)
- Identify the use of ultrasonics in different fields (L3)

## UNIT-V

### Crystallography and X-ray diffraction

**Crystallography-** Space lattice, Basis, unit cell and lattice parameters – Bravais Lattice – Crystal systems – Packing fraction – Coordination number – Packing fraction of SC, BCC & FCC – Miller indices – Separation between successive (hkl) planes.

**X-Ray Diffraction-** Bragg’s law – Bragg’s X-ray diffractometer – Crystal structure determination by Powder method.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Classify various crystal systems (L2)
- Identify different planes in the crystal structure (L3)
- Analyze the crystalline structure by Bragg’s X-ray diffractometer (L4)
- Apply powder method to measure the crystallinity of a solid (L4)

#### Prescribed Text books:

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand and Company
2. Engineering physics – D.K. Battacharya and Poonam Tandon, Oxford University press.

#### Reference Books:

1. Engineering Physics - Sanjay D. Jain, D. Sahasrambudhe and Girish, University Press
2. Engineering Physics – K. Thyagarajan, McGraw Hill Publishers
3. Engineering Physics – D K Pandey, S. Chaturvedi, Cengage Learning
4. Engineering Physics – M.R. Srinivasan, New Age Publications



### Course Outcomes

- Study the different realms of physics and their applications in both scientific and technological systems through physical optics. (L2)
- Identify the wave properties of light and the interaction of energy with the matter (L3).
- Asses the electromagnetic wave propagation and its power in different media (L5).
- Understands the response of dielectric and magnetic materials to the applied electric and magnetic fields. (L3)
- Elucidates the importance of nano materials along with their engineering applications. (L5)
- Explain the basic concepts of acoustics and ultrasonics. (L2)
- Apply the concept of NDT to material testing. (L3)
- Study the important properties of crystals like the presence of long-range order, periodicity and structure determination using X-ray diffraction technique. (L5)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– II Sem**

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**(20A52101T) COMMUNICATIVE ENGLISH**  
(Common to All Branches of Engineering)

**Course Objectives**

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

**UNIT -1**

**Lesson: On the Conduct of Life: William Hazlitt**

**Listening:** Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions. **Speaking:** Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others. **Reading:** Skimming to get the main idea of a text; scanning to look for specific pieces of information. **Reading for Writing :** Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph. **Grammar and Vocabulary:** Parts of Speech, Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countable and uncountable; singular and plural; basic sentence structures; simple question form - wh-questions; word order in sentences.

**Learning Outcomes**

At the end of the module, the learners will be able to

- Understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- Ask and answer general questions on familiar topics and introduce oneself/others
- Employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- Recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- Form sentences using proper grammatical structures and correct word forms

**UNIT -2**

**Lesson: The Brook: Alfred Tennyson**

**Listening:** Answering a series of questions about main idea and supporting ideas after listening to audio texts. **Speaking:** Discussion in pairs/small groups on specific topics followed by short structured talks. **Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together. **Writing:** Paragraph writing (specific topics) using suitable cohesive devices;

mechanics of writing - punctuation, capital letters. **Grammar and Vocabulary:** Cohesive devices - linkers, sign posts and transition signals; use of articles and zero article; prepositions.

### Learning Outcomes

At the end of the module, the learners will be able to

- Comprehend short talks on general topics
- Participate in informal discussions and speak clearly on a specific topic using suitable discourse markers
- Understand the use of cohesive devices for better reading comprehension
- Write well structured paragraphs on specific topics
- Identify basic errors of grammar/ usage and make necessary corrections in short texts

## UNIT -3

### Lesson: The Death Trap: Saki

**Listening:** Listening for global comprehension and summarizing what is listened to. **Speaking:** Discussing specific topics in pairs or small groups and reporting what is discussed **Reading:** Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension. **Writing:** Summarizing, Paragraph Writing **Grammar and Vocabulary:** Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

### Learning Outcomes

At the end of the module, the learners will be able to

- Comprehend short talks and summarize the content with clarity and precision
- Participate in informal discussions and report what is discussed
- Infer meanings of unfamiliar words using contextual clues
- Write summaries based on global comprehension of reading/listening texts
- Use correct tense forms, appropriate structures and a range of reporting verbs in speech and writing

## UNIT-4

### Lesson: Innovation: Muhammad Yunus

**Listening:** Making predictions while listening to conversations/ transactional dialogues without video; listening with video. **Speaking:** Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. **Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data. **Writing:** Letter Writing: Official Letters/Report Writing **Grammar and Vocabulary:** Quantifying expressions - adjectives and adverbs; comparing and contrasting; Voice - Active & Passive Voice

### Learning Outcomes

At the end of the module, the learners will be able to

- Infer and predict about content of spoken discourse
- Understand verbal and non-verbal features of communication and hold formal/informal conversations

- Interpret graphic elements used in academic texts
- Produce a coherent paragraph interpreting a figure/graph/chart/table
- Use language appropriate for description and interpretation of graphical elements

## UNIT -5

### **Lesson: Politics and the English Language: George Orwell**

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension. Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides. Reading: Reading for comprehension. Writing: Writing structured essays on specific topics using suitable claims and evidences. Grammar and Vocabulary: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

### **Learning Outcomes**

At the end of the module, the learners will be able to

- Take notes while listening to a talk/lecture and make use of them to answer questions
- Make formal oral presentations using effective strategies
- Comprehend, discuss and respond to academic texts orally and in writing
- Produce a well-organized essay with adequate support and detail
- Edit short texts by correcting common errors

### **Text Book:**

1. Language and Life: A Skills Approach- I Edition 2019, Orient Black Swan

### **Reference Books:**

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Raymond Murphy's English Grammar in Use Fourth Edition (2012) E-book
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.
5. Oxford Learners Dictionary, 12<sup>th</sup> Edition, 2011
6. Norman Lewis Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary (2014)
7. Speed Reading with the Right Brain: Learn to Read Ideas Instead of Just Words by David Butler

### **Course Outcomes**

- Retrieve the knowledge of basic grammatical concepts
- Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English
- Apply grammatical structures to formulate sentences and correct word forms
- Analyze discourse markers to speak clearly on a specific topic in informal discussions
- Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.
- Create a coherent paragraph interpreting a figure/graph/chart/table

**Web links**

[www.englishclub.com](http://www.englishclub.com)

[www.easyworldofenglish.com](http://www.easyworldofenglish.com)

[www.languageguide.org/english/](http://www.languageguide.org/english/)

[www.bbc.co.uk/learningenglish](http://www.bbc.co.uk/learningenglish)

[www.eslpod.com/index.html](http://www.eslpod.com/index.html)

[www.myenglishpages.com](http://www.myenglishpages.com)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– II Sem**

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**(20A03201T) MATERIAL SCIENCE & ENGINEERING**

**Course Objectives**

- To teach the principles of physical metallurgy, i.e. crystallography of metals, constitution of alloys, phase diagrams.
- Expose commercially important metals and alloys (both ferrous and non ferrous) with engineering constraints.
- Explain the methods to change the properties of materials through heat treatment processes
- Familiarize properties and applications of ceramics, polymers and composite materials.
- Demonstrate the fundamental properties of nano-materials and their applications.

**UNIT I**

**Structure of Metals:** Crystal Structures: Unit cells, Metallic crystal structures, Imperfection in solids: Point, Line, interstitial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

**Constitution of Alloys:** Necessity of Alloying, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-Iron-carbide diagram and microstructural aspects of ferrite, cementite, austenite, ledeburite, and cast iron.

**Learning Outcomes:**

At the end of this unit the student will be able to

- Understand the importance of material science in engineering.(12)
- Recall the definitions and terminology of crystallography. (11)
- Distinguish metals and alloys. (14)
- Make use of the principles of construction of binary phase diagrams. (13)
- Identify various invariant reactions in binary phase diagrams. (13)
- Know the concept of metallography in studying the microstructures of metals and alloys. (12)

**UNIT II**

**Steels:**

Plain carbon steels, use and limitations of plain carbon steels. AISI& BIS classification of steels. Classification of alloy steels. Microstructure, properties and applications of alloy steels-stainless steels and tool steels.

**Cast irons:**

Microstructure, properties and applications of white cast iron, malleable cast iron, grey cast iron, nodular cast iron and alloy cast irons.

**Learning Outcomes:**

At the end of this unit the student will be able to

- Classify various types of steels, their properties and applications. (12)
- Identify various types of cast irons, their properties and applications. (13)
- Compare steels and cast irons and their limitations in applications. (13)

**UNIT III**

**Heat Treatment of Steels:** Annealing, tempering, normalizing and hardening, isothermal transformation diagrams for Fe-Fe<sub>3</sub>C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening - carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, and vacuum and plasma hardening

**Learning Outcomes:**

At the end of this unit the student will be able to

- Understand the importance of iron - iron carbide phase diagram. (12)
- Know the influence of heat treatment in modification of properties of steels. (12)
- Develop a heat treatment cycle based on properties required. (13)
- Comprehend the principles of surface hardening methods. (12)

**UNIT IV**

**Non-ferrous Metals and Alloys:** Microstructure, properties and applications of copper, aluminium, titanium, nickel and their alloys. Study of Al-Cu phase diagram

**Learning Outcomes:**

At the end of this unit the student will be able to

- Understand the importance of non-ferrous metals and alloys in engineering applications. (12)
- Demonstrate various properties and applications of non-ferrous alloys. (14)
- Differentiate between hardening of ferrous and non-ferrous alloys. (14)

**UNIT V**

**Ceramics, Polymers and Composites:** Structure, properties and applications of ceramics, polymers and composites. Introduction to super alloys and nanomaterials.

**Learning Outcomes:**

At the end of this unit the student will be able to

- Understand the properties of ceramics and their applications. (12)
- Summarize the properties of polymers and composites and their use. (12)
- Interpret the properties of nano materials and their applications. (12)
- Identify the difference between the micro and nano scale materials and their uses. (L3)

### Course Outcomes:

After completing the course, the student will be able to

- Explain the principles of binary phases. (I2)
- Select steels and cast irons for a given application. (I3)
- Apply heat treatment to different applications. (I3)
- Utilize nonferrous metals and alloys in engineering. (I3)
- Choose composites for various applications. (I3)
- Assess the properties of nano-scale materials and their applications. (I2)
- Differentiate between hardening of ferrous and non-ferrous alloys. (L4)

### Text Book(s)

1. V.Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
2. R.Balasubramaniam, Callister's Material Science and Engineering, 2/e, Wiley India, 2014.

### References

1. Y. Lakhtin, Engineering Physical Metallurgy, University Press of the Pacific, 2000.
2. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.
3. L.H.Van Vlack, Elements of Material Science and Engineering, 6/e, Pearson Education, 2008.
4. George E.Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– II Sem**

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**(20A03101T) ENGINEERING DRAWING**  
(Common to All Branches of Engineering)

**Course Objectives:**

- Bring awareness that Engineering Drawing is the Language of Engineers.
- Familiarize how industry communicates technical information.
- Teach the practices for accuracy and clarity in presenting the technical information.
- Develop the engineering imagination essential for successful design.

**Unit: I**

Introduction to Engineering Drawing: Principles of Engineering Drawing and its significance- Conventions in drawing-lettering - BIS conventions.

- a) Conic sections including the rectangular hyperbola- general method only,
- b) Cycloid, epicycloids and hypocycloid c) Involute

**Learning Outcomes:**

At the end of this unit the student will be able to

- Understand the significance of engineering drawing
- Know the conventions used in the engineering drawing
- Identify the curves obtained in different conic sections
- Draw different curves such as cycloid, involute and hyperbola

**Unit: II**

Projection of points, lines and planes: Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line. Projections of regular plane surfaces.

**Learning Outcomes:**

At the end of this unit the student will be able to

- Understand the meaning of projection
- Know how to draw the projections of points, lines
- Differentiate between projected length and true length
- Find the true length of the lines

**Unit: III**

**Projections of solids:** Projections of regular solids inclined to one or both planes by rotational or auxiliary views method.

**Learning Outcomes:**

At the end of this unit the student will be able to

- Understand the procedure to draw projection of solids
- Differentiate between rotational method and auxiliary view method.
- Draw the projection of solid inclined to one plain
- Draw the projection of solids inclined to both the plains

#### Unit: IV

**Sections of solids:** Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone. True shapes of the sections.

#### Learning Outcomes:

At the end of this unit the student will be able to

- Understand different sectional views of regular solids
- Obtain the true shapes of the sections of prism
- Draw the sectional views of prism, cylinder, pyramid and cone

#### Unit: V

**Development of surfaces:** Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts.

#### Learning Outcomes:

At the end of this unit the student will be able to

- Understand the meaning of development of surfaces
- Draw the development of regular solids such as prism, cylinder, pyramid and cone
- Obtain the development of sectional parts of regular shapes

#### Text Books:

1. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, Chennai, 2012.
2. N.D.Bhatt, Engineering Drawing, 53/e, Charotar Publishers, 2016.

#### Reference Books:

1. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2009
2. Venugopal, Engineering Drawing and Graphics, 3/e, New Age Publishers, 2000
3. Shah and Rana, Engineering Drawing, 2/e, Pearson Education, 2009
4. K.C.John, Engineering Graphics, 2/e, PHI, 2013
5. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2008.

#### Course Outcomes:

After completing the course, the student will be able to

- Draw various curves applied in engineering. (12)
- Show projections of solids and sections graphically. (12)
- Draw the development of surfaces of solids. (13)

#### Additional Sources

Youtube: [http://sewor,Carleton.ca/g,kardos/88403/drawings.html](http://sewor.Carleton.ca/g,kardos/88403/drawings.html) conic sections-online, red woods.edu

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME) – I Sem**

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**(20A03101P) ENGINEERING GRAPHICS LAB**  
 (Common to All Branches of Engineering)

**Course Objectives:**

- Instruct the utility of drafting & modeling packages in orthographic and isometric drawings.
- Train the usage of 2D and 3D modeling.
- Instruct graphical representation of machine components.

**Computer Aided Drafting:**

**Introduction to AutoCAD:** Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions.

Dimensioning principles and conventional representations.

**Orthographic Projections:** Systems of projections, conventions and application to orthographic projections - simple objects.

**Isometric Projections:** Principles of isometric projection- Isometric scale; Isometric views: lines, planes, simple solids.

**Text Books:**

1. K. Venugopal, V.Prabhu Raja, Engineering Drawing + Auto Cad, New Age International Publishers.
2. Kulkarni D.M, AP Rastogi and AK Sarkar, Engineering Graphics with Auto Cad, PHI Learning, Eastern Economy editions.

**Reference Books:**

1. T. Jayapooan, Engineering Graphics using Auto Cad, Vikas Publishing House
2. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, Chennai, 2012.
3. Linkan Sagar, BPB Publications, Auto Cad 2018 Training Guide.
4. K.C.John, Engineering Graphics, 2/e, PHI, 2013
5. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2008.

**Course Outcomes:**

After completing the course, the student will be able to

- Use computers as a drafting tool. (L2)
- Draw isometric and orthographic drawings using CAD packages. (L3)

**Additional Sources**

1. Youtube: [http://sewor,Carleton.cag,kardos/88403/drawings.html](http://sewor.Carleton.cag,kardos/88403/drawings.html) conic sections-online, red woods.edu

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– II Sem**

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**(20A52101P) COMMUNICATIVE ENGLISH LAB**  
(Common to All Branches of Engineering)

**Course Objectives**

- students will be exposed to a variety of self instructional, learner friendly modes of language learning
- students will learn better pronunciation through stress, intonation and rhythm
- students will be trained to use language effectively to face interviews, group discussions, public speaking
- students will be initiated into greater use of the computer in resume preparation, report writing, format making etc

**List of Topics**

1. Phonetics
2. Reading comprehension
3. Describing objects/places/persons
4. Role Play or Conversational Practice
5. JAM
6. Etiquettes of Telephonic Communication
7. Information Transfer
8. Note Making and Note Taking
9. E-mail Writing
10. Group Discussions-1
11. Resume Writing
12. Debates
13. Oral Presentations
14. Poster Presentation
15. Interviews Skills-1

**Suggested Software**

Orel, Walden Infotech, Young India Films

**Reference Books**

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.
5. A Textbook of English Phonetics for Indian Students by T.Balasubramanyam

**Web Links**

[www.esl-lab.com](http://www.esl-lab.com)  
[www.englishmedialab.com](http://www.englishmedialab.com)  
[www.englishinteractive.net](http://www.englishinteractive.net)

## Course Outcomes

After completing the course, the student will be able to

- Listening and repeating the sounds of English Language
- Understand the different aspects of the English language
- proficiency with emphasis on LSRW skills
- Apply communication skills through various language learning activities
- Analyze the English speech sounds, stress, rhythm, intonation and syllable
- Division for better listening and speaking comprehension.
- Evaluate and exhibit acceptable etiquette essential in social and professional settings
- Create awareness on mother tongue influence and neutralize it in order to
- Improve fluency in spoken English.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– II Sem**

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**(20A56101P) ENGINEERING PHYSICS LAB**  
(Common to Civil, Mechanical and Food Technology)

**Course Objectives:**

- Understand the role of Optical fiber parameters in engineering applications.
- Recognize the significance of laser by studying its characteristics and its application in finding the particle size.
- Illustrates the magnetic and dielectric materials applications.
- Identifies the various sensor applications.

**List of Topics**

1. Determine the thickness of the wire using wedge shape method
2. Determination of the radius of curvature of the lens by Newton's ring method
3. Determination of wavelength by plane diffraction grating method
4. Determination of dispersive power of prism.
5. Determination of wavelength of LASER light using diffraction grating.
6. Determination of particle size using LASER.
7. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle
8. Determination of dielectric constant by charging and discharging method.
9. Magnetic field along the axis of a circular coil carrying current –Stewart Gee's method.
10. Measurement of magnetic susceptibility by Gouy's method
11. Study the variation of B versus H by magnetizing the magnetic material (B-H curve)
12. Determination of ultrasonic velocity in liquid (Acoustic grating)
13. Rigidity modulus of material of a wire-dynamic method (Torsional pendulum)
14. Sonometer: Verification of the three laws of stretched strings
15. Determination of spring constant of springs using Coupled Oscillator

**References:**

1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017.
2. <http://vlab.amrita.edu/index.php> -Virtual Labs, Amrita University

**Course Outcomes:**

After completing the course, the student will be able to

- Operate various optical instruments (L2)
- estimate wavelength of laser and particles size using laser(L2)
- evaluate the acceptance angle of an optical fiber and numerical aperture (L3)
- estimate the susceptibility and related magnetic parameters of magnetic materials (L2)
- plot the intensity of the magnetic field of circular coil carrying current with distance (L3)
- determine magnetic susceptibility of the material and its losses by B-H curve (L3)
- apply the concepts of ultrasonics by acoustic grating (L2)

**Note Out of 15 experiments any 12 experiments (minimum 10) must be performed in a semester.**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– II Sem**

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**(20A03201P) MATERIAL SCIENCE & ENGINEERING LAB**

**Course Objectives:**

- To understand the microstructure and hardness of engineering materials.
- To explain grain boundaries and grain sizes of different engineering materials.

**List of Experiments:**

1. Metallography sample preparation
2. Microstructure of pure metals – Iron, copper and aluminum as per ASTM standards
3. Microstructure of low carbon steel, mild steel and high carbon microstructure of cast irons.
4. Microstructure of non-ferrous alloys – aluminum, copper, titanium, nickel and their alloys.
5. Hardenability of steels by Jominy End Quench Test.
6. Microstructure of heat treated steels.
7. Hardness of various untreated and treated steels.
8. Microstructure of ceramics, polymeric materials.
9. Microstructure of super alloy and nano-materials.
10. Hardness of ceramics, super alloys, nano-materials and polymeric materials (one sample on each)

**Course Outcomes:**

The student is able to

- Differentiate various microstructures of ferrous and non-ferrous metals and alloys. (14)
- Visualize grains and grain boundaries. (13)
- Importance of hardening of steels. (12)
- Evaluate hardness of treated and untreated steels. (14)
- Differentiate hardness of super alloys, ceramics and polymeric materials

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME) – II-I Sem**

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3	0	0	3

**20A54303 Complex variables, Transforms & Partial Differential Equations****Pre-requisite****Functions, Differentiations and Integration****Course Objectives:**

This course aims at providing the student to acquire the knowledge on the calculus of functions of complex variables. The aim is to analyze the solutions of partial differential equations.

**Course Outcomes (CO):** Student will be able to

- Understand the analyticity of complex functions and conformal mappings.
- Apply cauchy's integral formula and cauchy's integral theorem to evaluate improper integrals along contours.
- Understand the usage of laplace transforms.
- Evaluate the fourier series expansion of periodic functions.
- Formulate/solve/classify the solutions of partial differential equations and also find the solution of one-dimensional wave equation and heat equation.

**UNIT - I                      Complex Variable – Differentiation:                      9 Hrs**

Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations, analytic functions (exponential, trigonometric, logarithm), harmonic functions, finding harmonic conjugate-construction of analytic function by Milne Thomson method-Conformal mappings-standard transformations ( $e^z, \frac{1}{z}, kz$ ) Mobius transformations (bilinear) and their properties.

**UNIT - II                      Complex Variable – Integration:                      9 Hrs**

Line integral-Contour integration, Cauchy's integral theorem, Cauchy Integral formula, Liouville's theorem (without proof) and Maximum-Modulus theorem (without proof);power series expansions: Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals (around unit circle, semi circle with f(z) not having poles on real axis).

**UNIT - III                      Laplace Transforms                      9 Hrs**

Definition-Laplace transform of standard functions-existence of Laplace Transform – Inverse transform – First shifting Theorem, Transforms of derivatives and integrals – Unit step function – Second shifting theorem – Dirac's delta function – Convolution theorem – Laplace transform of Periodic function. Differentiation and integration of transform – solving Initial value problems to ordinary differential equations with constant coefficients using Laplace transforms.

**UNIT - IV                      Fourier series                      8 Hrs**

Determination of Fourier coefficients (Euler's) – Dirichlet conditions for the existence of Fourier series – functions having discontinuity-Fourier series of Even and odd functions – Fourier series in an arbitrary interval – Half-range Fourier sine and cosine expansions- typical wave forms - Parseval's formula- Complex form of Fourier series.

**UNIT - V                      Partial Differential Equations & Applications                      9 Hrs**

Solution of second order PDEs by Method of separation of variables – Solutions of one dimensional wave equation, one dimensional heat equation under initial and boundary conditions. Steady state two dimensional heat equations (Laplace equations).

**Textbooks:**

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India

**Reference Books:**

1. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
2. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.



**Online Learning Resources:**

1. [nptel.ac.in/courses/111107056](https://nptel.ac.in/courses/111107056)
2. [onlinelibrary.wiley.com](https://onlinelibrary.wiley.com)
3. <https://onlinecourses.nptel.ac.in/noc18ma12>.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME) – II-I Sem****L T P C  
3 0 0 3****20A01302T Fluid Mechanics and Hydraulic Machines  
(Common to Civil & Mechanical)****Pre-requisite                      Physics, Chemistry****Course Objectives:**

- To impart ability to solve engineering problems in fluid mechanics
- To explain basics of statics, kinematics and dynamics of fluids and various measuring techniques of hydrostatic forces on objects.
- To enable the students measure quantities of fluid flowing in pipes, tanks and channels
- To Introduce concepts of uniform and non-uniform flows through open channel.
- To impart knowledge on design of turbines and pumps.

**Course Outcomes (CO):**

- Familiarize basic terms used in fluid mechanics
- Understand the principles of fluid statics, kinematics and dynamics
- Understand flow characteristics and classify the flows and estimate various losses in flow through channels
- Analyze characteristics for uniform and non-uniform flows in open channels.
- Design different types of turbines, centrifugal and multistage pumps.

**UNIT - I                      Introduction to Fluid Statics**

Distinction between a fluid and a solid - characteristics of fluids - Fluid Pressure: Pressure at a point, Pascal's law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U Tube Differential Manometer. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

**UNIT - II                      Fluid kinematics and Dynamics**

Classification of fluid flow - Stream line, path line, streak line and stream tube; stream function, velocity potential function. One, two and three - dimensional continuity equations in Cartesian coordinates.

Fluid Dynamics: Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation: Venturimeter, orifice meter and Pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number

**UNIT - III                      Analysis Of Pipe Flow**

Energy losses in pipelines; Darcy – Weisbach equation; Minor losses in pipelines; Hydraulic Grade Line and Total Energy Line; Concept of equivalent length – Pipes in Parallel and Series. Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity. Reynolds experiment, Transition from laminar to turbulent flow. Resistance to flow of fluid in smooth and rough pipes-Moody's diagram – Introduction to boundary layer theory.

**UNIT - IV                      Flow in Open Channels**

Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section. Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Computation of Uniform flow. Specific energy, critical flow, discharge curve, Specific force, Specific depth, and Critical depth. Measurement of Discharge and Velocity – Broad Crested Weir. Gradually Varied Flow Dynamic Equation of Gradually Varied Flow. Hydraulic Jump and classification - Elements and characteristics- Energy dissipation.

**UNIT - V                      Hydraulic Machines**

Impact of Jets- Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes - velocity triangles at inlet and outlet - Work done and efficiency - Hydraulic Turbines: Classification of turbines; pelton wheel and its design. Francis turbine and its design - efficiency - Draft tube: theory - characteristic curves of hydraulic turbines - Cavitation - Working principles of a centrifugal pump, work done by impeller; heads, losses and efficiencies; minimum starting speed; Priming; specific speed; limitation of suction lift, net positive suction head (NPSH); Performance and characteristic curves; Cavitation effects; Multistage centrifugal pumps; troubles and remedies – Introduction to Reciprocating Pump.

**Textbooks:**

1. P. M. Modi and S. M. Seth, “Hydraulics and Fluid Mechanics”, Standard Book House
2. K. Subrahmanya, “Theory and Applications of Fluid Mechanics”, Tata McGraw Hill

**Reference Books:**

1. R. K. Bansal, A text of “Fluid Mechanics and Hydraulic Machines”, Laxmi Publications (P) Ltd., New Delhi.
2. K. Subramanya, Open channel Flow, Tata McGraw Hill.
3. N. Narayana Pillai, Principles of “Fluid Mechanics and Fluid Machines”, Universities Press Pvt Ltd, Hyderabad. 3rd Edition 2009.
4. C. S. P. Ojha, R. Berndtsson and P. N. Chadramouli, “Fluid Mechanics and Machinery”, Oxford University Press, 2010.
5. Banga & Sharma, “Hydraulic Machines”, Khanna Publishers.

**Online Learning Resources:**

1. <https://www.coursera.org/courses?query=fluid%20mechanics>
2. <https://www.udemy.com/topic/fluid-mechanics/>
3. [https://onlinecourses.nptel.ac.in/noc21\\_ce31/preview](https://onlinecourses.nptel.ac.in/noc21_ce31/preview)
4. <https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-01-unified-engineering-i-ii-iii-iv-fall-2005-spring-2006/fluid-mechanics/>
5. <http://lms.msionline.org/mod/folder/view.php?id=138>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME) – II-I Sem****L T P C**  
**3 0 0 3****20A03301T Manufacturing Processes****Course Objectives:**

- To introduce the students to working principle of different metal casting processes and gating system.
- To impart knowledge on plastic deformation, cold and hot working process, working of a rolling mill and types, extrusion processes.
- To teach principles of forging, tools and dies, working of forging processes.
- To develop fundamental understanding on classification of the welding processes, working of different types of welding processes and welding defects.
- To impart knowledge on manufacturing methods of plastics, ceramics and powder metallurgy.
- To introduce the basic concepts of Unconventional Machining Processes.

**Course Outcomes (CO):**

At the end of the course, the student will be able to

- Demonstrate different metal casting processes and gating systems. (L2)
- Classify working of various welding processes. (L2)
- Evaluate the forces and power requirements in rolling process. (L5)
- Apply the principles of various forging operations. (L3)
- Outline the manufacturing methods of plastics, ceramics and powder metallurgy. (L1)
- Identify different unconventional processes and their applications. (L3)

**UNIT - I****Casting Processes****8 Hrs****Introduction:** Importance and selection of manufacturing processes.

Introduction to casting process, process steps; pattern and design of gating system; Solidification of casting: Concept, solidification of pure metal and alloy; Special casting processes: Shell casting, investment casting, die casting, centrifugal casting, casting defects and remedies.

**UNIT - II****Metal Forming & Forging****8 Hrs**

Introduction, nature of plastic deformation, hot and cold working of metals, mechanics of metal forming; Rolling: Principle, types of rolling mill and products, roll passes, forces in rolling and power requirements; Extrusion: Basic extrusion process and its characteristics, hot extrusion and cold extrusion, wire drawing, tube drawing.

Principles of forging, tools and dies. Types: Smith forging, drop forging, forging hammers, rotary forging and forging defects. Sheet metal forming: Mechanics of sheet metal working, blanking, piercing, bending, stamping.

**UNIT - III****Metal Joining Processes****8 Hrs**

Classification of welding processes, types of welds and welded joints and V-I characteristics, arc welding, weld bead geometry, submerged arc welding, gas tungsten arc welding, gas metal arc welding. applications, advantages and disadvantages of the above processes, Plasma Arc welding, Laser Beam Welding, Electron Beam Welding and Friction Stir Welding. Heat affected zones in welding; soldering and brazing: Types and their applications, Welding defects: causes and remedies.

**UNIT - IV****Plastic Processing, Ceramics and Powder Metallurgy****8 Hrs****Plastics:** Types, properties and their applications, processing of plastics, extrusion of plastics, transfer molding and compression molding, injection molding, thermoforming, rotational molding, and blow molding**Ceramics:** Classification of ceramic materials, properties and their application, ceramic powder preparation; Processing of ceramic parts: Pressing, casting, sintering; Secondary processing of ceramics: Coatings, finishing.

**Powder Metallurgy:** Principle, manufacture of powders, steps involved.

**UNIT - V**

**Unconventional Machining Processes**

**10 Hrs**

principle and processes parameters of Electrical discharge machining (EDM), electro-chemical machining (ECM), Laser beam machining (LBM), plasma arc machining (PAM), electron beam machining, Abrasive jet machining (AJM), water jet machining (WJM), and ultrasonic machining(UM)

**Textbooks:**

1. Rao P.N., Manufacturing Technology – Volume I, 5/e, McGraw-Hill Education, 2018.
2. Kalpakjain S and Schmid S.R., Manufacturing Engineering and Technology, 7/e, Pearson, 2018.

**Reference Books:**

1. Introduction to Physical Metallurgy by Sidney H.Avner
2. Millek P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems, 4/e, John Wiley and Sons Inc, 2010.
3. Sharma P.C., A Text book of Production Technology, 8/e, S Chand Publishing, 2014.

**Online Learning Resources:**

1. <https://www.digimat.in/nptel/courses/video/112107145/L01.html>
2. <https://www.digimat.in/nptel/courses/video/112105126/L01.html>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME) – II-I Sem**

L	T	P	C
3	0	0	3

**20A03302 Thermodynamics****Course Objectives:**

- To introduce the concepts of heat, work, energy and governing rules for conversion of one form to other.
- To explain relationships between properties of matter and basic laws of thermodynamics.
- To teach the concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
- To introduce the concept of available energy for maximum work conversion.
- To impart knowledge on steam properties.
- To provide fundamental concepts of air standard cycles used in IC engines and gas turbines.

**Course Outcomes (CO):**

After completing the course, the student will be able to:

- Understand the importance of thermodynamic properties related to conversion of heat energy into work. (L1)
- Apply the laws of thermodynamics to boilers, heat pumps, refrigerators, heat engines, compressors and nozzles. (L3)
- Utilize steam properties to design steam based components. (L4)
- Analyze thermodynamic relations and air standard cycles. (L5)

**UNIT - I First law of Thermodynamics****10 Hrs**

**Introduction: Basic Concepts:** Macroscopic and microscopic viewpoints, definitions of thermodynamic terms, quasi – static process, point and path function, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics and Temperature measurement.

Joule's experiment - first law of thermodynamics, corollaries-perpetual motion machines of first kind, first law applied to non-flow and flow process- limitations of first law of thermodynamics.

**UNIT - II Second Law of Thermodynamics****8 Hrs**

Kelvin - Planck statement and Clausius statement and their equivalence, corollaries - perpetual motion machines of second kind - reversibility and irreversibility, cause of irreversibility - Carnot cycle, heat engine, heat pump and refrigerator, Carnot theorem, Carnot efficiency.

**UNIT - III Entropy, Availability and Irreversibility****8 Hrs**

Clausius inequality - Concept of Entropy- entropy equation for different processes and systems.

Definition of exergy and anergy, expressions for availability and irreversibility. Availability in steady flow, non-flow processes and irreversibility.

Maxwell relations, TdS equations difference in heat capacities, ratio of heat capacities.

**UNIT - IV Properties of Steam and use of Steam Tables****8 Hrs**

Pure Substances, P-V-T surfaces, T-s and h-s diagram, Mollier chart, dryness fraction, property tables, analysis of steam undergoing various thermodynamic processes using Mollier chart– steam calorimetry. Energy equation, Joule Thompson coefficient Clausius - Clapeyron equation.

**UNIT - V**

**Air Standard Cycles**

**8 Hrs**

Otto, Diesel and dual cycles, P-V and T -S diagrams - description and efficiencies, mean effective pressures. Brayton Cycle - Comparison of Otto, Diesel and dual cycles, Comparison of Brayton and Otto Cycles.

**Textbooks:**

1. P.K.Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. Yunus A. Cengel, Michael A. Boles, Thermodynamics, 7/e, Tata McGraw Hill, 2011.

**Reference Books:**

1. J.B.Jones and G.A.Hawkins, Introduction to Thermodynamics, 2/e, John Wiley & Sons, 2012.
2. Moran, Michael J. and Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 3/e, Wiley, 2015
3. R.K. Rajput, S.Chand & Co., Thermal Engineering, 6/e, Laxmi publications, 2010

**Online Learning Resources:**

1. <https://nptel.ac.in/courses/112/105/112105266/>
2. <https://nptel.ac.in/courses/112/104/112104113/>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME) – II-I Sem****L T P C  
3 0 0 3****20A01305T Mechanics of Materials****Course Objectives:**

- Understand the basics of stresses and strains
- Draw the shear force and bending moment drawings of various beams.
- Understand the Behaviour of members and Torsional forces
- Understand the Behaviour of cylinders
- Understand the stresses developing in curved beams.

**Course Outcomes (CO):**

- Evaluate stresses and strains
- To draw the SF and BM diagrams for various beams under different loading conditions
- Determine the resistance and deformation in machine members subjected to torsional loads and springs.
- Analyze and design thin, thick cylinders.
- Analysis of stresses in curved bars.

**UNIT - I Analysis of stress and strain**

Types of external loads - self weight - internal stresses - normal and shear stresses - strain - Hooke's law - Poisson's ratio - relationship between elastic constants - stress strain diagrams working stress - elongation of bars of constant and varying sections - Stress on inclined planes for axial and biaxial stress fields - principal stresses - Mohr's circle of stress - principal strains - strain rosette – principal stress/strain problem as an eigenvalue problem.

**UNIT - II Bending moment and shear force**

Different types of beams - shear force and bending moment diagrams for simply supported, overhanging and cantilever beams - relationship connecting intensity of loading, shearing force and bending moment - shear force and bending moment diagrams for statically determinate plane frames.

**UNIT - III Torsion and Springs**

Torsion formulation stresses and deformation in circular and hollow shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

**UNIT - IV Thin Cylinders, Spheres and Thick Cylinders**

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lamé's theory – Application of theories of failure.

**UNIT - V Bending of curved bars & Unsymmetrical Bending**

Stresses in bars of small initial curvature, Winkler-Bach theory, Stresses in bars of large initial curvature, Deflection of Crane hooks, Chain links, circular rings, stresses in circular rings. Introduction to unsymmetrical bending, Stresses and deflection in unsymmetrical bending, Shear center for angle, Channel and I-sections.

**Textbooks:**

1. Mechanics of Material – J. M. Gere and S. P. Timoshenko – CBS publisher
2. Popov, E.P., Mechanics of Materials, Prentice Hall India, New Delhi, 2002.

**Reference Books :**

1. Advanced Mechanics of Materials–A. P. Boresi and O. M. Sidebottom–John Wiley & Sons
2. Strength of Materials – R. K. Rajput – S. Chand & Company
3. Beer, F.P., Johnston, E.R. and DeWolf, J.T., Mechanics of Materials, 3rd ed., Tata McGraw-Hill
4. Strength of Material – Dr. Sadhu Singh – Khanna Publishers
5. Strength of Material, Vol. I and II – S. P. Timoshenko – EWP Press

**Online Learning Resources:**



1. <https://nptel.ac.in/courses/112/107/112107146/>
2. <https://ocw.mit.edu/courses/materials-science-and-engineering/3-11-mechanics-of-materials-fall-1999/>
3. <https://www.coursera.org/courses?query=mechanics%20of%20materials>
4. <https://www.udemy.com/course/strengthofmaterials/>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME) – II-I Sem**

**L T P C**  
**0 0 3 1.5**

**20A01302P FLUID MECHANICS AND HYDRAULIC MACHINES LAB**  
**(Common to Civil & Mechanical)**

**Course Objectives:**

By performing this laboratory, the student will be able to know the fluid flow measurements by considering different types flow measurement devices and working principles of various pumps and motors.

**Course Outcomes (CO):**

By performing the various tests in this laboratory the student will be able to know the principles of discharge measuring devices and head loss due to sudden contraction and expansion in pipes and working principles of various pumps and motors.

**List of Experiments:**

1. Verification of Bernoulli's equation.
2. Calibration of Venturi meter.
3. Calibration of Orifice meter
4. Determination of Coefficient of discharge for a small orifice by constant head method.
5. Determination of Coefficient of discharge for a small orifice by variable head method.
6. Determination of Coefficient of discharge for an external mouth piece by Constant head method.
7. Determination of Coefficient of discharge for an external mouth piece by variable head method.
8. Calibration of contracted Rectangular Notch.
9. Calibration of contracted Triangular Notch. Determination of friction factor
10. Determination of loss of head in a sudden contraction.
11. Determination of loss of head in a sudden Expansion.
12. Performance test on Impulse turbines
13. Performance test on reaction turbines (Francis and Kaplan Turbines)
14. Impact of jet
15. Performance test on centrifugal pumps, determination of operating point and efficiency

**References:**

1. Fluid Mechanics & Hydraulic Machines A Lab Manual by [Ts Desmukh](#) (Author), [Laxmi Publications \(P\) Ltd](#)
2. Fluid Mechanics & Machinery Laboratory Manual by [N Kumara Swamy](#) (Author), [Charotar Books Distributors](#)
3. Lab. Manual of Fluid Mechanics & Machines by [Gupta, Chandra](#) (Author), [cbspd](#) (Publisher)

Online Learning Resources/Virtual Labs:

1. <http://eerc03-iiith.vlabs.ac.in/>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME) – II-I Sem**

**L T P C**  
**0 0 3 1.5**

**20A03301P Manufacturing Processes Lab**

**Course Objectives:**

- Acquire practical knowledge on Metal Casting, Welding, Press Working and unconventional machining Processes

**Course Outcomes (CO):**

At the end of the lab, the student will be able to

- Fabricate different types of components using various manufacturing techniques. (L6)
- Adapt unconventional manufacturing methods. (L6)

**List of Experiments:**

**1. METAL CASTING**

- a) Gating Design and pouring time and solidification time calculations.
- b) Sand Properties Testing – Exercise for Strength and Permeability.
- c) Molding, Melting and Casting for ferrous/ non ferrous materials.

**2. WELDING**

- a) TIG Welding.
- b) MIG Welding.
- c) Friction stir welding.
- d) Any other Special Welding Processes.

**3. MECHANICAL PRESS WORKING**

- a) Press Tool: Blanking and Piercing operation with Simple, Compound and Combination dies.
- b) Closed die forging, Deep Drawing and Extrusion operations.

**4. UN CONVENTIONAL MANUFACTUNRING PROCESSES**

- a) Electro Discharge Machining (EDM) / Wire cut EDM
- b) Plasma arc cutting / Abrasive jet machining (AJM)
- c) Additive manufacturing with reverse engineering

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME) – II-I Sem**

**L T P C**  
**0 0 3 1.5**

**20A01305P Mechanics of Materials Lab**

**Course Objectives:**

- By performing this laboratory, the student will be able to know the structural behavior of various materials

**Course Outcomes (CO):**

- By performing the various tests in this laboratory the student will be able to know the structural behavior of various structural elements when subjected to external loads

**List of Experiments:**

1. Tension test.
2. Bending test on (Steel/Wood) Cantilever beam.
3. Bending test on simply supported beam.
4. Torsion test.
5. [Vickers Hardness Test](#)
6. [Rockwell Hardness Test](#)
7. [Brinell Hardness Test](#)
8. Compression test on Open coiled springs
9. Tension test on Closely coiled springs
10. Compression test on wood/ concrete
11. Izod Impact test on metals
12. Charpy Impact test on metals
13. Shear test on metals
14. [Direct Shear Test on Timber Specimen](#)
15. Use of electrical resistance strain gauges.
16. Continuous beam – deflection test.

Note : Any 12 of the above equipments

**References:**

1. **Strength of Materials Lab Manual** by [Anand Jayakumar A](#) , Notion Press

**Online Learning Resources/Virtual Labs:**

1. <http://sm-nitk.vlabs.ac.in/#>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME) – II-I Sem**

**L T P C**  
**3 0 0 3**

**(20A52201) UNIVERSAL HUMAN VALUES**

**(Common to all branches)**

**Course Objective:**

The objective of the course is four fold:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

**COURSE TOPICS:**

The course has 28 lectures and 14 practice sessions in 5 modules:

**Unit 1:**

**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
- Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

**Unit 2:**

**Understanding Harmony in the Human Being - Harmony in Myself!**

- Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’
- Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility
- Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of ‘I’ and harmony in ‘I’
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

### **Unit 3:**

#### **Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship**

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
- Understanding the meaning of Trust; Difference between intention and competence
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

### **Unit 4:**

#### **Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**

- Understanding the harmony in the Nature
- Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
- Understanding Existence as Co-existence of mutually interacting units in all- pervasive space
- Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

### **Unit 5:**

#### **Implications of the above Holistic Understanding of Harmony on Professional Ethics**

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for

augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
- Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

### Text Book

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

### Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantik, 1999.
2. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
5. E. F. Schumacher. "Small is Beautiful"
6. Slow is Beautiful –Cecile Andrews
7. J C Kumarappa "Economy of Permanence"
8. Pandit Sunderlal "Bharat Mein Angreji Raj"
9. Dharampal, "Rediscovering India"
10. Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland(English)
13. Gandhi - Romain Rolland (English)

### MOE OF CONDUCT (L-T-P-C 2-1-0-2)

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up “ordinary” situations rather than” extra-ordinary” situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practicals are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

**OUTCOME OF THE COURSE:**

By the end of the course,

- Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
- They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
- They would have better critical ability.
- They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME) – II-I Sem**

**L T P C**  
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**20A05305 Application Development with Python**

**Course Objectives:**

1. To learn the basic concepts of software engineering and life cycle models
2. To explore the importance of Databases in application Development
3. Acquire programming skills in core Python
4. To understand the importance of Object-oriented Programming

**Course Outcomes (CO):**

Students should be able to

1. Identify the issues in software requirements specification and enable to write SRS documents for software development problems
2. Explore the use of Object oriented concepts to solve Real-life problems
3. Design database for any real-world problem
4. Solve mathematical problems using Python programming language

**Module 1. Basic concepts in software engineering and software project management**

Basic concepts: abstraction versus decomposition, the evolution of software engineering techniques, Software development life cycle

Software project management: project planning and project scheduling

Task:

1. [Identifying the Requirements from Problem Statements](#)

**Module 2. Basic Concepts of Databases**

Database systems applications, Purpose of Database Systems, view of Data, Database Languages, Relational Databases, Data Definition Language(DDL) Statements: (Create table, Alter table, Drop table), Data Manipulation Language(DML) Statements

Task:

1. Implement Data Definition Language(DDL) Statements: (Create table, Alter table, Drop table)
2. Implement Data Manipulation Language(DML) Statements

**Module 3. Python Programming:**

**Introduction to Python:** Features of Python, Data types, Operators, Input and output, Control Statements, Looping statements

**Python Data Structures:** Lists, Dictionaries, Tuples.

**Strings:** Creating strings and basic operations on strings, string testing methods.

**Functions:** Defining a function- Calling a function- Types of functions-Function Arguments-Anonymous functions- Global and local variables

**OOPS Concepts;** Classes and objects- Attributes- Inheritance- Overloading- Overriding- Data hiding

**Modules and Packages:** Standard modules-Importing own module as well as external modules Understanding Packages Powerful Lamda function in python Programming using functions, modules and external packages

**Working with Data in Python:** Printing on screen- Reading data from keyboard- Opening and closing file- Reading and writing files- Functions-Loading Data with Pandas-Numpy

Tasks:

**1. OPERATORS**

- a. Read a list of numbers and write a program to check whether a particular element is present or not using membership operators.
- b. Read your name and age and write a program to display the year in which you will turn 100 years old.
- c. Read radius and height of a cone and write a program to find the volume of a cone.

d. Write a program to compute distance between two points taking input from the user (Hint: use Pythagorean theorem)

## 2. CONTROL STRUCTURES

- Read your email id and write a program to display the no of vowels, consonants, digits and white spaces in it using if...elif...else statement.
- Write a program to create and display a dictionary by storing the antonyms of words. Find the antonym of a particular word given by the user from the dictionary using while loop.
- Write a Program to find the sum of a Series  $1/1! + 2/2! + 3/3! + 4/4! + \dots + n/n!$ . (Input :n = 5, Output : 2.70833)
- In number theory, an abundant number or excessive number is a number for which the sum of its proper divisors is greater than the number itself. Write a program to find out, if the given number is abundant. (Input: 12, Sum of divisors of 12 = 1 + 2 + 3 + 4 + 6 = 16, sum of divisors 16 > original number 12)

## 3: LIST

- Read a list of numbers and print the numbers divisible by x but not by y (Assume x = 4 and y = 5).
- Read a list of numbers and print the sum of odd integers and even integers from the list.(Ex: [23, 10, 15, 14, 63], odd numbers sum = 101, even numbers sum = 24)
- Read a list of numbers and print numbers present in odd index position. (Ex: [10, 25, 30, 47, 56, 84, 96], The numbers in odd index position: 25 47 84).
- Read a list of numbers and remove the duplicate numbers from it. (Ex: Enter a list with duplicate elements: 10 20 40 10 50 30 20 10 80, The unique list is: [10, 20, 30, 40, 50, 80])

## 4: TUPLE

- Given a list of tuples. Write a program to find tuples which have all elements divisible by K from a list of tuples. test\_list = [(6, 24, 12), (60, 12, 6), (12, 18, 21)], K = 6, Output : [(6, 24, 12), (60, 12, 6)]
- Given a list of tuples. Write a program to filter all uppercase characters tuples from given list of tuples. (Input: test\_list = [(“GFG”, “IS”, “BEST”), (“Gfg”, “AVERAGE”), (“GfG”, ), (“Gfg”, “CS”)], Output : [(„GFG“, „IS“, „BEST“)]).
- Given a tuple and a list as input, write a program to count the occurrences of all items of the list in the tuple. (Input : tuple = ('a', 'a', 'c', 'b', 'd'), list = ['a', 'b'], Output : 3)

## 5: SET

- Write a program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x\*x).
- Write a program to perform union, intersection and difference using Set A and Set B.
- Write a program to count number of vowels using sets in given string (Input : “Hello World”, Output: No. of vowels : 3)
- Write a program to form concatenated string by taking uncommon characters from two strings using set concept (Input : S1 = "aacdb", S2 = "gafd", Output : "cbgf").

## 6: DICTIONARY

- Write a program to do the following operations:
  - Create a empty dictionary with dict() method
  - Add elements one at a time
  - Update existing key's value
  - Access an element using a key and also get() method
  - Deleting a key value using del() method
- Write a program to create a dictionary and apply the following methods:
  - pop() method
  - popitem() method
  - clear() method
- Given a dictionary, write a program to find the sum of all items in the dictionary.
- Write a program to merge two dictionaries using update() method.

## 7: STRINGS

- Given a string, write a program to check if the string is symmetrical and palindrome or not. A string is said to be symmetrical if both the halves of the string are the same and a string is said to be a palindrome string if one half of the string is the reverse of the other half or if a string appears same when read forward or backward.
- Write a program to read a string and count the number of vowel letters and print all letters except 'e' and 's'.

- c. Write a program to read a line of text and remove the initial word from given text. (Hint: Use split() method, Input : India is my country. Output : is my country)
- d. Write a program to read a string and count how many times each letter appears. (Histogram).

### 8: USER DEFINED FUNCTIONS

- a. A generator is a function that produces a sequence of results instead of a single value. Write a generator function for Fibonacci numbers up to n.
- b. Write a function merge\_dict(dict1, dict2) to merge two Python dictionaries.
- c. Write a fact() function to compute the factorial of a given positive number.
- d. Given a list of n elements, write a linear\_search() function to search a given element x in a list.

### 9: BUILT-IN FUNCTIONS

- a. Write a program to demonstrate the working of built-in statistical functions mean(), mode(), median() by importing statistics library.
- b. Write a program to demonstrate the working of built-in trigonometric functions sin(), cos(), tan(), hypot(), degrees(), radians() by importing math module.
- c. Write a program to demonstrate the working of built-in Logarithmic and Power functions exp(), log(), log2(), log10(), pow() by importing math module.
- d. Write a program to demonstrate the working of built-in numeric functions ceil(), floor(), fabs(), factorial(), gcd() by importing math module.

### 10. CLASS AND OBJECTS

- a. Write a program to create a BankAccount class. Your class should support the following methods for
  - i) Deposit
  - ii) Withdraw
  - iii) GetBalance
  - iv) PinChange
- b. Create a SavingsAccount class that behaves just like a BankAccount, but also has an interest rate and a method that increases the balance by the appropriate amount of interest (Hint:use Inheritance).
- c. Write a program to create an employee class and store the employee name, id, age, and salary using the constructor. Display the employee details by invoking employee\_info() method and also using dictionary (\_\_dict\_\_).
- d. Access modifiers in Python are used to modify the default scope of variables. Write a program to demonstrate the 3 types of access modifiers: public, private and protected.

### 11. FILE HANDLING

- a. . Write a program to read a filename from the user, open the file (say firstFile.txt) and then perform the following operations:
  - i. Count the sentences in the file.
  - ii. Count the words in the file.
  - iii. Count the characters in the file.
- b. . Create a new file (Hello.txt) and copy the text to other file called target.txt. The target.txt file should store only lower case alphabets and display the number of lines copied.
- c. Write a Python program to store N student's records containing name, roll number and branch. Print the given branch student's details only.

#### References:

1. Rajib Mall, "Fundamentals of Software Engineering", 5th Edition, PHI, 2018.
2. Ramez Elmasri, Shamkant, B. Navathe, "Database Systems", Pearson Education, 6th Edition, 2013.
3. Reema Thareja, "Python Programming - Using Problem Solving Approach", Oxford Press, 1st Edition, 2017.
4. Larry Lutz, "Python for Beginners: Step-By-Step Guide to Learning Python Programming", CreateSpace Independent Publishing Platform, First edition, 2018

#### Online Learning Resources/Virtual Labs:

1. <http://vlabs.iitkgp.ernet.in/se/>
2. <http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php>
3. <https://python-iitk.vlabs.ac.in>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME) – II-II Sem**

**L T P C**  
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**20A54402 Numerical Methods & Probability theory**  
**(Common to EEE, MECH)**

**Pre-requisite Basic Equations and Basic Probability**

**Course Objectives:**

This course aims at providing the student with the knowledge on various numerical methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations. The theory of Probability and random variables.

**Course Outcomes (CO):** Student will be able to

- Apply numerical methods to solve algebraic and transcendental equations
- Derive interpolating polynomials using interpolation formulae
- Solve differential and integral equations numerically
- Apply probability theory to find the chances of happening of events.
- Understand various probability distributions and calculate their statistical constants.

**UNIT - I Solution of Algebraic & Transcendental Equations:** 8 Hrs  
Introduction-Bisection method-Iterative method-Regula falsi method-Newton Raphson method  
System of Algebraic equations: Gauss Jordan method-Gauss Siedal method.

**UNIT - II Interpolation** 8 Hrs  
Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae.  
Gauss forward and backward formula, Stirling's formula, Bessel's formula.

**UNIT - III Numerical Integration & Solution of Initial value problems to Ordinary differential equations** 9 Hrs  
Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule  
Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method-Runge-Kutta Methods.

**UNIT - IV Probability theory:** 9 Hrs  
Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation.

**UNIT - V Random variables & Distributions:** 9 Hrs  
Probability distribution - Binomial, Poisson approximation to the binomial distribution and normal distribution-their properties-Uniform distribution-exponential distribution

Textbooks:

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole, PNIE.  
Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.

Reference Books:

1. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
2. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.

Online Learning Resources:

1. [https://onlinecourses.nptel.ac.in/noc17\\_ma14/preview](https://onlinecourses.nptel.ac.in/noc17_ma14/preview)
2. [nptel.ac.in/courses/117101056/17](http://nptel.ac.in/courses/117101056/17)
3. <http://nptel.ac.in/courses/111105090>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME) – II-II Sem**

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**20A03401T Applied Thermodynamics****Course Objectives:**

- To introduce students to the Working Principles of IC engines.
- To teach combustion process in SI and CI engines.
- To impart knowledge on different types of compressors.
- To familiarize concepts of thermodynamic cycles used in steam power plants and gas turbines
- To impart knowledge on the working of nozzles, turbines, refrigeration and air conditioning.

**Course Outcomes (CO):**

- After completing this course, the students can
- Understand the working of IC engines with combustion process. (L1)
- Select compressors for different applications. (L2)
- Use T-s diagram in vapour power and gas power cycles. (L3)
- Evaluate the relative performance of different steam turbines (L6)
- Select appropriate refrigerant for different applications. (L6)

**UNIT - I****IC Engines****10 Hrs**

Working and classification of IC engines, comparison of two stroke and four stroke engines, comparison of SI and CI Engines.

**Testing and Performance of IC Engines:** Methods of testing IC Engines, performance analysis of IC Engines.

**Combustion in IC Engines:** SI engine: stages of combustion, normal combustion, abnormal combustion, variables effecting ignition lag, Flame propagation and knocking. CI engine: stages of combustion, normal combustion, abnormal combustion, variables effecting delay period and knocking.

**UNIT - II****Air compressors****8 Hrs**

**Reciprocating Compressor:** Single stage reciprocating compressors, work required, effect of clearance in compressors, volumetric efficiency, multi stage compressor, effect of inter cooling in multi stage compressors, compressor performance.

**Rotary Compressor:** Working principle of a rolling piston type compressor (fixed vane type), multi vane type compressors, characteristics of rotary vane type compressor, working principle of centrifugal and axial flow compressors.

**UNIT - III****Vapour & Gas Power Cycles****8 Hrs**

Vapour power cycle, simple Rankine cycle, mean temp of heat addition, thermodynamic variables effecting efficiency, Rankine cycle – reheating and regeneration.

Simple gas turbine plant, Brayton cycle, closed cycle and open cycle for gas turbines, condition for optimum pressure ratio, actual cycle. Methods to improve performance: regeneration, intercooling and reheating.

**UNIT - IV****Nozzles & Steam Turbines****8 Hrs**

Type of nozzles - gas and steam nozzles. Compressible flow through nozzle- condition for maximum discharge - Nozzle efficiency - Super saturation.

Steam Turbines - impulse turbine and reaction turbine – compounding of impulse turbines - velocity diagrams in impulse and reaction turbines, blade efficiency, degree of reaction.

**UNIT - V****Refrigeration & Air-Conditioning****8 Hrs**

**Refrigeration:** Bell-Coleman cycle - vapour compression cycle, sub cooling and super heating-vapour absorption cycle, properties of common refrigerants.

**Principles of Psychrometry and Air Conditioning:** Psychrometric properties, psychrometric processes,

summer and winter air conditioning systems.

**Textbooks:**

1. Thermal Engineering, Mahesh V Rathore, Tata McGraw Hill 2017
2. M.L.Mathur and F.S.Mehta, Thermal Engineering, Jain brothers,2014

**Reference Books:**

1. Ganesan V, Internal Combustion Engines, Tata McGraw Hill, 2017.
2. Yahya, S. M., Turbines, Compressors and Fans, 4/e, Tata McGraw Hill, 2010.
3. Nag P.K, Engineering Thermodynamics, 4/e, Tata McGraw-Hill, 2008.
4. Onkar Singh, Thermal Turbomachines, 3/e, Wiley India, 2014.
5. Refrigeration and Air Conditioning, C.P.Arora

**Online Learning Resources:**

1. <https://nptel.ac.in/courses/112/103/112103307/>
2. <https://nptel.ac.in/courses/112/103/112103275/>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME) – II-II Sem**

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**20A03402 KINETICS OF MACHINERY****Course Objectives:**

The Objectives of this course are to:

- To provide a foundation for the study of Dynamics of Machinery and machine design.
- Comprehend the fundamentals of kinematics and to understand the concept of machines, mechanisms and related terminologies.
- Analyze a mechanism for displacement, velocity and acceleration at any point in a moving link.
- To develop skills for designing and analyzing linkages and mechanisms.
- Formulate the concept of synthesis and analysis of different mechanisms.
- To understand the Principles and working of various straight line motion mechanisms.
- To analyze Steering gear mechanisms and working of Hooke's joint.
- To understand the theory of gears, gear trains and cams.

**Course Outcomes (CO):**

- Build up critical thinking and problem-solving capacity of various mechanical engineering problems related to kinematics of machines (L4)
- Understand the basic principles of mechanisms in mechanical engineering (L1)
- Assess various concepts of mechanisms like straight line motion mechanisms, Steering gear mechanisms and working principles of power elements (Gears, gear trains, Cams) and design related problems effectively (L6)
- Examine the velocity and acceleration diagram for a given mechanism (L3)
- Utilize analytical, mathematical and graphical aspects of kinematics of Machines for effective design (L3)
- Construct the cam profile for a given motion (L3)
- Analyze various gear trains (L4)

**UNIT - I****MECHANISMS AND MACHINES****8 Hrs**

Elements or Links – Classification – Rigid Link, flexible and fluid link. Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained. Mechanisms and machines – classification of mechanisms and machines – kinematic chain – inversion of mechanisms – inversions of quadric cycle chain, single and double slider crank chain. Mobility of mechanisms.

**UNIT - II****Steering & Straight-Line Motion Mechanisms****8 Hrs**

**Straight Line Motion Mechanisms-** Exact and approximate, copied and generated types – Peaucellier, Hart, Scott Russel, Grasshopper, Watt, Tchebicheff and Robert Mechanisms. Pantograph.

**Steering Mechanisms:** Conditions for correct steering – Davis Steering gear, Ackermanns steering gear. Hooke's Joint (Universal coupling) -Single and double Hooke's joint — applications – Simple problems.

**UNIT - III****KINEMATICS****10 Hrs**

**Velocity and Acceleration Diagrams-** Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method – Slider crank mechanism, four bar mechanism. Acceleration diagrams for simple mechanisms, determination of Coriolis component of acceleration, Klein's construction: Analysis of slider crank mechanism for displacement, velocity and acceleration of slider using analytical method.

**Instantaneous Centre Method:** Instantaneous centre of rotation, centrode and axode – relative motion between two bodies – Three centers in-line theorem – Locating instantaneous centers for simple mechanisms and determination of angular velocity of points and links.

**UNIT - IV****Gears & GEAR TRAINS****10 Hrs**

**GEARS:** Higher pairs, toothed gears – types – law of gearing, condition for constant velocity Ratio for transmission of motion, Forms of tooth- cycloidal and involute profiles. Velocity of sliding – phenomena of interference – Methods to avoid interference - Condition for minimum number of teeth, expressions for arc of contact and path of contact. Introduction to Helical, Bevel and Worm gears.

**GEAR TRAINS:**

Introduction –Types of gears – Simple, Compound, Reverted and Epicyclic gear trains, Train value –

Methods of finding train value or velocity ratio – Tabular column method for Epicyclic gear trains. Torque in epicyclic gear trains. Differential gear of an automobile – Simple problems.

**UNIT - V**

**CAMS & Followers**

**8 Hrs**

**CAMS:** Definitions of cam and follower – uses – Types of followers and cams – Terminology. Types of follower motion - Uniform velocity, Simple harmonic motion, Cycloidal, uniform acceleration and retardation, Maximum velocity and maximum acceleration during outward and return strokes. Drawing of cam profiles.

**ANALYSIS OF MOTION OF FOLLOWERS:** Tangent cam with roller follower – circular arc (Convex) cam with flat faced and roller follower

**Textbooks:**

1. Theory of Machines and Mechanisms-S.S.Rattan, Tata McGraw Hill Publishers.
2. Theory of Machines R.S Khurmi& J.K Gupta, S Chand Publishers.

**Reference Books:**

1. Theory of Machines by Thomas Bevan/ CBS
2. Theory of Machines / R.K Bansal
3. Theory of Machines Sadhu Singh PearsonsEdn
4. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age
5. The theory of Machines /Shiegley/ Oxford.
6. Theory of machines – PL. Balaney/khanna publishers

**Online Learning Resources:**

1. <https://www.digimat.in/nptel/courses/video/112104121/L01.html>
2. <https://nptel.ac.in/courses/112/105/112105268/>



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME) – II-II Sem****L T P C**  
**3 0 0 3****20A03403T Manufacturing Technology****Course Objectives:**

- To introduce the parameters in the metal cutting operation.
- To relate tool wear and tool life and the variables that control them.
- To calculate machining times for different machining processes.
- To impart knowledge on various metal cutting processes. (Lathe, drilling, boring shaping, slotting, milling and grinding).
- To teach the principles of jigs and fixtures and types of clamping and work holding devices.

**Course Outcomes (CO):**

At the end of the course, the student will be able to

- Choose cutting processes and variables. (L3)
- Relate tool wear and tool life. (L1)
- Calculate the machining parameters for different machining processes. (L5)
- Identify methods to generate different types of surfaces. (L3)
- Explain work-holding requirements. (L2)
- Design jigs and fixtures. (L6)

**UNIT - I****Material Removal Processes****8 Hrs**

**Metal Cutting:** Single and multi-point cutting tools, orthogonal and oblique cutting, Merchant circle diagram, chip formation, tool wear and tool life, surface finish and integrity, machinability, cutting tools and materials, cutting fluids.

**UNIT - II****Lathe and Drilling Machines****12 Hrs**

**Lathe and Lathe Operations:** Principles of working, specifications, types of lathes, operations, work and tool holders. Taper turning, thread turning attachments for lathes. Machining time calculations. Turret and capstan lathes - Principle of working -

**Drilling Machines:** Principles of working, specifications, types, and operations performed - tool holding devices - nomenclature of twist drill, Machining time calculations

**UNIT - III****Boring, Reaming and Taping****8 Hrs**

**Boring Machines-** Principles of working, specifications, types, and operations performed - tool holding devices - nomenclature of boring tools, Machining time calculations

**Reaming and Reamers:** Principles of working, specifications, types, and operations performed – tool holding devices - nomenclature of reamers. Machining time calculations

**Taping and Taps:** Principles of working, specifications, types, and operations performed - tool holding devices - nomenclature of taps.

**UNIT - IV****Milling, Shaping and Abrasive Machining****10 Hrs**

**Milling operations and Milling machines -** Principles of working, specifications, classifications of milling machines, machining operations, types and geometry of milling cutters, methods of indexing, and accessories to milling machines, machining time calculations.

**Shaping, Slotting and planing machines -** Principles of working - principal parts, specification, classification, operations performed, machining time calculations

**Abrasive Machining:** Grinding and grinding machines: Grinding process, types of grinding machines,

grinding process parameters, honing, lapping, other finishing processes.

**UNIT - V**

**Jigs and Fixtures**

**8 Hrs**

Principles of design of Jigs and fixtures and uses, 3-2-1 principle of location and clamping, classification of Jigs & Fixtures, types of clamping and work holding devices, typical examples of jigs and fixtures.

**Textbooks:**

1. P.N. Rao, Manufacturing Technology: Metal Cutting and Machine Tools, (Volume 2), 3/e, Tata McGraw-Hill Education, 2013
2. R.K. Jain and S.C. Gupta, Production Technology, 17/e, Khanna Publishers, 2012.

**Reference Books:**

1. Kalpakzian S and Schmid SR, Manufacturing Engineering and Technology, 7/e, Pearson, 2018.
2. Milton C.Shaw , Metal Cutting Principles, 2/e, Oxford, 2012
3. Hindustan Machine Tools, Production Technology, TMH, 2001
4. V.K.Jain, Advanced Machining Process, 12/e, Allied Publications, 2010
5. AB. Chattopadhyay, Machining and Machine Tools, 2/e, Wiley, 2017
6. Halmi A Yousuf & Hassan, , Machine Technology: Machine Tools and Operations, CRC Press Taylor and Francis Group, 2008

**Online Learning Resources:**

1. <https://www.digimat.in/nptel/courses/video/112107239/L01.html>
2. <https://nptel.ac.in/courses/112/104/112104304/>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME) – II-II Sem****L T P C**  
**3 0 0 3****20A52301 MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS****(Common to All branches of Engineering)****Course Objectives:**

- To inculcate the basic knowledge of micro economics and financial accounting
- To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost
- To Know the Various types of market structure and pricing methods and strategy
- To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
- To provide fundamental skills on accounting and to explain the process of preparing financial statements

**Course Outcomes (CO):**

- Define the concepts related to Managerial Economics, financial accounting and management.
- Understand the fundamentals of Economics viz., Demand, Production, cost, revenue and markets
- Apply the Concept of Production cost and revenues for effective Business decision
- Analyze how to invest their capital and maximize returns
- Evaluate the capital budgeting techniques
- Develop the accounting statements and evaluate the financial performance of business entity.

**UNIT - I                   Managerial Economics**

Introduction – Nature, meaning, significance, functions, and advantages. Demand-Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting- Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management.

**UNIT - II                   Production and Cost Analysis**

Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least-cost combination– Short run and Long run Production Function- Isoquants and Isocosts, MRTS - Cobb-Douglas Production Function - Laws of Returns - Internal and External Economies of scale. Cost & Break-Even Analysis - Cost concepts and Cost behavior- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems)-Managerial significance and limitations of Break-Even Analysis.

**UNIT - III                   Business Organizations and Markets**

Introduction – Nature, meaning, significance, functions and advantages. Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly- Monopolistic Competition–Oligopoly-Price-Output Determination - Pricing Methods and Strategies

**UNIT - IV                   Capital Budgeting**

Introduction – Nature, meaning, significance, functions and advantages. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting– Features, Proposals, Methods and Evaluation. Projects – Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems)

**UNIT - V                   Financial Accounting and Analysis**

Introduction – Nature, meaning, significance, functions and advantages. Concepts and Conventions- Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account,

Profit and Loss Account and Balance Sheet with simple adjustments). *Financial Analysis* - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

**Textbooks:**

1. Varshney&Maheswari: Managerial Economics, Sultan Chand, 2013.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH, 2019

**Reference Books:**

1. Ahuja HI Managerial economics Schand,3/e,2013
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International, 2013.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage, 2013.

**Online Learning Resources:**

<https://www.slideshare.net/123ps/managerial-economics-ppt>  
<https://www.slideshare.net/rossanz/production-and-cost-45827016>  
<https://www.slideshare.net/darkyla/business-organizations-19917607>  
<https://www.slideshare.net/balarajbl/market-and-classification-of-market>  
<https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396>  
<https://www.slideshare.net/ashu1983/financial-accounting>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME) – II-II Sem**

L	T	P	C
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**20A52302 ORGANISATIONAL BEHAVIOUR**  
(Common to All branches of Engineering)

**Course Objectives:**

- To enable student's comprehension of organizational behavior
- To offer knowledge to students on self-motivation, leadership and management
- To facilitate them to become powerful leaders
- To Impart knowledge about group dynamics
- To make them understand the importance of change and development

**Course Outcomes (CO):**

- Define the Organizational Behaviour, its nature and scope.
- Understand the nature and concept of Organizational behaviour
- Apply theories of motivation to analyse the performance problems
- Analyse the different theories of leadership
- Evaluate group dynamics
- Develop as powerful leader

**UNIT - I Introduction to Organizational Behavior**

Meaning, definition, nature, scope and functions - Organizing Process – Making organizing effective -Understanding Individual Behaviour –Attitude -Perception - Learning – Personality.

**UNIT - II Motivation and Leading**

Theories of Motivation- Maslow's Hierarchy of Needs - Herzberg's Two Factor Theory - Vroom's theory of expectancy – Mc Clelland's theory of needs–Mc Gregor's theory X and theory Y– Adam's equity theory – Locke's goal setting theory– Alderfer's ERG theory .

**UNIT - III Organizational Culture**

Introduction – Meaning, scope, definition, Nature - Organizational Climate - Leadership - Traits Theory–Managerial Grid - Transactional Vs Transformational Leadership - Qualities of good Leader - Conflict Management -Evaluating Leader- Women and Corporate leadership.

**UNIT - IV Group Dynamics**

Introduction – Meaning, scope, definition, Nature- Types of groups - Determinants of group behavior - Group process – Group Development - Group norms - Group cohesiveness - Small Groups - Group decision making - Team building - Conflict in the organization– Conflict resolution

**UNIT - V Organizational Change and Development**

Introduction –Nature, Meaning, scope, definition and functions- Organizational Culture - Changing the Culture – Change Management – Work Stress Management - Organizational management – Managerial implications of organization's change and development

**Textbooks:**

1. Luthans, Fred, Organisational Behaviour, McGraw-Hill, 12 Th edition 2011
2. P Subba Ran, Organisational Behaviour, Himalya Publishing House 2017

**Reference Books:**

- McShane, Organizational Behaviour, TMH 2009
- Nelson, Organisational Behaviour, Thomson, 2009.
- Robbins, P. Stephen, Timothy A. Judge, Organisational Behaviour, Pearson 2009.
- Aswathappa, Organisational Behaviour, Himalaya, 2009

**Online Learning Resources:**

<httphttps://www.slideshare.net/Knight1040/organizational-culture-9608857s://www.slideshare.net/AbhayRajpoot3/motivation-165556714>  
<https://www.slideshare.net/harshrastogi1/group-dynamics-159412405>  
<https://www.slideshare.net/vanyasingla1/organizational-change-development-26565951>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME) – II-II Sem**

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**20A52303 Business Environment  
(Common to All branches of Engineering)**

**Course Objectives:**

- To make the student to understand about the business environment
- To enable them in knowing the importance of fiscal and monetary policy
- To facilitate them in understanding the export policy of the country
- To Impart knowledge about the functioning and role of WTO
- To Encourage the student in knowing the structure of stock markets

**Course Outcomes (CO):**

- Define Business Environment and its Importance.
- Understand various types of business environment.
- Apply the knowledge of Money markets in future investment
- Analyse India's Trade Policy
- Evaluate fiscal and monetary policy
- Develop a personal synthesis and approach for identifying business opportunities

**UNIT - I Overview of Business Environment**

Introduction – meaning Nature, Scope, significance, functions and advantages. Types-Internal & External, Micro and Macro. Competitive structure of industries -Environmental analysis-advantages & limitations of environmental analysis& Characteristics of business.

**UNIT - II Fiscal & Monetary Policy**

Introduction – Nature, meaning, significance, functions and advantages. Public Revenues - Public Expenditure - Evaluation of recent fiscal policy of GOI. Highlights of Budget- Monetary Policy - Demand and Supply of Money –RBI -Objectives of monetary and credit policy - Recent trends- Role of Finance Commission.

**UNIT - III India's Trade Policy**

Introduction – Nature, meaning, significance, functions and advantages. Magnitude and direction of Indian International Trade - Bilateral and Multilateral Trade Agreements - EXIM policy and role of EXIM bank -Balance of Payments– Structure & Major components - Causes for Disequilibrium in Balance of Payments - Correction measures.

**UNIT - IV World Trade Organization**

Introduction – Nature, significance, functions and advantages. Organization and Structure - Role and functions of WTO in promoting world trade - GATT -Agreements in the Uruguay Round –TRIPS, TRIMS - Disputes Settlement Mechanism - Dumping and Anti-dumping Measures.

**UNIT - V Money Markets and Capital Markets**

Introduction – Nature, meaning, significance, functions and advantages. Features and components of Indian financial systems - Objectives, features and structure of money markets and capital markets - Reforms and recent development – SEBI – Stock Exchanges - Investor protection and role of SEBI, Introduction to international finance.

**Textbooks:**

1. Francis Cherunilam (2009), International Business: Text and Cases, Prentice Hall of India.
2. K. Aswathappa, Essentials of Business Environment: Texts and Cases & Exercises 13th Revised Edition.HPH2016

**Reference Books:**

- 1.K. V. Sivayya, V. B. M Das (2009), Indian Industrial Economy, Sultan Chand Publishers, New Delhi, India.
2. Sundaram, Black (2009), International Business Environment Text and Cases, Prentice Hall of India, New Delhi, India.
3. Chari. S. N (2009), International Business, Wiley India.
- 4.E. Bhattacharya (2009), International Business, Excel Publications, New Delhi.

**Online Learning Resources:**

- <https://www.slideshare.net/ShompaDhali/business-environment-53111245>
- <https://www.slideshare.net/rbalsells/fiscal-policy-ppt>
- <https://www.slideshare.net/aguness/monetary-policy-presentationppt>
- <https://www.slideshare.net/DaudRizwan/monetary-policy-of-india-69561982>
- <https://www.slideshare.net/ShikhaGupta31/indias-trade-policyppt>
- <https://www.slideshare.net/viking2690/wto-ppt-60260883>
- <https://www.slideshare.net/prateeknepal3/ppt-mo>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME) – II-II Sem**

**L T P C**  
**0 0 3 1.5**

**20A03401P Applied Thermodynamics Lab**

**Course Objectives:**

- Understand the functioning and performance of I.C. Engines
- To find heat losses in various engines

**Course Outcomes (CO):**

Upon the successful completion of course, students will be able to

- Explain different working cycles of engine
- Describe various types of combustion chambers in IC engines
- Illustrate the working of refrigeration and air conditioning systems
- Evaluate heat balance sheet of IC engine.
- 

**LIST OF EXPERIMENTS**

Demonstration of diesel and petrol engines by cut models

1. Valve timing diagram of 4-stroke diesel engine
2. Port timing diagram of 2-stroke petrol engine
3. Performance of 2-stroke single cylinder petrol engine
4. Morse test on multi cylinder petrol engine
5. Performance of 4-stroke single cylinder diesel engine
6. Assembly and disassembly of diesel and petrol engines
7. Exhaust gas analysis
8. Performance of two stage reciprocating air compressor
9. Determination of nozzle characteristics
10. Performance of Refrigeration system
11. Performance of Air conditioning system
12. Performance of heat pump



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME) – II-II Sem**

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**20A03403P Manufacturing Technology Lab**

**Course Objectives:**

- Familiarize the construction and working of various machine tools.
- Teach selection of parameters for different machining processes.

**Course Outcomes (CO):**

After completion of this course the student may be able to

- Implement the concept of machining with various machine tools.(L5)
- Get hands on experience on various machine tools and machining operations. (L5)

**List of Experiments:**

1. Demonstration of operations on general purpose machines: Lathe, drilling, milling, shaper, slotting, cylindrical and surface grinding machines.
2. Step turning and knurling on lathe machine
3. Taper turning and knurling on lathe machine
4. Thread cutting (left hand or right hand) on lathe machine.
5. Drilling and Boring operations.
6. Reaming and tapping operations.
7. Milling (Gear cutting) by using simple and Compound indexing.
8. key way/Groove cutting on milling machine
9. Shaping and planing operations
10. Slotting operations
11. Cylindrical and surface grinding operations
12. Grinding of single point cutting tool

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME) – II-II Sem**

**L T P C**  
**0 0 3 1.5**

**20A03404 Computer Aided Machine Drawing**

**Course Objectives:**

- Introduce conventional representations of material and machine components.
- Train to use software for 2D and 3D modeling.
- Familiarize with thread profiles, riveted, welded and key joints.
- Teach solid modeling of machine parts and their sections.
- Explain creation of 2D and 3D assembly drawings.
- Familiarize with limits, fits and tolerances in mating components

**Course Outcomes (CO):**

After completion of this lab student will be able to

- Demonstrate the conventional representations of materials and machine components.
- Model riveted, welded and key joints using CAD system.
- Create solid models and sectional views of machine components.
- Generate solid models of machine parts and assemble them.
- Translate 3D assemblies into 2D drawings.
- Create manufacturing drawing with dimensional and geometric tolerances.

**The following contents are to be done by any 2D software package**

**Conventional representation of materials and components:**

**Detachable joints:** Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint with washer and locknut, stud joint, screw joint and foundation bolts.

**Riveted joints:** Drawing of rivet, lap joint, butt joint with single strap, single riveted, double riveted double strap joints.

**Welded joints:** Lap joint and T joint with fillet, butt joint with conventions.

**Keys:** Taper key, sunk taper key, round key, saddle key, feather key, woodruff key.

**Couplings:** rigid – Muff, flange; flexible – bushed pin-type flange coupling, universal coupling, Oldhams' coupling.

**The following contents to be done by any 3D software package**

**Sectional views**

Creating solid models of complex machine parts and create sectional views.

**Assembly drawings: (Any four of the following using solid model software)**

Lathe tool post, tool head of shaping machine, tail stock, machine vice, gate valve, carburettor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva

cam, universal coupling,

**Manufacturing drawing:**

Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

**Textbooks:**

1. K.L.Narayana, P.Kannaiah and K.Venkat Reddy, Production Drawing, New Age International Publishers, 3/e, 2014
2. Software tools/packages- Auto CAD, Solid works or equivalent.

**Reference Books:**

3. Cecil Jensen, Jay Helsel and Donald D.Voisinet, Computer Aided Engineering Drawing, Tata Mcgraw-Hill, NY, 2000.
4. James Barclay, Brian Griffiths, Engineering Drawing for Manufacture, Kogan Page Science, 2003.
5. N.D.Bhatt, Machine Drawing, Charotar, 50/e, 2014.

**Online Learning Resources:**

<https://eedocs.files.wordpress.com/2014/02/machinedrawing.pdf>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech (ME) – II-II Sem****L T P C**  
**1 0 2 2****20A52401 Soft Skills**

Course Objectives:

- To encourage all round development of the students by focusing on soft skills
- To make the students aware of critical thinking and problem-solving skills
- To develop leadership skills and organizational skills through group activities
- To function effectively with heterogeneous teams

**Course Outcomes (CO):**

By the end of the program students should be able to

- Memorize various elements of effective communicative skills
- Interpret people at the emotional level through emotional intelligence
- apply critical thinking skills in problem solving
- analyse the needs of an organization for team building
- Judge the situation and take necessary decisions as a leader
- Develop social and work-life skills as well as personal and emotional well-being

**UNIT – I****Soft Skills & Communication Skills****10 Hrs**

Introduction, meaning, significance of soft skills – definition, significance, types of communication skills - Intrapersonal &amp; Inter-personal skills - Verbal and Non-verbal Communication

**Activities:****Intrapersonal Skills-** Narration about self- strengths and weaknesses- clarity of thought – self- expression – articulating with felicity

(The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)

**Interpersonal Skills-** Group Discussion – Debate – Team Tasks - Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.**Verbal Communication-** Oral Presentations- Extempore- brief addresses and speeches- convincing- negotiating- agreeing and disagreeing with professional grace.**Non-verbal communication** – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation**UNIT – II****Critical Thinking****10 Hrs**

Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking

**Activities:**

Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues – placing the problem – finding the root cause - seeking viable solution – judging with rationale – evaluating the views of others - Case Study, Story Analysis

**UNIT – III****Problem Solving & Decision Making****10 Hrs**

Meaning &amp; features of Problem Solving – Managing Conflict – Conflict resolution – Methods of decision making – Effective decision making in teams – Methods &amp; Styles

**Activities:**

Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision.

Case Study &amp; Group Discussion

**UNIT – IV****Emotional Intelligence & Stress Management****10 Hrs**

Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips

**Activities:**

Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.

Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation, Organizing Debates

**UNIT – V**

**Leadership Skills**

**10 Hrs**

Team-Building – Decision-Making – Accountability – Planning – Public Speaking – Motivation – Risk-Taking - Team Building - Time Management

**Activities:**

Forming group with a consensus among the participants- choosing a leader- encouraging the group members to express views on leadership- democratic attitude- sense of sacrifice – sense of adjustment – vision – accommodating nature- eliciting views on successes and failures of leadership using the past knowledge and experience of the participants, Public Speaking, Activities on Time Management, Motivation, Decision Making, Group discussion etc.

**NOTE-:**

1. The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes, epics, scriptures, autobiographies and literary sources which bear true relevance to the prescribed skill.
2. Case studies may be given wherever feasible for example for Decision Making- The decision of King Lear or for good Leadership – Mahendar Singh Dhoni etc.

**Textbooks:**

1. Personality Development and Soft Skills (English, Paperback, Mitra Barun K.) Publisher: Oxford University Press; Pap/Cdr edition (July 22, 2012)
2. Personality Development and Soft Skills: Preparing for Tomorrow, Dr Shikha Kapoor Publisher : I K International Publishing House; 0 edition (February 28, 2018)

**Reference Books:**

1. Soft skills: personality development for life success by Prashant Sharma, BPB publications 2018.
2. Soft Skills By Alex K. Published by S.Chand
3. Soft Skills: An Integrated Approach to Maximise Personality Gajendra Singh Chauhan, Sangeetha Sharma Published by Wiley.
4. Communication Skills and Soft Skills (Hardcover, A. Sharma) Publisher: Yking books
5. SOFT SKILLS for a BIG IMPACT (English, Paperback, Renu Shorey) Publisher: Notion Press
6. Life Skills Paperback English Dr. Rajiv Kumar Jain, Dr. Usha Jain Publisher: Vayu Education of India

**Online Learning Resources:**

1. [https://youtu.be/DUlsNJtg2L8?list=PLLy\\_2iUCG87CQhELCYtvXh0E\\_y-bOO1\\_q](https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCYtvXh0E_y-bOO1_q)
2. [https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel\\_j2PUy0pwjVUgj7KIJ](https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KIJ)
3. <https://youtu.be/-Y-R9hDI71U>
4. <https://youtu.be/gkLsn4ddmTs>
5. <https://youtu.be/2bf9K2rRWwo>
6. <https://youtu.be/FchfE3c2jzc>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME) – II-II Sem**

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**20A99401 Design Thinking for Innovation**  
**(Common to All branches of Engineering)**

**Course Objectives:**

The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.

**Course Outcomes (CO):**

- Define the concepts related to design thinking.
- Explain the fundamentals of Design Thinking and innovation
- Apply the design thinking techniques for solving problems in various sectors.
- Analyse to work in a multidisciplinary environment
- Evaluate the value of creativity
- Formulate specific problem statements of real time issues

**UNIT - I Introduction to Design Thinking 10 Hrs**

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

**UNIT - II Design Thinking Process 10 Hrs**

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, customer, journey map, brain storming, product development

**Activity:** Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

**UNIT - III Innovation 8 Hrs**

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

**Activity:** Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

**UNIT - IV Product Design 8 Hrs**

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

**Activity:** Importance of modelling, how to set specifications, Explaining their own product design.

**UNIT - V Design Thinking in Business Processes 10 Hrs**

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

**Activity:** How to market our own product, About maintenance, Reliability and plan for startup.

**Textbooks:**

1. Change by design, Tim Brown, Harper BOLLINS (2009)
2. Design Thinking for Strategic Innovation, Idris Mootee, 2013, John Wiley & Sons.

**Reference Books:**

1. Design Thinking in the Classroom by David Lee, Ulysses press

2. Design the Future, by Shrrutin N Shetty, Norton Press
3. Universal principles of design- William lidwell, kritinaholden, Jill butter.
4. The era of open innovation – chesbrough.H

**Online Learning Resources:**

<https://nptel.ac.in/courses/110/106/110106124/>

<https://nptel.ac.in/courses/109/104/109104109/>

[https://swayam.gov.in/nd1\\_noc19\\_mg60/preview](https://swayam.gov.in/nd1_noc19_mg60/preview)

## COMMUNITY SERVICE PROJECT

.....Experiential learning through community engagement

### Introduction

- Community Service Project is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development
- Community Service Project involves students in community development and service activities and applies the experience to personal and academic development.
- Community Service Project is meant to link the community with the college for mutual benefit. The community will be benefited with the focused contribution of the college students for the village/ local development. The college finds an opportunity to develop social sensibility and responsibility among students and also emerge as a socially responsible institution.

### Objective

Community Service Project should be an integral part of the curriculum, as an alternative to the 2 months of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigency when students cannot pursue their summer internships. The specific objectives are;

- To sensitize the students to the living conditions of the people who are around them,
- To help students to realize the stark realities of the society.
- To bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability
- To make students aware of their inner strength and help them to find new /out of box solutions to the social problems.
- To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
- To help students to initiate developmental activities in the community in coordination with public and government authorities.
- To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.

### Implementation of Community Service Project

- Every student should put in a 6 weeks for the Community Service Project during the summer vacation.
- Each class/section should be assigned with a mentor.
- Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of people like - youth, women, house-wives, etc
- A log book has to be maintained by each of the student, where the activities undertaken/involved to be recorded.
- The logbook has to be countersigned by the concerned mentor/faculty incharge.
- Evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
- The final evaluation to be reflected in the grade memo of the student.
- The Community Service Project should be different from the regular programmes of NSS/NCC/Green Corps/Red Ribbon Club, etc.
- Minor project report should be submitted by each student. An internal Viva shall also be conducted by a committee constituted by the principal of the college.
- Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training



### Procedure

- A group of students or even a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, so as to enable them to commute from their residence and return back by evening or so.
- The Community Service Project is a twofold one –
  - First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas. A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.
  - Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like –
    - Agriculture
    - Health
    - Marketing and Cooperation
    - Animal Husbandry
    - Horticulture
    - Fisheries
    - Sericulture
    - Revenue and Survey
    - Natural Disaster Management
    - Irrigation
    - Law & Order
    - Excise and Prohibition
    - Mines and Geology
    - Energy
    - Internet
    - Free Electricity
    - Drinking Water

## EXPECTED OUTCOMES

### BENEFITS OF COMMUNITY SERVICE PROJECT TO STUDENTS

#### Learning Outcomes

- Positive impact on students' academic learning
- Improves students' ability to apply what they have learned in "the real world"
- Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development
- Improved ability to understand complexity and ambiguity

#### Personal Outcomes

- Greater sense of personal efficacy, personal identity, spiritual growth, and moral development
- Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills

#### Social Outcomes

- Reduced stereotypes and greater inter-cultural understanding
- Improved social responsibility and citizenship skills
- Greater involvement in community service after graduation

#### Career Development

- Connections with professionals and community members for learning and career opportunities
- Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity

### **Relationship with the Institution**

- Stronger relationships with faculty
- Greater satisfaction with college
- Improved graduation rates

### **BENEFITS OF COMMUNITY SERVICE PROJECT TO FACULTY MEMBERS**

- Satisfaction with the quality of student learning
- New avenues for research and publication via new relationships between faculty and community
- Providing networking opportunities with engaged faculty in other disciplines or institutions
- A stronger commitment to one's research

### **BENEFITS OF COMMUNITY SERVICE PROJECT TO COLLEGES AND UNIVERSITIES**

- Improved institutional commitment
- Improved student retention
- Enhanced community relations

### **BENEFITS OF COMMUNITY SERVICE PROJECT TO COMMUNITY**

- Satisfaction with student participation
- Valuable human resources needed to achieve community goals
- New energy, enthusiasm and perspectives applied to community work
- Enhanced community-university relations.

### **SUGGESTIVE LIST OF PROGRAMMES UNDER COMMUNITY SERVICE PROJECT**

The following the recommended list of projects for Engineering students. The lists are not exhaustive and open for additions, deletions and modifications. Colleges are expected to focus on specific local issues for this kind of projects. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a group of students should take the responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and benefits of this kind of projects. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting shall be ensured.

#### **For Engineering Students**

1. **Water facilities and drinking water availability**
2. **Health and hygiene**
3. **Stress levels and coping mechanisms**
4. **Health intervention programmes**
5. **Horticulture**
6. **Herbal plants**
7. **Botanical survey**
8. **Zoological survey**
9. **Marine products**
10. **Aqua culture**
11. **Inland fisheries**
12. **Animals and species**
13. **Nutrition**
14. **Traditional health care methods**
15. **Food habits**
16. **Air pollution**

17. Water pollution
18. Plantation
19. Soil protection
20. Renewable energy
21. Plant diseases
22. Yoga awareness and practice
23. Health care awareness programmes and their impact
24. Use of chemicals on fruits and vegetables
25. Organic farming
26. Crop rotation
27. Flourey culture
28. Access to safe drinking water
29. Geographical survey
30. Geological survey
31. Sericulture
32. Study of species
33. Food adulteration
34. Incidence of Diabetes and other chronic diseases
35. Human genetics
36. Blood groups and blood levels
37. Internet Usage in Villages
38. Android Phone usage by different people
39. Utilisation of free electricity to farmers and related issues
40. Gender ration in schooling lvel- observation.

**Complimenting the community service project the students may be involved to take up some awareness campaigns on social issues/special groups. The suggested list of programmes are;**

#### **Programmes for School Children**

1. Reading Skill Programme (Reading Competition)
2. Preparation of Study Materials for the next class.
3. Personality / Leadership Development
4. Career Guidance for X class students
5. Screening Documentary and other educational films
6. Awareness Programme on Good Touch and Bad Touch (Sexual abuse)
7. Awareness Programme on Socially relevant themes.

#### **Programmes for Women Empowerment**

1. Government Guidelines and Policy Guidelines
2. Womens' Rights
3. Domestic Violence
4. Prevention and Control of Cancer
5. Promotion of Social Entrepreneurship

#### **General Camps**

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water
5. ODF awareness camp
6. Swatch Bharath
7. AIDS awareness camp

8. Anti Plastic Awareness
9. Programmes on Environment
10. Health and Hygiene
11. Hand wash programmes
12. Commemoration and Celebration of important days

**Programmes for Youth Empowerment**

1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

**Common Programmes**

1. Awareness on RTI
2. Health intervention programmes
3. Yoga
4. Tree plantation
5. Programmes in consonance with the Govt. Departments like –
  - i. Agriculture
  - ii. Health
  - iii. Marketing and Cooperation
  - iv. Animal Husbandry
  - v. Horticulture
  - vi. Fisheries
  - vii. Sericulture
  - viii. Revenue and Survey
  - ix. Natural Disaster Management
  - x. Irrigation
  - xi. Law & Order
  - xii. Excise and Prohibition
  - xiii. Mines and Geology
  - xiv. Energy

**Role of Students:**

- Students may not have the expertise to conduct all the programmes on their own. The students then can play a facilitator role.
- For conducting special camps like Health related, they will be coordinating with the Governmental agencies.
- As and when required the College faculty themselves act as Resource Persons.
- Students can work in close association with Non-Governmental Organizations like Lions Club, Rotary Club, etc or with any NGO actively working in that habitation.
- And also with the Governmental Departments. If the programme is rolled out, the District Administration could be roped in for the successful deployment of the programme.
- An in-house training and induction programme could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

**Timeline for the Community Service Project Activity**

**Duration: 8 weeks**

**1. Preliminary Survey (One Week)**

- A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.
- A survey form based on the type of habitation to be prepared before visiting the habitation with the help of social sciences faculty. (However, a template could be designed for different habitations, rural/urban.
- The Governmental agencies, like revenue administration, corporation and municipal authorities and village secretariats could be aligned for the survey.

**2. Community Awareness Campaigns (One Week)**

- Based on the survey and the specific requirements of the habitation, different awareness campaigns and programmes to be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.

**3. Community Immersion Programme (Three Weeks)**

Along with the Community Awareness Programmes, the student batch can also work with any one of the below listed governmental agencies and work in tandem with them. This community involvement programme will involve the students in exposing themselves to the experiential learning about the community and its dynamics. Programmes could be in consonance with the Govt. Departments.

**4. Community Exit Report (One Week)**

- During the last week of the Community Service Project, a detailed report of the outcome of the 8 weeks work to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that particular habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University.

Throughout the Community Service Project, a daily log-book need to be maintained by the students batch, which should be countersigned by the governmental agency representative and the teacher-mentor, who is required to periodically visit the students and guide them.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– III-I Sem**

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**(20A03501) CAD/CAM**

**Course Objectives:**

- Understand the basics of CAD/CAM, geometric representation, transformations.
- Explain geometric modeling methods in CAD.
- Familiarize numerical control (NC), computer numerical control (CNC) and direct numerical control (DNC) machines.
- Impart knowledge on manual part programming and computer aided part programming.
- Explain the principles robotics, CIM, AR,VR and AI in CIM

**Course Outcomes:**

- Apply the basics of geometric representation and transformations in CAD/CAM. L3
- Choose geometric modelling methods for building CAD models. L1
- Compare NC, CNC and DNC. L2
- Develop manual and computer aided part programming for turning and milling operations. L3
- Summarize the principles of robotics AR, VR and AI in CIM.

**UNIT I Introduction to CAD/CAM**

**CAD/CAM:** Introduction, hardware and software, I/O devices, benefits. Graphics standards-Neutral file formats – IGES, STEP.

**2D and 3D geometric transformations:** Translation, scaling, rotation, mirroring, homogenous transformations, concatenation of transformations, viewing transformations.

**UNIT II Geometric Modelling**

**Parametric representation:** Representation of curves, Hermite curves, Spline, Bezier and B-spline curves in twodimensions; Geometric modelling of surfaces: Surface patch, Coons and bicubic patches, Bezier and B-spline surfaces, sweep surfaces, surface of revolution, blending of surfaces

**Geometric Modelling of Solids:** Wireframe, surface modelling, solid entities, Boolean operations, CSG approach and B-rep of solid modelling, geometric modelling of surfaces.

**UNIT III Computer Aided Manufacturing (CAM)**

**Computer Aided Manufacturing (CAM):** Structure of numerical control (NC) machine tools, designation of axes, drives and actuation systems, feedback devices, computernumerical control (CNC) and direct numerical control (DNC), adaptive control system, CNC tooling, automatic tool changers and work holding devices, functions of CNC and DNC systems.

**UNIT IV Part Programming and APT Programming**

**Part Programming:** Part programming instruction formats, information codes, preparatory functions, miscellaneous functions (G-codes, M-codes). Tool codes and tool length offset, interpolations canned cycles.

**APT Programming:** APT language structure, APT geometry, Definition of point, line, circle, plane.

**APT Motion Commands:** set-up commands, pint to point motion commands; continuous path motion commands part programming preparation for typical examples (milling and turning operation)

**UNIT V Automation**

**Automation:** Anatomy and configuration of robot, characteristics of robots,grippers, application of robots in manufacturing, robot programming languages, Group Technology, Introduction to computer integrated manufacturing, Introduction to Virtual Reality (VR), Augmented Reality (AR) and Artificial Intelligence (AI).

**Textbooks:**

1. P. N. Rao, CAD/CAM: Principles and applications, 3/e, Tata McGraw-Hill, Delhi, 2017.
2. Ibrahim Zeid, R.Siva Subramanian, CAD/CAM: Theory and Practice, 2/e, Tata McGraw-Hill, Delhi, 2009.

**Reference Books:**

1. Mikell P. Groover, Emory W. Zimmers , CAD/CAM, 5/e, Pearson Prentice Hall of India, Delhi, 2008.
2. P. Radhakrishnan, S. Subramanyan& V. Raju, CAD/CAM/CIM, 3/e, New Age International Publishers, 2008.
3. Computer Aided Manufacturing, 3/e, Tien Chien Chang, Pearson, 2008.

**Online Learning Resources:**

- [https://onlinecourses.nptel.ac.in/noc20\\_me44/preview](https://onlinecourses.nptel.ac.in/noc20_me44/preview)
- <https://www.youtube.com/watch?v=EgKc9L7cbKc>
- <https://www.youtube.com/watch?v=KXFpTb9cBpY>
- [https://web.iitd.ac.in/~hegde/cad/lecture/L01\\_Introduction.pdf](https://web.iitd.ac.in/~hegde/cad/lecture/L01_Introduction.pdf)
- [https://www.vssut.ac.in/lecture\\_notes/lecture1530947994.pdf](https://www.vssut.ac.in/lecture_notes/lecture1530947994.pdf)
- [https://www.iare.ac.in/sites/default/files/lecture\\_notes/CAD\\_CAM\\_Lecture\\_NOTES.pdf](https://www.iare.ac.in/sites/default/files/lecture_notes/CAD_CAM_Lecture_NOTES.pdf)

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– III-I Sem

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## (20A03502) DESIGN OF MACHINE MEMBERS

**Course Objectives:**

- Provide an introduction to design of machine elements.
- Familiarize with fundamental approaches to failure prevention for static and dynamic loading.
- Explain design procedures to different types of joints.
- Teach principles of clutches and brakes and design procedures.
- Instruct different types of bearings and design procedures.

**Course Outcomes:**

At the end of the course the students will be able to

- Estimate safety factors of machine members subjected to static and dynamic loads. (L5)
- Design fasteners subjected to variety of loads. (L6)
- Select of standard machine elements such as keys, shafts, couplings, springs and bearings. (L1)
- Design clutches brakes and spur gears. (L6)

**UNIT I Introduction, Design for Static and Dynamic loads**

**Mechanical Engineering Design:** Design process, design considerations, codes and standards of designation of materials, selection of materials.

**Design for Static Loads:** Modes of failure, design of components subjected to axial, bending, torsional and impact loads. Theories of failure for static loads.

**Design for Dynamic Loads:** Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, fatigue design for infinite life. Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses.

**UNIT II Design of Bolted and Welded Joints**

**Design of Bolted Joints:** Threaded fasteners, preload of bolts, various stresses induced in the bolts. Torque requirement for bolt tightening, gasketed joints and eccentrically loaded bolted joints.

**Welded Joints:** Strength of lap and butt welds, Joints subjected to bending and torsion. Eccentrically loaded welded joints.

**UNIT III Power transmission shafts and Couplings**

**Power Transmission Shafts:** Design of shafts subjected to bending, torsion and axial loading. Shafts subjected to fluctuating loads using shock factors.

**Couplings:** Design of flange and bushed pin couplings, universal coupling.

**UNIT IV Design of Clutches, Brakes and Springs**

**Friction Clutches:** Torque transmitting capacity of disc and centrifugal clutches. Uniform wear theory and uniform pressure theory.

**Brakes:** Different types of brakes. Concept of self-energizing and self-locking of brake. Band and block brakes, disc brakes.

**Springs:** Design of helical compression, tension, torsion and leaf springs.

**UNIT V Design of Bearings and Gears**

**Design of Sliding Contact Bearings:** Lubrication modes, bearing modulus, McKee's equations, design of journal bearing. Bearing Failures.

**Design of Rolling Contact Bearings:** Static and dynamic load capacity, Stribeck's Equation, equivalent bearing load, load-life relationships, load factor, selection of bearings from manufacturer's catalogue.

**Design of Gears:** Spur gears, beam strength, Lewis equation, design for dynamic and wear loads.

**Textbooks:**

1. R.L. Norton, Machine Design an Integrated approach, 2/e, Pearson Education, 2004.
2. V.B.Bhandari, Design of Machine Elements, 3/e, Tata McGraw Hill, 2010.
3. Dr. N. C. Pandya & Dr. C. S. Shah, Machine design, 17/e, Charotar Publishing House Pvt. Ltd, 2009.

**Reference Books:**

1. R.K. Jain, Machine Design, Khanna Publications, 1978.
2. J.E. Shigley, Mechanical Engineering Design, 2/e, Tata McGraw Hill, 1986.
3. M.F.Spotts and T.E.Shoup, Design of Machine Elements, 3/e, Prentice Hall (Pearson Education), 2013.
4. K. Mahadevan & K. Balaveera Reddy, Design data handbook, CBS Publications, 4/e, 2018.

**Online Learning Resources:**



- <https://www.yumpu.com/en/document/view/18818306/lesson-3-course-name-design-of-machine-elements-1-nptel>
- <https://www.digimat.in/nptel/courses/video/112105124/L01.html>
- <https://dokumen.tips/documents/nptel-design-of-machine-elements-1.html>
- <http://www.nitttrc.edu.in/nptel/courses/video/112105124/L25.html>

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– III-I Sem

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## (20A03503T) METROLOGY AND MEASUREMENTS

**Course Objectives:**

- Introduce the basic concepts of metrology and measurement methods.
- Demonstrate the importance of metrology in manufacturing
- Explain the concepts of transducers and its practical applications.
- Expose with various measuring instruments
- Familiarize calibration methods of various measuring instruments.

**Course Outcomes:**

- List various measuring instruments used in metrology.
- Examine geometry of screw threads and gear profiles.
- Measure force, torque and pressure.
- Calibrate various measuring instruments.

**UNIT I****Concept of measurement**

**Concept of Measurement:** General concept-generalized measurement system, units and standards, measuring instruments, sensitivity, readability, range of accuracy, precision, static and dynamic response, repeatability, systematic and random errors, correction, calibration, terminology and limits fits and tolerances, hole basis and shaft basis system, interchangeability.

**Limit Gauges And Gauge Design:** Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle. Design of Go and No Go gauges.

**Linear and Angular Measurement:** Linear measuring instruments: Vernier instruments, micrometers, slip gauges, tool makers microscope. Comparators: Mechanical, pneumatic and electrical. **Angular measurements:** Sine bar, bevel protractor and angle dekkor, rollers and spheres used to determine the tapers.

**UNIT – II****Flatness and Surface Roughness measurement**

**Flatness Measurement:** Measurement of flatness – straight edges – surface plates, optical flat and autocollimators, interferometers and their applications.

**Surface Roughness Measurement:** Terminology systems, differences between surface roughness and surface waviness- Numerical assessment of surface finish - CLA, R.M.S Value- $R_a$ ,  $R_z$  values, Methods of measurement of surface finish-profilograph, talysurf, BIS symbols for indication of surface roughness.

**UNIT – III****Screw Thread and Gear Measurement**

**Screw thread measurements:** Elements of threads, errors in screw threads, various methods for measuring external and internal screw threads, screw thread gauges.

**Gear Measurement:** Gear tooth terminology, measurement of gear elements-run out, lead, pitch backlash, profile, pressure angle, tooth thickness, diameter of gear, constant chord and base tangent method.

**Coordinate Measuring Machine (CMM)-** Construction and features.

**UNIT – IV****Measurement of Displacement and Strain**

**Measurement of Displacement:** Theory and construction of various transducers to measure displacement – Piezo-electric, inductive, capacitance, resistance, ionization and photoelectric transducers, calibration procedures.

**Measurements of Strain:** Various types of electrical strain gauges, gauge factor, method of usage of resistance strain gauge for bending, compressive and tensile strains, usage for measuring torque, strain gauge rosettes.

**UNIT – V****Measurement of Force, Torque and Pressure**

**Measurement of Force:** Direct method - analytical balance, platform balance; elastic members – load cells, cantilever beams and proving rings.

**Measurement of Torque:** Torsion bar dynamometer, servo controlled dynamometer and absorption dynamometer.

**Measurement of Pressure:** Standards and calibration, basic methods of pressure measurement, dead weight gauges and manometers, High and low pressure measurement, Elastic transducers.

**Textbooks:**

1. Beckwith, Marangoni, Linehard, Mechanical Measurements, 6/e, PHI, 2013.
2. R.K. Jain, Engineering Metrology, 20/e, Khanna Publishers, 2013.

**Reference Books:**

1. Mahajan, Engineering Metrology, 2/e, Dhanpat Rai, 2013.
2. S.Bhaskar, Basic Principles - Measurements and Control Systems, Anuradha Publications, 2014.
3. Anand K Bewoor & Vinay A Kulkarni, Metrology & Measurement, 15/e, McGrawHill, 2015.
4. D.S. Kumar, Mechanical Measurements & Control, Metropolitan Publishers, 5/e, 2015.

**Online Learning Resources:**

- [https://nitsri.ac.in/Department/Mechanical%20Engineering/MEC\\_405\\_Book\\_2,\\_for\\_Unit\\_2B.pdf](https://nitsri.ac.in/Department/Mechanical%20Engineering/MEC_405_Book_2,_for_Unit_2B.pdf)
- <https://www.digimat.in/nptel/courses/video/112104250/L47.html>
- <https://www.digimat.in/nptel/courses/video/112106138/L01.html>  
<https://www.digimat.in/nptel/courses/video/112106179/L01.html>  
<https://www.youtube.com/watch?v=tczyyM4Dyk>
- [https://www.youtube.com/watch?v=\\_UsAiZmRC1M](https://www.youtube.com/watch?v=_UsAiZmRC1M)  
<https://www.youtube.com/watch?v=oCkaxMI19X8>

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– III-I Sem

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(20A03504a) AUTOMATION AND ROBOTICS  
(PROFESSIONAL ELECTIVE-I)**Course Objectives:**

The objectives of this course are to

- Describe the basic concepts of automation in manufacturing systems.
- Acquire the fundamental concepts of automated flow lines and their analysis.
- Classify automated material handling, automated storage and retrieval systems.
- Illustrate adaptive control systems and automated inspection methods.
- Define the fundamental concepts of industrial robotics.
- Apply basic mathematics to calculate the robot kinematic and dynamic mechanics
- Understand the robot programming methods and software packages.

**Course Outcomes:**

At the end of the course student will be able to

- Classify the types of hardware components of automation and control system.
- Design a simple material handling system for low-cost manufacturing
- Design a simple gripper for robot
- Compare the types of actuators used in robot manipulator
- Understand the requirements and features of robot programming
- Demonstrate the various applications of robots in manufacturing

**UNIT I Introduction**

**Introduction:** Automation in production system, need, types, Principles and Strategies of automation, levels of automation, basic elements of an automated system, hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

**Automated flow lines & transfer mechanisms,** fundamentals of transfer Lines, flow lines with or without buffer storage.

**UNIT II Assembly Line Balancing and Automated Manufacturing System**

**Assembly Line Balancing:** Assembly process and systems assembly line, line balancing algorithms, ways of improving line balance, flexible assembly lines.

**Material handling and Identification Technologies:** Overview of automatic material handling systems, principles and design consideration, material transport systems, storage systems, overview of automatic identification methods.

**Automated Manufacturing Systems:** Components, classification and overview of manufacturing systems, manufacturing cells, GT and cellular manufacturing, FMS and its planning and implementation.

**UNIT III Introduction to Robotics**

**Introduction:** Brief history of robots, classification of robot, functional line diagram, degrees of freedom. Elements of robot - types and its functions, factors to be considered in the design of grippers.

**Robot Actuators And Feedback Components:** Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

**UNIT IV Kinematics and Dynamics of a Manipulator**

**Manipulator Kinematics:** Homogenous transformations as applicable to translation, rotations- D-H notation, Forward and inverse kinematics.

**Manipulator Dynamics:** Differential transformations, Jacobians, Lagrange - Euler and Newton - Euler formations.

**UNIT V Robot Programming and Applications+**

**Robot Programming:** Methods of programming - requirements and features of programming languages, software packages, problems with programming languages. Motion path control- slew motion, joint integrated motion, straight line motion; avoidance of obstacles.

**Robot Application in Manufacturing:** Material Transfer - Material handling, loading and unloading; Process - spot and continuous arc welding & spray painting; Assembly and Inspection.

**Textbooks:**

1. Mikell P. Groover, Automation, Production Systems and Computer Integrated Manufacturing- Pearson Education. 5/e, 2009.
2. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, Industrial Robotics — McGraw Hill, 1986.

**Reference Books:**

1. S. R. Deb & Sankha Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill Education, 2009.
2. R K Mittal and I J Nagrath, Robotics and control, Illustrated Edition, Tata McGraw Hill India 2003.
3. Saeed B. Niku, Introduction to Robotics – Analysis, System, Applications, 2/e, John Wiley & Sons, 2010.
4. Richard D. Klafter, Thomas Robotic Engineering an integrated approach, PHI publications 1988.

**Online Learning Resources:**

- <https://www.digimat.in/nptel/courses/video/112104288/L01.html>
- <https://www.edx.org/learn/robotics>
- <https://www.youtube.com/watch?v=xrwz9IxpMJg>
- <https://nptel.ac.in/courses/112101098>
- [https://onlinecourses.nptel.ac.in/noc20\\_de11/preview](https://onlinecourses.nptel.ac.in/noc20_de11/preview)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– III-I Sem**

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**(20A03504b) TOOL DESIGN**  
**(PROFESSIONAL ELECTIVE-I)**

**Course Objectives:**

The objectives of this course are to

- Describe the basic concepts of Tool Design.
- Classify Fits and Tolerances used in Tool Design.
- Define the fundamental concepts of Designing of Jigs and Fixtures.
- Apply basic mathematics to design the press tool dies.
- Understand the nomenclature of the milling cutters.
- Explain the conceptual design of CNC machine tools.

**Course Outcomes:**

At the end of the course student will be able to

- Compare the Ferrous and non ferrous tool materials
- Classify the types of chip formation during orthogonal cutting
- Design Drill Jigs and Fixtures
- Design a simple gripper for robot
- Understand the concept of design of die and piercing operations
- Understand about the tool holding methods, Automatic tool changers and tool positions in CNC Machine

**UNIT I INTRODUCTION TO TOOL DESIGN**

Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials- Carbides, Ceramics and Diamond - Non metallic tool materials-Designing with relation to heat treatment.

**UNIT II DESIGN OF CUTTING TOOLS**

Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters.

**UNIT III DESIGN OF JIGS AND FIXTURES**

Introduction – Fixed Gages – Gage Tolerances –selection of material for Gauges – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – General considerations in the design of drill jigs – Drill bushings – Methods of construction –Types of Fixtures – Vice Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures.

**UNIT IV DESIGN OF PRESS TOOL DIES**

Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Centre of pressure -Strip layout – Short-run tooling for Piercing – Bending dies – Drawing dies-Design and drafting.

**UNIT V TOOL DESIGN FOR CNC MACHINE TOOLS**

Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine.

**Textbooks:**

1. Cyril Donaldson, George H.LeCain, V.C. Goold, “Tool Design”, Tata McGraw Hill Publishing Company Ltd., 2000.
2. E.G.Hoffman,” Jig and Fixture Design”, Thomson Asia Pvt Ltd, Singapore, 2004.

**Reference Books:**

1. P.C.Sharma, A Text book of Production Engineering, S.Chand Publications, 1999.
2. Prakash Hiralal Joshi, “Tooling data”, Wheeler Publishing, 2000
3. Venkataraman K., “Design of Jigs, Fixtures and Presstools”, TMH, 2005.
4. Haslehurst M., “Manufacturing Technology”, The ELBS, 1978.

**Online Learning Resources:**

- [https://www.iare.ac.in/sites/default/files/lecture\\_notes/TOOL%20DESIGN\\_Lecture\\_Notes.pdf](https://www.iare.ac.in/sites/default/files/lecture_notes/TOOL%20DESIGN_Lecture_Notes.pdf)
- [https://www.cet.edu.in/noticefiles/261\\_MMP%20Lecture%20Notes-ilovepdf-compressed.pdf](https://www.cet.edu.in/noticefiles/261_MMP%20Lecture%20Notes-ilovepdf-compressed.pdf)

- <https://www.vssut.ac.in/lecture-notes.php?url=production-engineering>
- <https://nptel.ac.in/courses/112/105/112105233/>
- <https://www.youtube.com/watch?v=7MkX-sW97rI>
- <https://nptel.ac.in/courses/112/105/112105126/#>

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– III-I Sem

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**(20A03504c) POWER PLANT ENGINEERING  
(PROFESSIONAL ELECTIVE-I)**

**Course Objectives:**

- Familiarize the sources of energy, power plant economics and environmental aspects.
- Outline the working components of different power plant.
- Explain renewable energy sources; characteristics, working principle, classify types, layouts, and plant operations.
- Impart types of nuclear power plants, and outline working principle and advantages and hazards.

**Course Outcomes:**

- Outline sources of energy, power plant economics, and environmental aspects
- Explain power plant economics and environmental considerations
- Describe working components of a steam power plant
- Illustrate the working mechanism of Diesel and Gas turbine power plants
- summarize types of renewable energy sources and their working principle
- Demonstrate the working principle of nuclear power plants

**UNIT I Introduction to the Sources of Energy**

**Introduction to the Sources of Energy** - Resources and Development of Power in India. Layouts of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power Cycles - Comparison and Selection.

**Power Plant Economics and Environmental Considerations:** Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor - Tariff - Related Exercises. Effluents from Power Plants and Impact on Environment - Pollutants and Pollution Standards - Methods of Pollution Control. Inspection And Safety Regulations.

**UNIT II Steam Power Plant**

Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Combustion Process- Properties of Coal - Overfeed and Under Feed Fuel Beds, Travelling Grate Stokers, Spreader Stokers, Retort Stokers, Pulverized Fuel Burning System And Its Components, Combustion Needs and Draught System, Cyclone Furnace, Design and Construction, Dust Collectors, Cooling Towers And Heat Rejection. Analysis of Pollution from Thermal Power Plants - Pollution Controls.CO<sub>2</sub> Recorders

**UNIT III Diesel and Gas Turbine Power Plants**

**Diesel Power Plant:** Diesel Power Plant: Introduction - IC Engines, Types, Construction- Fuel Storage

**Gas Turbine Plant:** Introduction - Classification - Construction - Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

**UNIT IV Hydro Electric Power Plants**

**Hydro Electric Power Plant:** Waterpower - Hydrological Cycle / Flow Measurement - Drainage Area Characteristics - Hydrographs - Storage and Pondage - Classification of Dams and Spill Ways.

**Hydro Projects & Plant:** Classification - Plant Auxiliaries - Plant Operation Pumped Storage Plants.

**UNIT V Non-Conventional Source of Energy**

**Power From Non-Conventional Sources:** Utilization of Solar Collectors- Principle of its Working, Wind Energy - Types of Turbines - HAWT & VAWT-Tidal Energy. MHD power Generation.

**Nuclear Power Station:** Nuclear Fuel - Nuclear Fission, Chain Reaction, Breeding and Fertile Materials - Nuclear Reactor -Reactor Operation.

**Types Of Reactors:** Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding - Radioactive Waste Disposal.

**Textbooks:**

1. P.K. Nag, Power Plant Engineering, 3/e, TMH, 2013.
2. Arora and S. Domkundwar, A course in Power Plant Engineering, Dhanpat Rai & Co (P) Ltd, 2014.

**Reference Books:**



1. Rajput, A Textbook of Power Plant Engineering, 4/e, Laxmi Publications, 2012.
2. Ramalingam, Power plant Engineering, SciTech Publishers, 2013.
3. P.C. Sharma, Power Plant Engineering, S.K. Kataria Publications, 2012.

**Online Learning Resources:**

- [https://www.iare.ac.in/sites/default/files/lecture\\_notes/PPE\\_Lecture\\_NOTES.pdf](https://www.iare.ac.in/sites/default/files/lecture_notes/PPE_Lecture_NOTES.pdf)
- <http://www.digimat.in/nptel/courses/video/112107291/L21.html>
- [https://onlinecourses.nptel.ac.in/noc19\\_me63/preview](https://onlinecourses.nptel.ac.in/noc19_me63/preview)
- <https://www.youtube.com/watch?v=iWWyI8CZhUw>
- [https://www.youtube.com/watch?v=D0i1E\\_1E\\_TE](https://www.youtube.com/watch?v=D0i1E_1E_TE)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– III-I Sem**

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**(20A03503P) METROLOGY AND MEASUREMENTS LAB**

**Course Objectives:**

- To experiment with measuring equipments used for linear and angular measurements.
- To find common types of errors in measurement equipment.
- To experiment with different types of sensors, transducers and strain gauges equipment.
- To make use of thermocouples for measurement of temperature.

**Course Outcomes:** At the end of course the students will be able to:

- Apply different instruments to measure length, width, depth, bore diameters, internal and external tapers, tool angles, and surface roughness.
- Measure effective diameter of thread profile.
- Conduct different machine alignment tests.
- Measure temperature, displacement, and pressure.

**List of Experiments:**

**Section A:**

1. Measurement of bores by internal micrometers and dial bore indicators.
2. Use of gear teeth Vernier callipers and checking the chordal addendum and chordal height of spur gear.
3. Alignment test on the lathe and milling machine using dial indicators
4. Study of Tool makers microscope and its application
5. Angle and taper measurements by Bevel protractor, Sine bar spirit level etc.
6. Thread measurement by Two wire/Three wire method.
7. Surface roughness measurement by Talysurf instrument.
8. Use of straight edge and spirit level in finding the flatness of surface plate.

**Section B:**

1. Calibration of Pressure Gauges
2. Study and calibration of McLeod gauge for low pressure.
3. Calibration of transducer or thermocouple for temperature measurement.
4. Calibration of LVDT transducer for displacement measurement.
5. Calibration of capacitive transducer for angular measurement.
6. Calibration of photo and magnetic speed pickups for the measurement of speed.
7. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.

**Virtual Lab:**

1. To use Vernier Callipers for the measurement of dimensions of given object.  
<https://amrita.olabs.edu.in/?sub=1&brch=5&sim=16&cnt=4>
2. To use Micrometer Screw Gauge for the measurement of dimensions (Length, Thickness, Diameter) of given object.  
<https://amrita.olabs.edu.in/?sub=1&brch=5&sim=156&cnt=4>
3. To calculate Young's modulus of elasticity of steel wire by Vernier method
4. <https://amrita.olabs.edu.in/?sub=1&brch=5&sim=155&cnt=4>

**References:**

1. Dr. R. Manikandan, Metrology and Measurements laboratory manual, Notion Press; 1/e, 2020.
2. Arul R, Metrology and Measurements Lab Manual, Notion Press; 1/e, 2020.

**Online Learning Resources/Virtual Labs:**

- <https://amrita.olabs.edu.in/?sub=1&brch=5&sim=16&cnt=4>
- <https://amrita.olabs.edu.in/?sub=1&brch=5&sim=156&cnt=4>
- <https://amrita.olabs.edu.in/?sub=1&brch=5&sim=36&cnt=4>
- <https://www.sciencedirect.com/science/article/pii/S2212827116003929>
- <https://sjce.ac.in/wp-content/uploads/2018/04/Metrology-and-Measurement-Laboratory-Manual.pdf>
- [https://www.youtube.com/watch?v=jfUNqg8iWmg&list=PL9Q\\_yrIFD9Opks9GDke48rETYcnBFBumj&index=5](https://www.youtube.com/watch?v=jfUNqg8iWmg&list=PL9Q_yrIFD9Opks9GDke48rETYcnBFBumj&index=5)
- [https://www.youtube.com/watch?v=X7PjoNEvIMs&list=PL9Q\\_yrIFD9Opks9GDke48rETYcnBFBumj&index=6](https://www.youtube.com/watch?v=X7PjoNEvIMs&list=PL9Q_yrIFD9Opks9GDke48rETYcnBFBumj&index=6)

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– III-I Sem

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## (20A03506) COMPUTER AIDED MODELING LABORATORY

**Course Objectives:**

- To train the students with CAD packages.
- To impart the 2D and 3D modeling skills to the students.
- To import and export different IGES files from one software to another

**Course Outcomes:**

- Students will be able to design different parts of mechanical equipment's
- Students will be able to apply their skills in various designing and Manufacturing Industries.

**List of Experiments:**

1. Generation of the following curves using “C”/ Python language
    - a) Cubic Splines
    - b) Bezier curves
    - c) B-Splines.
  2. Generation of the following surfaces using “C”/Python language
    - a) Bezier surfaces
    - a) B-Spline surfaces
  3. Typical tasks of Modeling using any solid modeling packages such as PRO/E, IDEAS, CATIA, etc.,
    - a) Solid Boolean algebra - 1 Exercise
    - b) Wireframe & Surface Modelling – 3 Exercises
    - c) 3D – Drafting in detail – 1 Exercise
    - d) Production Drawing with Geometric Dimensioning and Tolerances– 3 Exercises
- (Preferably for the assembly drawings drawn in Computer Aided Machine Drawing in previous semester)

**References:**

1. James D Meadows "[Geometric Dimensioning and Tolerancing-Applications, Analysis & Measurement ASME Y14.5-2018.](#)
2. KL Narayana, P Kannaiah and K.Venkat Reddy, Production Drawing, New Age publishers, 2014.
3. Ibrahim Zeid, Tata Mc Graw hill, CAD/CAM Theory and Practice, 2012.

**Online Learning Resources/Virtual Labs:**

- [https://www.youtube.com/watch?v=er7xJFKv5k&list=PL5w7L\\_xR0pu2wLbJtOuK49WxJJVjyKks&index=2](https://www.youtube.com/watch?v=er7xJFKv5k&list=PL5w7L_xR0pu2wLbJtOuK49WxJJVjyKks&index=2)
- [https://www.youtube.com/watch?v=Gy0MKabzDa8&list=PLrOFa8sDv6jccqLnN7UDa1YW4s\\_hR6YX0](https://www.youtube.com/watch?v=Gy0MKabzDa8&list=PLrOFa8sDv6jccqLnN7UDa1YW4s_hR6YX0)
- [https://www.youtube.com/watch?v=k3kFC9uTdUk&list=PLM5xm8DJKViImdv5ZXxQ2NyIdSlid\\_jCB](https://www.youtube.com/watch?v=k3kFC9uTdUk&list=PLM5xm8DJKViImdv5ZXxQ2NyIdSlid_jCB)

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– III-I Sem

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(20A03507) INNOVATION THROUGH IoT  
(Skill Oriented course III)**Course Objectives:**

- To get practical knowledge on Raspberry Pi and Arduino.
- Develop the building blocks of design thinking such as empathize, ideate, prototyping, testing and validation for real-time applications.
- To apply the concepts of design thinking concepts to IoT
- To provide skills on the applications of product design.

**Course Outcomes:** At the end of the course, the student will be able to

- Write a program of Raspberry Pi/Arduino for IoT applications
- Understand the relationship between IoT, Cloud services and Software agents
- Explain the troubleshooting methods in IoT based systems
- Apply the design thinking concepts to any type of IoT based applications
- Define a problem statement by conducting the survey
- Design a creative solution for a specified problem.

**Module 1**

Introduction to Micro Controllers:

Exp 1: Programming of Raspberry Pi3 / Arduino.

Exp 2: Peripheral interfacing to the microcontroller.

**Module 2**

Introduction and applications of IoT , Cloud services &amp; Software Agents:

Exp 1: Trace the relationship between IoT, Cloud services and Software agents.

Exp 2: Troubleshooting the microcontroller-based systems (IoT based systems or Products).

**Module 3**

Introduction to Design &amp; Concepts of IoT: Using the concepts of IoT, Implement the 5 stages (Empathize, Define, Prototype, Ideate, Test) of Design thinking for the following

Exp 1: Measurement of temperature and humidity (whether monitoring).

Exp 2: Soil monitoring (Temperature, Humidity, Phosphorus, Zinc, Iron) / Crop Monitoring.

Exp 3: Design of automatic car wiper for rain sensing

Exp 4: Intelligent transportation system

Exp 5: Vehicle monitoring system

Exp 6: Traffic monitoring and control

Exp 7: Design a device for Fleet and driver management.

Exp 8: Smart lighting system

Exp 9: Smart parking systems

Exp 10: Development of Smart cities

Exp 11: Measurement of water level

**Module 4:**

Conduct survey and identify the problem on the above experiments, either individual/group and to avail problem statement for further development.

**Module 5:**

With the help of problem statement in experiment 6, draw product/system after applying CREATE (Combine, Rearrange, Enhance, Adapt, Turn around, Eliminate) Tool.

**Module 6:**

Story boarding of design ideas to transform ,‘information about needs‘ into design concepts.

**References:**

1. Jeff Cicolani, Beginning Robotics with Raspberry Pi and Arduino, Apress, 2018.
2. Martin Bates, Interfacing PIC Microcontrollers, Embedded Design by Interactive Simulation, Elsevier Science, 2013.
3. Yasser Ismail, Internet of Things (IoT) for Automated and Smart Applications, IntechOpen, 2019.

4. Manish K Patel, The 8051 Microcontroller Based Embedded Systems, McGraw Hill Education (India), 2014.
5. Robin E Bentley, Handbook of Temperature Measurement: Temperature and Humidity measurement, Volume 1, Springer, 1998.
6. Charles Bell, Beginning Sensor Networks with Arduino and Raspberry Pi, Apress, 2014.
7. Julian Happian-Smith, An Introduction to Modern Vehicle Design, Butterworth-Heinemann, 2001.
8. Susan McCahan, Phil Anderson, Mark Kortschot, Peter E. Weiss, Kimberly A. Woodhouse, Designing Engineers: An Introductory Text, Wiley, 2015.

**Online Learning Resources/Virtual Labs:**

1. <https://www.youtube.com/watch?v=IZKpCz6LEdg>
2. <https://www.youtube.com/watch?v=QZSY7lnp3zg>
3. [https://www.youtube.com/watch?v=nh5x\\_H\\_Iko](https://www.youtube.com/watch?v=nh5x_H_Iko)
4. <https://www.youtube.com/watch?v=2rGaz1C0COU>
5. <https://www.youtube.com/watch?v=r-BtrSznwTg>
6. <https://www.youtube.com/watch?v=OnjX009dPMc>
7. <https://www.youtube.com/watch?v=UeSKdGzXY18>
8. [https://www.youtube.com/watch?v=EE7\\_26bq7Tg](https://www.youtube.com/watch?v=EE7_26bq7Tg)
9. <https://www.youtube.com/watch?v=ktJ5gRkF7og>
10. <https://www.youtube.com/watch?v=nVhL0cv5a5s>
11. <https://www.youtube.com/watch?v=9BpBbIk7E1Y>
12. <https://www.youtube.com/watch?v=tKJZxsEeVzk>
13. <https://www.youtube.com/watch?v=euZkv0wJBiM>
14. <https://www.youtube.com/watch?v=qyoZTUGzdGY>



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME) – III-I Sem**

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**20A99201 ENVIRONMENTAL SCIENCE**  
 (Common to All Branches of Engineering)

**Course Objectives:**

- To make the students to get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life
- To save earth from the inventions by the engineers.

**Course Outcomes (CO):**

At the end of the course, the student will be able to

- Grasp multidisciplinary nature of environmental studies and various renewable and nonrenewable resources.
- Understand flow and bio-geo- chemical cycles and ecological pyramids.
- Understand various causes of pollution and solid waste management and related preventive measures.
- About the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation.
- Casus of population explosion, value education and welfare programmes.

**UNIT - I****8 Hrs**

**Multidisciplinary Nature Of Environmental Studies:** – Definition, Scope and Importance – Need for Public Awareness.

**Natural Resources :** Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

**UNIT - II****12 Hrs**

**Ecosystems:** Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

- a. Forest ecosystem.
- b. Grassland ecosystem
- c. Desert ecosystem
- d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**Biodiversity And Its Conservation :** Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

**UNIT - III****8 Hrs**

**Environmental Pollution:** Definition, Cause, effects and control measures of :

- a. Air Pollution.
- b. Water pollution
- c. Soil pollution
- d. Marine pollution
- e. Noise pollution
- f. Thermal pollution
- g. Nuclear hazards

**Solid Waste Management:** Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

**UNIT - IV**

**10 Hrs**

**Social Issues and the Environment:** From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

**UNIT - V**

**8 Hrs**

**Human Population And The Environment:** Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

**Field Work:** Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc..

**Textbooks:**

1. Text book of Environmental Studies for Undergraduate Courses ErachBharucha for University Grants Commission, Universities Press.
2. Palaniswamy, “Environmental Studies”, Pearson education
3. S.AzeemUnnisa, “Environmental Studies” Academic Publishing Company
4. K.Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd.

**Reference Books:**

1. Deeksha Dave and E.Sai Baba Reddy, “Textbook of Environmental Science”, Cengage Publications.
2. M.Anji Reddy, “Text book of Environmental Sciences and Technology”, BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”, Prentice hall of India Private limited
5. G.R.Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering and Science, Prentice hall of India Private limited.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– III-II Sem**

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**(20A03601) DYNAMICS OF MACHINERY**

**Course Objectives:**

- Analysis of forces acting in mechanisms
- Effects of unbalance forces
- Modelling and analyzing the vibration behaviour of spring mass damper system
- The principles in mechanisms used for governing of machines

**Course Outcomes:** At the end of the course, the student will be able to

- Determine the forces acting on various linkages when a mechanism is subjected to external forces.
- Identify and correct the unbalances of rotating body
- Analyze the vibratory motion of SDOF systems.
- Reduce the magnitude of vibration and isolate vibration of dynamic systems
- Determine dimensions of Governors for speed control.

**UNIT I Friction and Power Screws**

Friction: Inclined plane, friction of screws and nuts, pivot and collar, uniform pressure, uniform wear. Friction circle and friction axis, lubricated surfaces, boundary friction, film lubrication.

Power screws: Forms of threads, self locking of screws, efficiency of different screws, Square, trapezoidal, screw threads.

**UNIT II Precession, Turning Moment Diagram and Fly Wheel**

Precession: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motorcycle, aeroplanes and ships.

Turning Moment Diagrams and Fly Wheels: Turning moment diagrams for steam engine, IC Engine and multi cylinder engine. Crank effort - coefficient of Fluctuation of energy, coefficient of Fluctuation of speed – Fly wheels and their design, Fly wheels for Punching machines.

**UNIT III Governors**

Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung governors with auxiliary springs. Sensitiveness, isochronism and hunting. Effort and power of a governor.

**UNIT IV Balancing**

Balancing: Balancing of rotating masses - single and multiple – single and different planes.

Balancing Of Reciprocating Masses: Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples – V-engine, multi cylinder inline and radial engines for primary and secondary balancing.

**UNIT V Vibration**

Free and forced vibration of single degree of freedom system, Role of damping, whirling of shafts and critical speeds. Simple problems on free, forced and damped vibrations. Vibration Isolation & Transmissibility. Transverse vibrations of beams with concentrated and distributed loads. Dunkerly's method, Raleigh's method. Torsional vibrations - two and three rotor systems.

**Textbooks:**

1. S.S. Rattan, Theory of Machines, MGH Publishers, 3/e, 2013.
2. R.L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2017.

**Reference Books:**

1. Thomas Bevan, Theory of machines, Pearson, 3/e, 2012.
2. J.E. Shigley, The theory of machines and mechanisms, McGraw hill, 2/e, 1995.
3. R.S. Khurmi, J.K. Gupta, Theory of machines S.Chand publications, 2005.

**Online Learning Resources:**

- <https://nptel.ac.in/courses/112104114>
- <https://nptel.ac.in/courses/112101096>
- [https://archive.org/details/NPTEL-MechEngr-Dynamics\\_of\\_Machines](https://archive.org/details/NPTEL-MechEngr-Dynamics_of_Machines)
- <https://www.youtube.com/watch?v=OIZXxPVpmBs>
- <https://www.digimat.in/nptel/courses/video/112104114/L01.html>

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– III-II Sem

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## (20A03602) FINITE ELEMENT METHODS

**Course Objectives:**

- Familiarize basic principles of finite element analysis procedure.
- Explain theory and characteristics of finite elements that represent engineering structures.
- Apply finite element solutions to structural, thermal, dynamic problem.
- Learn to model complex geometry problems and solution techniques.

**Course Outcomes:** Upon successful completion of this course you should be able to

- Understand the concepts behind variational methods and weighted residual methods in FEM.
- Identify the application and characteristics of FEA elements such as bars, beams, and isoparametric elements, and 3-D element.
- Develop element characteristic equation procedure and generation of global stiffness equation will be applied.
- Able to apply Suitable boundary conditions to a global structural equation, and reduce it to a solvable form.
- Able to identify how the finite element method expands beyond the structural domain, for problems involving dynamics, heat transfer and fluid flow.

**UNIT I Introduction to finite element methods**

Introduction to finite element methods for solving field problems, applications, Stress and equilibrium, Boundary conditions, Strain-Displacement relations, Stress- strain relations for 2D and 3D Elastic problems. Potential energy and equilibrium, Rayleigh-Ritz method, Formulation of Finite Element Equations.

**One dimensional Problems:** Finite element modelling of 1D bar elements coordinates and shape functions. Requirements for Convergence and Interpolation functions, Pascal's Triangle, Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

**UNIT II 1D Analysis of Trusses and Beams**

**Analysis of trusses:** Stiffness Matrix for 1D truss element, Stress Calculations and Problems with maximum of three elements.

**Analysis of beams:** Element Stiffness Matrix and Load vector for 1 D beam element, Hermite shape functions and simple problems.

**UNIT III 2D Analysis**

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of load Vector, Stresses.

Finite element modeling of Axi-symmetric solids subjected to axi-symmetric loading with triangular elements.

**UNIT IV Quadrilateral Elements & Thermal Analysis**

**Quadrilateral Elements:** Isoparametric, Sub parametric and Super parametric elements, Modelling of 4 noded and 8 noded quadrilateral elements and simple problems. Numerical Integration.

**Steady state heat transfer analysis:** One dimensional analysis of composite slab and fin.

**UNIT V Dynamic analysis**

Analysis of a 1D uniform shaft subjected to torsion – Simple problems

**Dynamic analysis:** Formulation of finite element model, element – mass matrices, evaluation of Eigen values and Eigen vectors for a bar and shaft.

**Textbooks:**

1. T. Chandraputla, Ashok Belegundu, Introduction to Finite Element in Engineering, Pearson Publications, 4/e, 2011.
2. S.S.Rao, The Finite Element Methods in Engineering, Elsevier Butterworth -Heinemann, 2/e, 2011.
3. S.Md.Jalaludeen, Finite Element Analysis in Engineering, 2/e, Anuradha Publications, 2016.

**Reference Books:**

1. J N Reddy, An introduction to the Finite Element Method, McGraw – Hill, New York, 1993.

2. R D Cook, D S Malkus and M E Plesha, Concepts and Applications of Finite Element Analysis, 3/e, John Wiley, New York, 1989.
3. K J Bathe, Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs, 1982.
4. G.LakshmiNarasaiah, Finite Element Analysis, 1/e, B.S. Publications, 2008.
5. O C Zienkiewicz and R L Taylor, the Finite Element Method, 3/e. McGraw-Hill, 1989.

**Online Learning Resources:**

- <https://nptel.ac.in/courses/112/104/112104193/>
- <https://nptel.ac.in/courses/112/104/112104205/>
- <https://nptel.ac.in/courses/105/105/105105041/>
- <https://nptel.ac.in/courses/112/106/112106130/>
- <https://nptel.ac.in/courses/112/103/112103295/>

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– III-II Sem

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## (20A03603) HEAT TRANSFER

**Course Objectives:**

- To impart the basic laws of conduction, convection and radiation heat transfer and their applications
- To familiarize the convective heat transfer concepts
- To explain basics of radiation heat transfer
- To make conversant with the heat transfer analysis related to thermal systems like heat exchangers, evaporator, and condenser.

**Course Outcomes:**

At the end of the course, the student will be able to

- Apply the concepts of different modes of heat transfer. (L3)
- Apply knowledge of conduction heat transfer in the design of insulation of furnaces and pipes. (L3)
- Analyse free and forced convection phenomena in external and internal flows. (L4)
- Design of thermal shields using the concepts of black body and non-black body radiation. (L5)
- Apply the basics of mass transfer for applications in diffusion of gases. (L3)

**UNIT I****Introduction**

Basic modes of heat transfer- rate equations- generalized heat conduction equation-various forms - steady state heat conduction solution for plane and composite slabs - cylinders - critical thickness of insulation- heat conduction through fins of uniform cross section- fin effectiveness and efficiency.

**Unsteady State Heat Transfer Conduction-** Transient heat conduction- lumped system analysis and use of Heisler charts.

**UNIT II****Convection**

**Convection:** Basic concepts of convection–heat transfer coefficients - types of convection –forced convection and free convection.

**Free Convection:** development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for convective heat transfer on plates and cylinders in horizontal and vertical orientation

**Forced convection:** in external flow–concepts of hydrodynamic and thermal boundary layer- use of empirical correlations for flow over plates and cylinders. Fluid friction – heat transfer analogy, approximate solution to laminar boundary layer equation for external flow. Internal flow – Use of empirical relations for convective heat transfer in horizontal pipe flow-problems.

**UNIT III****Boiling and Condensation**

Different regimes of boiling- nucleate, transition and film boiling – condensation – film wise and drop wise condensation-problems.

**UNIT IV****Heat Exchangers**

Types of heat exchangers- parallel flow- counter flow- cross flow heat exchangers- overall heat transfer coefficient- LMTD and NTU methods- fouling in heat exchangers-problems.

**UNIT V**

**Radiation:** Radiation heat transfer – thermal radiation – laws of radiation - Black and Gray bodies – shape factor-radiation exchange between surfaces - Radiation shields - Greenhouse effect- simple problems.

**Mass Transfer:** Conservation laws and constitutive equations - Fick's law of diffusion, isothermal equi-mass - Equimolar diffusion- - diffusion of gases and liquids- mass transfer coefficient.

**Textbooks:**

1. P.K. Nag, Heat Transfer, 3/e, Tata McGraw-Hill, 2011.
2. J.P.Holman, Heat Transfer, 9/e, Tata McGraw-Hill, 2008.
3. [S. C. Arora](#) & [S. Domkundwar](#) , A Course in Heat and Mass Transfer, Dhan pat Rai & CO.(P) LTD-Delhi , 2007.
4. R.C.Sachdeva, Fundamentals of Engineering Heat & Mass transfer, New Age International Publishers, 2017.

**Reference Books:**

1. F. P. Incropera and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, 6/e, John Wiley, 2007.
2. Cengel. A.Yunus, Heat Transfer- A Practical Approach, 4/e, Tata McGraw-Hill, 2007.
3. S.P. Sukhatme, A Text book of Heat Transfer, Universities Press, 2005
4. Lienhard and Lienhard, A Heat and Mass Transfer, Cambridge Press, 2011.
5. C.P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer data book, New Age Publications, 2014.
6. Er.R.K.Rajput, A Text book of Heat & Mass Transfer, S.Chand publishers,1/e,2018.

**Online Learning Resources:**

- <https://ocw.mit.edu/courses/mechanical-engineering/2-051-introduction-to-heat-transfer-fall-2015/>
- <https://www.udemy.com/topic/heat-transfer/>
- <https://www.youtube.com/watch?v=TWTQx3W-2k8>
- [https://onlinecourses.nptel.ac.in/noc20\\_ch21/preview](https://onlinecourses.nptel.ac.in/noc20_ch21/preview)
- <https://ekeeda.com/degree-courses/mechanical-engineering/heat-transfer>
- <https://www.coursera.org/lecture/thermodynamics-intro/02-04-heat-transfer-gyDfJ>
- <https://www.youtube.com/watch?v=cjJ2LV5lkB8>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– III-II Sem**

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**(20A03604a) NON-DESTRUCTIVE TESTING (NDT)**  
**(Professional Elective – II)**

**Course Objectives:**

- Introduce basic concepts of non-destructive testing.
- Familiarize with characteristics of ultrasonic test, transducers, rejection and effectiveness.
- Describe concept of liquid Penetrant, eddy current and magnetic particle tests, its applications and limitations.
- Explain the principles of infrared and thermal testing, applications and honey comb and sandwich structures case studies.

**Course Outcomes:**

At the end of the course, student will be able to

- Explain various methods of non-destructive testing.
- Apply relevant non-destructive testing method different applications.
- Explain the applications of railways, nuclear and chemical industries.
- Outline the limitations and disadvantages of nde.
- Explain the applications of NDA of pressure vessels, casting and welding constructions

**UNIT - I Introduction to non-destructive testing 8 Hrs**

**Introduction to non-destructive testing:** Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography.

**UNIT - II Ultrasonic test 8 Hrs**

**Ultrasonic test:** Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect , Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

**UNIT - III Liquid penetrant, Eddy Current & Magnetic Particle Test 10 Hrs**

**Liquid Penetrant Test:** Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing.

**Eddy Current Test:** Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current-Testing Effectiveness of Eddy Current Testing.

**Magnetic Particle Test:** Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

**UNIT - IV Infrared & Thermal Testing 8 Hrs**

**Infrared And Thermal Testing:** Introduction and fundamentals to infrared and thermal testing–Heat transfer –Active and passive techniques –Lock in and pulse thermography–Contact and non contact thermal inspection methods–Heat sensitive paints –Heat sensitive papers –thermally quenched phosphors liquid crystals –techniques for applying liquid crystals –other temperature sensitive coatings –Inspection methods –Infrared radiation and infrared detectors–thermo mechanical behavior of materials–IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures–Case studies.

**UNIT - V Industrial Applications of NDE: 8 Hrs**

**Industrial Applications of NDE:** Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions.

Textbooks:

1. J Prasad, GCK Nair ,Non destructive test and evaluation of Materials, Tata mcgraw-Hill Education Publishers, 2008.
2. Josef Krautkrämer, Herbert Krautkrämer, Ultrasonic testing of materials, 3/e, Springer-Verlag, 1983.
3. X. P. V. Maldague, Non destructive evaluation of materials by infrared thermography, 1/e, Springer-Verlag, 1993.

**Reference Books:**

1. Gary L. Workman, Patrick O. Moore, Doron Kishoni, Non-destructive, Hand Book, Ultrasonic Testing, 3/e, Amer Society for Nondestructive, 2007.
2. ASTM Standards, Vol 3.01, Metals and alloys.

**Online Learning Resources:**

- <http://www.twivirtualacademy.com/online-courses/ndt/>
- <https://www.classcentral.com/course/swayam-theory-and-practice-of-non-destructive-testing-9872>
- [https://onlinecourses.nptel.ac.in/noc20\\_mm07/preview](https://onlinecourses.nptel.ac.in/noc20_mm07/preview)
- <https://www.youtube.com/watch?v=dyMR58TZMbo>
- <https://www.youtube.com/watch?v=Wam-Ewcn3aQ>
- [https://www.iare.ac.in/sites/default/files/lecture\\_notes/IARE\\_NDT\\_LECTURE\\_NOTES.pdf](https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_NDT_LECTURE_NOTES.pdf)
- <https://lecturenotes.in/subject/390/non-destructive-testing>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– III-II Sem** **L T P C**  
**3 0 0 3**  
**(20A03604b) PRODUCTION AND OPERATIONS MANAGEMENT**  
**(Professional Elective – II)**

**Course Objectives:**

At the end of the course, the student will be able to learn

- Introduction to the technical design and manufacturing operations and supply management to the sustainability of an enterprise.
- Need for forecasting and types of forecasting.
- Import the basic principles of project management and other business functions such as value engineering, purchasing, marketing, finance etc.
- Analyze the new demands of the globally competitive business environment that supply chain managers face today.
- Knowledge on various scheduling algorithms applicable to single machine, parallel machines, flow shop and job shop models.

**Course Outcomes:**

At the end of the course, the student will be able to

- Demonstrate the operations and supply management to the sustainability of an enterprise
- Identify the need for forecasting and understand different forecasting methods
- Identify various production and plant layouts
- Examine the quality control of the production
- Apply Just in Time (JIT) basic principles and applications
- Recommend the production schedule for productivity
- Design, analyze and implement single machine, parallel machine, flow shop and job shop scheduling algorithms

**UNIT - I Introduction**

10 Hours

**Introduction:** Operations Management – Definition, Objectives, Types of Production System, Difference between OM & PM, Historical Development of Operations Management, Current Issues in Operation Management, Product Design – Requirements of Good Product Design, Product Development – Approaches, Concepts in Product Development, Standardization, Simplification, Speed to Market, Introduction to Concurrent Engineering.

**UNIT - II Forecasting:**

8 Hours

**Forecasting:** Introduction, Statistical Forecasting Techniques, Moving Average,

Exponential Smoothing Technique, Errors in Forecasting and Evaluation of Forecasting Techniques.

**UNIT - III Value Engineering and Plant Layout:**

8 Hours

**Value Engineering and Plant Layout:** Value Engineering – Objectives, Types of Values,

Function and Cost, Product Life Cycle, Steps in Value Engineering, Methodology in Value Engineering, FAST Diagram and Matrix Method. Facility Location and Layout – Factor

Considerations in Plant Location, Comparative Study of Rural and Urban Sites, Methods of

Selection of Plant Layout, Objectives of Good layout, Principles, Types of Layout, Line

Balancing



**UNIT - IV Aggregate Planning and MRP:**

8 Hours

**Aggregate Planning and MRP:** Aggregate Planning – Definition, Different Strategies, Various Models of Aggregate Planning- Transportation and Graphical Models, Master scheduling, Material Requirement Planning(MRP)- Terminology, Types of Demands, Inputs to MRP, Techniques of MRP, Lot Sizing Methods, Benefits and Drawbacks of MRP, Manufacturing Resources Planning (MRP II), Just in Time (JIT) Philosophy, Kanban System, Calculation of Number of Kanbans, Pull Systems vs. Push Systems, Requirements for Implementation of JIT, JIT Production Process, Benefits of JIT.

**UNIT - V Scheduling:**

8 Hours

**Scheduling:** Policies, Types of Scheduling, Scheduling Strategies, Scheduling and Loading Guidelines, Forward and Backward Scheduling, Gantt Charts, Priority Decision Rules, Flow Shop Scheduling, Job Shop Scheduling, Line of Balance.

**Textbooks:**

1. Buffa E.S. and Sarin R.K., Modern Production / Operations Management, 8<sup>th</sup> Edition, Wiley India Pvt. Ltd., New Delhi, 2009.
2. Joseph G. Monks, Operations Management-Theory and Problems, 3<sup>rd</sup> Edition, McGraw Hill Education, 1987.

**Reference Books:**

1. James L. Riggs, Jim Rigs, Production Systems: Planning, Analysis and Control, 4<sup>th</sup> Edition, Wave Land Press, 1992.
2. Chary S.N., Production and Operations Management, 5<sup>th</sup> Edition, McGraw Hill Education, 2017.
3. Richard B.Chase, Ravi Shankar, Robert Jacobs F., Operations and Supply Chain Management, 15<sup>th</sup> Edition, McGraw Hill Education, 2018.
4. Pannerselvam R., Production and Operations Management, 3<sup>rd</sup> Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
5. Steven Nahmias, Tava Lennon Olsen, Production and Operation Analysis: Strategy – Quality – Analytics – Applications, 7<sup>th</sup> Edition, Waveland Press Inc., 2015.

**Online Learning Resources:**

- [https://www.vssut.ac.in/lecture\\_notes/lecture1429900757.pdf](https://www.vssut.ac.in/lecture_notes/lecture1429900757.pdf)
- <https://lecturenotes.in/subject/100/production-and-operation-management>
- <https://www.studocu.com/in/document/guru-gobind-singh-indraprastha-university/production-operations-management/full-unit-1-lecture-notes-6/3528988>
- [https://mrcet.com/downloads/digital\\_notes/ME/III%20year/POM%20NOTES.pdf](https://mrcet.com/downloads/digital_notes/ME/III%20year/POM%20NOTES.pdf)
- [https://www.iare.ac.in/sites/default/files/lecture\\_notes/IARE\\_OM\\_NOTES.pdf](https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_OM_NOTES.pdf)
- <https://nptel.ac.in/courses/112107238>
- <https://nptel.ac.in/courses/110107141>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– III-II Sem** **L T P C**  
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**(20A03604c) TOTAL QUALITY MANAGEMENT (TQM)**  
**(Professional Elective – II)**

**Course Objectives:**

- Introduce the students, the basic concepts of Total Quality Management.
- Expose with various quality issues in Inspection.
- Gain Knowledge on quality control and its applications to real time.
- Know the extent of customer satisfaction by the application of various quality concepts.
- Understand the importance of Quality standards in Production.

**Course Outcomes (CO):**

At the end of this course, the student will be able to

- Develop an understanding on quality Management philosophies and frameworks
- Adopt TQM methodologies for continuous improvement of quality
- Measure the cost of poor quality, process effectiveness and efficiency to identify areas for improvement
- Apply benchmarking and business process reengineering to improve management processes.
- Determine the set of indications to evaluate performance excellence of an organization.

**UNIT - I                      Introduction** Lecture Hrs: 10  
**Introduction:** Definition of Quality, Dimensions of Quality, Definition of Total quality management, Quality Planning, Quality costs – Analysis, Techniques for Quality costs, Basic concepts of Total Quality Management.

**UNIT - II                      Historical Review:** Lecture Hrs: 9  
**Historical Review:** Quality council, Quality statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of successful quality leader, Contributions of Gurus of TQM, Case studies.

**UNIT - III                      TQM Principles:** Lecture Hrs:8  
**TQM Principles:** Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment teams, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure Case studies.

**UNIT - IV                      TQM Tools:** Lecture Hrs:9  
**TQM Tools:** Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, The seven tools of quality, Process capability, Concept of Six Sigma, New Seven management tools, Case studies.

**UNIT - V                      Quality Systems:** Lecture Hrs:8  
**Quality Systems:** Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality

System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits, Case Studies.

**Text Books:**

1. Dale H Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2. Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd., 2005.
3. Joel E.Ross , Total Quality Management, Third Eition, CRC Press, 2017.

**Reference Books:**

1. Narayana V and Sreenivasan N.S, Quality Management – Concepts and Tasks, New Age International, 1996.
2. Robert L.Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd, 1993.
3. Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata Mcgraw Hill, 2015
4. Samuel Ho , TQM – An Integrated Approach, Kogan Page Ltd, USA, 1995.

**Online Learning Resources:**

- <https://www.youtube.com/watch?v=VD6tXadibk0>
- <https://www.investopedia.com/terms/t/total-quality-management-tqm.asp>
- <https://blog.capterra.com/what-is-total-quality-management/>
- <https://nptel.ac.in/courses/110/104/110104080/>
- [https://onlinecourses.nptel.ac.in/noc21\\_mg03/preview](https://onlinecourses.nptel.ac.in/noc21_mg03/preview)
- <https://nptel.ac.in/courses/110/104/110104085/>
- <https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-mg39/>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– III-II Sem**

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**(20A03606) COMPUTER AIDED DESIGN LABORATORY**

**Course Objectives:**

- To use the commercial Finite Element packages to build Finite Element models and solve a selected range of engineering problems.
- To validate a Finite Element model using a range of techniques.
- To communicate effectively in writing to report (both textually and graphically) the method used, the implementation and the numerical results obtained.
- To discuss the accuracy of the Finite Element solutions.

**Course Outcomes**

- Ability to solve engineering problems using the commercial software's such as ANSYS, SIMUFACT, ABAQUS, SIMULIA, Mathematical, MAT LAB, GNU Octave, Scilab, MAPLE/ COMSOL.

**List of Experiments:**

Finite Element Analysis using Simulation package for different structures. The discretization can be done with 1-D, 2-D & 3-D elements to perform the following analysis for post processing:

**1. Static Analysis**

- a. Stress analysis of 2D truss.
- b. Stress analysis of a plate with a circular hole and L-Bracket – 2D and 3D
- c. Stress analysis of beams (cantilever, simply supported & fixed ends)
- d. Stress analysis of an axi-symmetric component
- e. Torsion based Problem

**2. Thermal Analysis**

- a. Conductive heat transfer analysis of a 2D and 3D components
- b. Conduction and Convective heat transfer analysis of a 2D component
- c. Heat transfer rate of a composite wall
- d. Coupled field analysis of a component

**3. Modal Analysis**

- a. Mode frequency analysis of a 2D component
- b. Mode frequency analysis of beams (cantilever, simply supported)

**Note: Students should practice the above problems with combinations of ANSYS, Octave, Scilab, MATLAB/ Mathematica, MAPLE/COMSOL etc. based on the available software's of either licensed or freeware. Staff can make use of Freeware in solving the FEA Problems with different combination of simulation packages.**

**References:**

1. Nitin S Gokhale and Sanjay Deshpande, Practical Finite Element Analysis, Finite to Infinite Publishers, 1/e, 2008.
2. Joe Stefanelli, Finite Element Analysis in Practice-Instructor Manual, Auto-desk, 2010.
3. J.M. Ferreira, MATLAB codes for Finite Element Method", Springer Publications, 2020.
4. Heinrich, Juan C., Pepper, Darrell W, The finite element method: basic concepts and applications with MATLAB, MAPLE, and COMSOL.,CRC Press, 3/e, 2017.

**Online Learning Resources/Virtual Labs:**

- <https://www.youtube.com/watch?v=1gamqpyZjTg>
- <https://www.youtube.com/watch?v=4c-sPXoID0w>
- <https://www.youtube.com/watch?v=XS YRnEfPMqA>
- <https://au.mathworks.com/discovery/finite-element-analysis.html>
- [https://w3.pppl.gov/m3d/reference/fsem\\_intro.pdf](https://w3.pppl.gov/m3d/reference/fsem_intro.pdf)
- [https://www.youtube.com/watch?v=WXKUCky9CtA&list=PL3YYYtsmbXgdRoY27y3ZEjF5qE7YYeX\\_I](https://www.youtube.com/watch?v=WXKUCky9CtA&list=PL3YYYtsmbXgdRoY27y3ZEjF5qE7YYeX_I)
- <https://www.youtube.com/watch?v=n3FDQqrRjQa>
- [https://www.youtube.com/watch?v=oHYVzAih\\_VM](https://www.youtube.com/watch?v=oHYVzAih_VM)

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– III-II Sem

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## (20A03607) COMPUTER AIDED MANUFACTURING LABORATORY

**Course Objectives:**

- To get practical knowledge on manual part programming of CNC lathe machine by using G codes and M codes.
- To get practical knowledge on manual part programming of CNC milling and drilling machine by using G codes and M codes.
- To get the practical knowledge on APT language.
- To get practical application of Industrial Robots

**Course Outcomes:** Upon successful completion students should be able to:

- Use and understanding of Preparatory and Miscellaneous (G& M) codes to generate or edit a program which will operate a CNC Lathe/ Milling and Drilling.
- Apply mathematical methods to calculate World/ Joint/ Tool coordinates in robotics.
- Apply the programming concepts of Robots for simple applications in material handling and assembly

**List of Experiments:**

1. Manual part programming (using G and M codes) in CNC Lathe Machine:
  - a. Part programming for linear interpolation, circular interpolation, chamfering and grooving.
  - b. Part programming by using standard Canned cycles for facing, turning, taper turning and thread cutting, Chess Bishop profile
  - c. Multiple turning operations which cover all lathe operations covering maximum G codes and M codes
2. Manual part programming (using G and M codes) in CNC Milling Machine:
  - a. Part programming for linear interpolation, circular interpolation and contour motions.
  - b. Part programming involving Canned cycles for drilling, Peck drilling and boring and pocketing & Mirroring.
  - c. Part programming for Gear cutting profile
3. APT (Automatically Programmed Tools) Language-Cutting tool path generation by using any CAM simulation package / Experiment for different machining operations.
  - a. APT Lathe Programming's – 2 Experiments
  - b. APT Milling Programming's - 2 Experiments
4. Robotics: By using 5 or 6 – Axis robot
  - a. Pick and Place with palletizing/ de-palletizing of components
  - b. Nut, Bolt and Washer Assembly with robot.

**References:**

1. P Radhakrishnan, Computer Numerical Control (CNC) Machines, New Central Book agency, 2013.
2. S.R.DEB, Robotics Technology and Flexible Automation, McGraw Hill Education, 2017.
3. CHAO- HWA CHANG and MICHEL. A. MELKANOFF, NC Machine Programming and software Design, Prentice Hall Publishers, 1989.

**Online Learning Resources/Virtual Labs:**

- <https://www.youtube.com/watch?v=NCEHRvFQqMo>
- [https://www.youtube.com/watch?v=Gwy\\_Vh46fCM](https://www.youtube.com/watch?v=Gwy_Vh46fCM)
- <https://www.youtube.com/watch?v=0sxLwytzT2Y>
- <https://www.youtube.com/watch?v=rgZT3RtfUqA>
- <https://www.youtube.com/watch?v=osqX7iQEnuI>
- <https://www.youtube.com/watch?v=-F0i1LDk2XI>
- <https://www.youtube.com/watch?v=i-PgeWbDgq4>
- <https://www.youtube.com/watch?v=sJm1Nyb-AkE>
- <https://www.youtube.com/watch?v=UxO0xqvGcM>
- <https://www.youtube.com/watch?v=Ic-iKGS7dk>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– III-II Sem**

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**(20A03603P) HEAT TRANSFER LAB**

**Course Objectives:**

Students undergoing this course would

- Understand different modes of heat transfer
- Gain knowledge about natural and forced convection phenomenon
- Estimate experimental uncertainty in measurements

**Course Outcomes:**

Upon the successful completion of course, students will be able to

- Explain different modes of heat transfer
- Identify parameters for measurement for calculating heat transfer
- Determine effectiveness of heat exchanger
- Design new equipment related to heat transfer
- Apply principles of heat transfer in wide application in industries.

**List of Experiments:**

1. Determine the overall heat transfer coefficient across the width of composite wall
2. Determine the thermal conductivity of a metal rod
3. Determine the thermal conductivity of insulating powder material through concentric sphere apparatus
4. Determine the thermal conductivity of insulating material through lagged pipe apparatus
5. Determine the efficiency of a pin fin in natural and forced convection.
6. Determine the heat transfer coefficient for a vertical cylinder in natural convection
7. Determine the heat transfer coefficient in forced convection of air in a horizontal tube.
8. Determine the heat transfer coefficients on film and drop wise condensation apparatus.
9. Determine the effectiveness of a parallel and counter flow heat exchanger.
10. Study the pool boiling phenomenon and different regimes of pool boiling.
11. Experiment on pool boiling
12. Determine the emissivity of the test plate surface.
13. Experiment on Stefan-Boltzmann apparatus
14. Determine the heat transfer rate coefficient in fluidized bed apparatus.

**Virtual Lab:-**

1. Determination of thermal conductivity of a metal rod  
<https://sites.google.com/view/vlab-bnmitmech/home/heat-transfer-lab/determination-of-thermal-conductivity-of-a-metal-rod>
2. Natural Convection heat transfer  
<https://sites.google.com/view/vlab-bnmitmech/home/heat-transfer-lab/natural-convection>
3. Heat Transfer by Radiation  
<https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=802&cnt=1>
4. Heat transfer by Conduction  
<https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=801&cnt=1>
5. The Study of phase change  
<https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=709&cnt=1>
6. Black Body Radiation: Determination of Stefan's Constant  
<https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=548&cnt=1>
7. Newton's Law of Cooling  
<https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=354&cnt=1>
8. Lee's Disc Apparatus  
<https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=353&cnt=1>
9. Thermo Couple-Seebeck Effect
10. <https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=351&cnt=1>

**References:**

1. Abdul Matheen, Heat Transfer Laboratory Manual, Laxmi Publications; 2/e, 2007.

**Online Learning Resources/Virtual Labs:**

- <https://sites.google.com/view/vlab-bnmitmech/home/heat-transfer-lab>
- [https://www.iare.ac.in/sites/default/files/lab1/IARE\\_HT\\_LAB\\_MANUAL.pdf](https://www.iare.ac.in/sites/default/files/lab1/IARE_HT_LAB_MANUAL.pdf)
- [https://mrcet.com/downloads/digital\\_notes/ME/III%20year/\(R18A0388\)Heat%20Transfer%20Lab.pdf](https://mrcet.com/downloads/digital_notes/ME/III%20year/(R18A0388)Heat%20Transfer%20Lab.pdf)
- <https://mrcet.com/downloads/ME/Mech%20III-II.pdf>

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– III-II Sem

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**(20A03608) 3D PRINTING PRACTICE**  
**(Skill Oriented Course-IV)**

**Course Objectives:**

Students undergoing this course would

- Understand different methods of 3D Printing.
- Gain knowledge about simulation of FDM process
- Estimate time and material required for manufacturing a 3D component

**Course Outcomes:**

Upon the successful completion of course, students will be able to

- Explain different types of 3d Printing techniques
- Identify parameters for powder binding and jetting process
- Determine effective use of ABS material for 3D Printing
- Apply principles of mathematics to evaluate the volume of material require.

**Module 1:**

Introduction to Prototyping, Working of 3D Printer, Types of 3D printing Machines:

Exp 1: Modelling of Engineering component and conversion of STL format.

Exp 2: Slicing of STL file and study of effect of process parameter like layer thickness, orientation, and infill on build time using software.

**Exercise 1 : Component-1****Exercise 2 : Component-2****Module 2:**

Exp 1 : 3D Printing of modelled component by varying layer thickness.

Exp 2 : 3D Printing of modelled component by varying orientation.

Exp 3: 3D Printing of modelled component by varying infill.

**Module 3:**

Study on effect of different materials like ABS, PLA, Resin etc, and dimensional accuracy.

**Module 4:**

Identifying the defects in 3D Printed components.

**Module 5**

Exp1: Modelling of component using 3D Scanner of real life object of unknown dimension in reverse engineering.

Exp 2: 3D Printing of above modelled component.

**References:**

1. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1/e, Springer, 2010.
2. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2/e, World Scientific Publishers, 2003.

**Online Learning Resources/Virtual Labs:**

- <https://www.hubs.com/knowledge-base/introduction-fdm-3d-printing/>
- <https://slideplayer.com/slide/6927137/>
- <https://www.mdpi.com/2073-4360/12/6/1334>
- <https://www.centropiaggio.unipi.it/sites/default/files/course/material/2013-11-29%20-%20FDM.pdf>
- <https://lecturenotes.in/subject/197>
- [https://www.cet.edu.in/noticefiles/258\\_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf](https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf)
- [https://www.vssut.ac.in/lecture\\_notes/lecture1517967201.pdf](https://www.vssut.ac.in/lecture_notes/lecture1517967201.pdf)
- <https://www.youtube.com/watch?v=NkC8TNts4B4>



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– III-II Sem** **L T P C**  
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**(20A99601) INTELLECTUAL PROPERTY RIGHTS AND PATENTS**  
**(Mandatory Non-Credit Course)**

**Course Objectives:**

This course introduces the student to the basics of Intellectual Property Rights, Copy Right Laws, Cyber Laws, Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations

**Course Outcomes:**

- Understand IPR law & Cyber law
- Discuss registration process, maintenance and litigations associated with trademarks
- Illustrate the copy right law
- Enumerate the trade secret law.

**UNIT I**

Introduction to Intellectual Property Law – Evolutionary past – Intellectual Property Law Basics – Types of Intellectual Property – Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration – Infringement – Regulatory – Overuse or Misuse of Intellectual Property Rights – Compliance and Liability Issues.

**UNIT II**

Introduction to Copyrights – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works – Rights of Distribution – Rights of performers – Copyright Formalities and Registration – Limitations – Infringement of Copyright – International Copyright Law-Semiconductor Chip Protection Act.

**UNIT III**

Introduction to Patent Law – Rights and Limitations – Rights under Patent Law – Patent Requirements – Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation – International Patent Law – Double Patenting – Patent Searching – Patent Cooperation Treaty – New developments in Patent Law- Invention Developers and Promoters.

**UNIT IV**

Introduction to Trade Mark – Trade Mark Registration Process – Post registration procedures – Trade Mark maintenance – Transfer of rights – Inter parties Proceedings – Infringement – Dilution of Ownership of Trade Mark – Likelihood of confusion – Trade Mark claims – Trade Marks Litigation – International Trade Mark Law.

**UNIT V**

Introduction to Trade Secrets – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreement – Trade Secret Law – Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law. Introduction to Cyber Law – Information Technology Act – Cyber Crime and E-commerce – Data Security – Confidentiality – Privacy – International aspects of Computer and Online Crime.

**Textbooks:**

1. Deborah E.Bouchoux: “Intellectual Property”. Cengage learning, New Delhi
2. Kompal Bansal & Parishit Bansal “Fundamentals of IPR for Engineers”, BS Publications (Press)
3. Cyber Law. Texts & Cases, South-Western’s Special Topics Collections

**References:**

1. Prabhuddha Ganguli: ‘ Intellectual Property Rights’ Tata Mc-Graw – Hill, New Delhi
2. Richard Stim: “Intellectual Property”, Cengage Learning, New Delhi.
3. R. Radha Krishnan, S. Balasubramanian: “Intellectual Property Rights”, Excel Books. New Delhi.
4. M. Ashok Kumar and Mohd. Iqbal Ali: “Intellectual Property Right” Serials Pub.

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– IV-I Sem

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**(20A03701a) MODERN MANUFACTURING METHODS  
(Professional Elective-III)**

**Course Objectives:**

- Define various Modern Machining Processes.
- Acquire knowledge in the elementary mechanism and machinability of materials with different Modern Machining Processes.
- Determine basic principles of operation for each process and their applications.
- State various parameters influencing MRR in Non – Traditional Machining Process.
- Classify and understand the working of Additive Manufacturing Processes.

**Course Outcomes:** At the end of the course, the student will be able to

- Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.
- Classify the mechanism of Mechanical Energy based machining processes, its applications and limitations.
- Differentiate Electrical Energy Based machining processes, mechanism of metal removal, machine tool selection.
- Interpret Electro Chemical machining process, economic aspects of ECM and problems on estimation of metal removal rate.

**UNIT I**

**Non – Traditional Machining Processes:** Introduction, Need, Classification and Brief Overview, Considerations in Process selection, Materials, Applications.

**Mechanical Energy Based Processes:** Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultra Sonic Machining – Working Principle, Description of Equipment, Process Parameters, Metal Removal Rate, Applications, Advantages and Limitations.

**UNIT II**

**Electrical Energy Based Processes:** Electric Discharge Machining – Working Principles, Description of Equipment, Process Parameters, Surface Finish and MRR, Electrode / Tool, Power and Control Circuits, Tool Wear, Dielectric Fluid, Flushing, Advantages, Limitations and Applications. Wire cut EDM – Working Principle and Applications.

**UNIT III**

**Chemical and Electro Chemical Energy Based Processes:** Chemical Machining and Electro Chemical Machining – Working Principle, Description of Equipment, Etchants, Maskants, Techniques of Applying Maskants, Process Parameters, Surface Finish and MRR, Electro Chemical Grinding, Electro Chemical Honing, Applications, Advantages and Limitations.

**UNIT IV**

**Thermal Energy Based Processes:** Laser Beam Machining and Drilling, Plasma Arc Machining, Electron Beam Machining – Working Principle, Description of Equipment, Process Parameters, Applications, Advantages and Limitations.

**UNIT V**

**Additive Manufacturing:** Introduction to Additive Manufacturing, Classification of Additive Manufacturing Processes, Working Principle, Advantages, Limitations and Applications of Stereolithography (SLA), Fused Deposition Modeling, Selective Laser Sintering, Laminated Object Manufacturing

**Textbooks:**

1. Jain V.K., Advanced Machining Processes, 1<sup>st</sup> Edition, Allied Publishers Pvt. Ltd., New Delhi, 2007.
2. Pandey P.C and Shan H.S., Modern Machining Processes, 1/e, McGraw Hill, New Delhi, 2007.
3. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1/e, Springer, 2010.

**Reference Books:**

1. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2/e, World Scientific Publishers, 2003.
2. Benedict G.F., Nontraditional Manufacturing Processes, 1/e, CRC Press, 1987.
3. Mishra P.K., Nonconventional Manufacturing, 1/e, Narosa Publishing House, New Delhi, 2014.

4. McGeough J.A., Advanced Methods of Machining, 1/e, Springer, 1988.

**Online Learning Resources:**

- <https://nptel.ac.in/courses/112/107/112107078/>
- [https://youtu.be/t3y\\_Ys3LgGM](https://youtu.be/t3y_Ys3LgGM)
- [https://www.youtube.com/watch?v=E4VZ\\_rFqpG4&t=1s](https://www.youtube.com/watch?v=E4VZ_rFqpG4&t=1s)
- [https://youtu.be/-tcaR7oSx\\_w](https://youtu.be/-tcaR7oSx_w)
- <https://youtu.be/Uybg6VLoRQ>
- <https://youtu.be/Uybg6VLoRQ>
- <https://youtu.be/aWQsEX1TrSI>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– IV-I Sem**

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**(20A03701b) DESIGN FOR MANUFACTURING  
(Professional Elective-III)**

**Course Objectives:**

- Explain the product development cycle and manufacturing issues to be considered in design.
- Familiarize manufacturing consideration in cast, forged, and weld components.
- Describe the manufacture of sheet metal components.
- Impart knowledge plastics as substitution to metallic parts.

**Course Outcomes:** After successful completion of the course, the student will be able to

- Design mechanical components with economical consideration
- Select materials and machining processes
- Identify the necessity for redesigning components out of manufacturing considerations
- Consider the manufacturing considerations while designing cast, forged weld and sheet metal components
- Design plastic parts with manufacturing considerations

**UNIT I Introduction**

**Introduction:** Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design.

**Materials:** Selection of materials for design-developments in material technology-criteria for material selection-material selection interrelationship with process selection-process selection charts.

**UNIT II Machining processes**

Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

**UNIT III Metal Casting and Joining**

**Metal casting:** Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

**Metal joining:** Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

**UNIT IV Forging, Extrusion & Sheet metal work**

**Forging:** Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

**Extrusion & Sheet metal work:** Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

**UNIT V Plastics**

Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

**Textbooks:**

1. George E Dieter and Linda Schmidt, Engineering Design, 4/e, McGraw Hill, 2015.
2. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, 5/e, PHI Learning 2011.
3. David M Anderson, Design for Manufacturability, CRC Press, 2013.

**Reference Books:**

1. James G Bralla, Design For Manufacturability Handbook, 2/e, McGraw Hill, 2004.
2. Dr.P.C.Sharma, Production Technology, S.Chand& Company, 2009.
3. G. Boothroyd, Product Design for Manufacture & Assembly, CRC Press, 3/e, 2010.

**Online Learning Resources:**

- <https://nptel.ac.in/courses/112/101/112101005/>
- [https://www.iare.ac.in/sites/default/files/lecture\\_notes/DFMA\\_Lecture\\_Notes.pdf](https://www.iare.ac.in/sites/default/files/lecture_notes/DFMA_Lecture_Notes.pdf)

- <https://ocw.mit.edu/courses/mechanical-engineering/2-008-design-and-manufacturing-ii-spring-2004/lecture-notes/>
- <https://dokumen.tips/documents/design-for-manufacturing-and-assembly-1-lecture-notes-on-design-for-manufacturing.html>
- <https://www.youtube.com/watch?v=ofmbhbVCUqI>
- [https://onlinecourses.nptel.ac.in/noc21\\_me66/preview](https://onlinecourses.nptel.ac.in/noc21_me66/preview)

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– IV-I Sem

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**(20A03701c) OPERATIONS RESEARCH**  
**(Professional Elective-III)**

**Course Objectives:**

- To impart the basic concepts of modelling, models and statements of the operations research.
- Formulate and solve linear programming problem/situations.
- Model strategic behaviour in different economic situations.
- To solve transportation problems to minimize cost.
- Apply Queuing theory to solve problems of traffic congestion, counters in banks, railway bookings etc.
- Explain scheduling and sequencing of production runs and develop proper replacement policies.

**Course Outcomes:** At the end of the course, the student will be able to

- Develop mathematical models for practical problems. (L3)
- Apply linear programming to transportation problems. (L3)
- Solve games using various techniques. (L3)
- Solve production scheduling and develop inventory policies. (L6)
- Apply optimality conditions for constrained and unconstrained nonlinear problems. (L3)
- Apply dynamic programming methods. (L3)

**UNIT Introduction to OR**

**Introduction to Operations Research (OR):** OR definition - Classification of Models, modeling – Methods of solving OR Models, limitations and applications of OR models

**Linear Programming(LP):** Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Two-Phase Simplex Method, Special Cases of LP- Degeneracy, Infeasibility and Multiple Optimal Solutions; Concept of dual theorem

**UNIT – II Transportation and Assignment Problems**

Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution –North West Corner Rule, Least Cost Method, Vogel's Approximation Method; Optimality Method – Modified Distribution (MODI) Method; Special Cases – Unbalanced Transportation Problem, Degenerate Problem. Assignment Problem – Formulation, Hungarian Method for Solving Assignment Problems, Traveling Salesman problem.

**UNIT – III Game theory & Job Sequencing**

**Game theory:** Optimal solution of two person zero sum games, the max min and min max principle. Games without saddle points, mixed strategies. Reduction by principles of dominance, arithmetic, algebraic method and graphical method.

**Job Sequencing:** Introduction to Job shop Scheduling and flow shop scheduling, Solution of Job Sequencing Problem, Processing of n Jobs through two machines, Processing of n Jobs through m machines, graphical method.

**UNIT – IV Queuing Theory & Inventory Control**

**Queuing Theory:** Introduction – Terminology, Arrival Pattern, Service Channel, Population, Departure Pattern, Queue Discipline, Birth & Death Process, Single Channel Models with Poisson Arrivals, Exponential Service Times with infinite and finite queue length; Multichannel Models with Poisson Arrivals, Exponential Service Times with infinite queue length.

**Inventory Control:** Introduction, Deterministic models – EOQ model with and without shortages, Production model, Buffer stock and discount inventory models with single price breaks. Selective inventory control.

**UNIT – V Replacement and Maintenance Analysis & DP**

**Replacement and Maintenance Analysis:** Introduction – Types of Maintenance, Make or buy decision. Types of Replacement Problems, Determination of Economic Life of an Asset, and Simple Probabilistic Model for Items which completely fail-Individual Replacement Model, Group Replacement Model. **Dynamic**

**Programming (DP):** Introduction –Bellman's Principle of Optimality – Applications of Dynamic Programming – Shortest Path Problem – Capital Budgeting Problem – Solution of Linear Programming Problem by DP.

**Textbooks:**

1. Sharma S.D., Operations Research: Theory, Methods and Applications, 15/e, Kedar Nath Ram Nath, 2010
2. Taha H.A., Operations Research, 9/e, Prentice Hall of India, New Delhi, 2010.

**Reference Books:**

1. Hiller F.S., and Liberman G.J., Introduction to Operations Research, 7/e, Tata McGraw Hill, 2010.
2. Sharma J.K., Operations Research: Theory and Applications, 4/e, Laxmi Publications, 2009.
3. Prem kumar Gupta and Hira, Operations Research, 3/e, S Chand Company Ltd., New Delhi, 2003.
4. Pannerselvam R., Operations Research, 2/e, Pentice Hall of India, New Delhi, 2006.
5. Sundaresan.V, and Ganapathy Subramanian.K.S, Resource Management Techniques: Operations Research, A.R Publications, 2015.

**Online Learning Resources:**

- <http://www2.informs.org/Resources/>
- <http://www.mit.edu/~orc/>
- <http://www.ieor.columbia.edu/>
- <http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm>
- <http://www.wolfram.com/solutions/OperationsResearch/>

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– IV-I Sem

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**(20A03702a) AUTOMOBILE ENGINEERING  
(Professional Elective-IV)**

**Course Objectives:**

- Impart the knowledge of vehicle structure and its components.
- Demonstrate various components of petrol engines and diesel engines.
- Trains about the various electrical system, circuits, and testing of automobiles.
- Explain the concepts of steering, suspension and braking system in automobile.

**Course Outcomes:** After successful completion of this course, the student will be able to

- Identify different parts of automobile
- Explain the working of various parts like engine and brakes
- Describe the working of steering and the suspension systems.
- Summarize the wheels and tires
- Outline the future developments in the automobile industry

**UNIT I Introduction to vehicle structure and engine components**

Vehicle construction - Chassis and body - Specifications - Engine - Types - Construction - Location of engine - Cylinder arrangement - Construction details - Cylinder block - Cylinder head - Cylinder liners - Piston – piston rings - Piston pin - Connecting rod - Crankshaft - Valves. Lubrication system - Types - Oil pumps - Filters. Crankcase ventilation.

**UNIT II Ignition and fuel supply systems**

Ignition system - Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – Unit Injector – Nozzle types - Electronic Fuel Injection system (EFI) – GDI, MPFI, DTSI.

**UNIT – III Steering and suspension system**

Principle of steering - Steering Geometry and wheel alignment - Steering linkages – Steering gearboxes - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers.

**UNIT – IV Wheels, Tyres and Braking System**

Wheels and Tyres - Construction - Type and specification - Tyre wear and causes - Brakes - Needs – Classification – Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders – Anti-lock Braking System(ABS).

**UNIT – V Automobile electrical systems and advances in automobile engineering**

Battery-General electrical circuits- Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program(ESP), Traction Control System (TCS) - Global Positioning System (GPS), Hybrid vehicle, Fuel Cell.

**Textbooks:**

1. Kirpal Singh, Automobile Engineering, Vol.1&2, Standard Publications, 13/e, 2020.
2. William.H.Crouse, Automotive Mechanics, 10/e, McGraw-Hill, 2006.
3. David A. Corolla, Automotive Engineering: Powertrain, Chassis System and Vehicle Body, Butterworth-Heinemann Publishing Ltd, 2009.
4. Richard Stone, Jeffrey K. Ball, Automotive Engineering Fundamentals" SAE International, 2004.

**Reference Books:**

1. Bosch, Automotive Hand Book, 6/e, SAE Publications, 2007.
2. K. Newton and W. Steeds, The motor vehicle, 13/e, Butterworth-Heinemann Publishing Ltd, 1989.
3. Joseph Heitner, Automotive Mechanics Principles and Practices, 2/e, CBS publishing 2004.

**Online Learning Resources:**

- <https://nptel.ac.in/courses/107106088>
- <https://nptel.ac.in/courses/107106080>
- <https://hindustanuniv.ac.in/assets/pdf/ug/CBCS/cbcs-automobile-2018.pdf>



- [https://ed.iitm.ac.in/~shankarram/Course\\_Files/ED5160/ED5160.htm](https://ed.iitm.ac.in/~shankarram/Course_Files/ED5160/ED5160.htm)
- [https://dbatu.ac.in/wp-content/uploads/2020/07/B-Tech-Automobile\\_Final-Yr\\_22.06.2020-1.pdf](https://dbatu.ac.in/wp-content/uploads/2020/07/B-Tech-Automobile_Final-Yr_22.06.2020-1.pdf)
- <https://www.youtube.com/channel/UCGLlbnSTaLNUPhDwsMe-SgQ>

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– IV-I Sem

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**(20A03702b) MECHANICAL VIBRATIONS  
(Professional Elective-IV)**

**Course Objectives:**

- Demonstrate basic concepts and definitions of mechanical vibrations. To write equation of motion for discrete spring-mass systems with different configuration using classical and energy methods.
- To train the students about basic concepts of forced vibrations, vibration transmissibility and isolation and seismic instruments. Further to understand about various vibration control methods.
- To familiarize the students about two degree freedom system and various types of vibration absorbers.
- To analyze the two degree and multi degree of freedom systems.

**Course Outcomes:** After successful completion of the course, the student will be able to

- Find natural frequency of un-damped single degree freedom systems
- Analyze the two degree freedom systems with and without damping
- Calculate transmissibility and isolation
- Solve problems on vibration absorber
- Calculate natural frequencies of multi degree freedom system
- Measure vibration parameters
- Use mechanical exciters and electro dynamic shaker

**UNIT I Single Degree Freedom Systems**

**Single Degree Freedom Systems:** Un-damped free vibration: Classical method, Energy method, equivalent systems, torsional systems. Damped free vibration- Viscous damping, under damping, critical damping, over damping. Coulomb damping, equivalent damping coefficient. Simple problems.

**Whirling of shafts: Transverse vibrations:** Dunkerley's lower bound approximation, Critical speed of shafts.

**UNIT II Forced vibrations of Single Degree Freedom Systems**

Steady state forced vibration, sources of excitation, impressed harmonic force, resonance impressed force due to unbalance, motion excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping.

**UNIT III Two Degree Freedom Systems:**

Formulation of Equation of motion, Natural frequencies and modes of vibration by classical method, coupled pendulum, forced vibration, dynamic vibration absorber.

**UNIT IV Multi Degree Freedom Systems:**

Lagrangian method for formulation of equation of motion Influence co-efficient method, Lumped mass and distributed mass systems, Stodola method, Holzer's method, model analysis of free and forced vibrations.

**UNIT V Vibration measurement and Applications**

Transducers: variable resistance transducers, Piezoelectric transducers, electro dynamic transducers and linear variable differential transformer transducer; Vibration pickups: vibrometer, accelerometer, velometer and phase distortion; Frequency-measuring instruments; Vibration exciters- Mechanical exciters and electro dynamic shaker.

**Textbooks:**

1. Singiresu S. Rao, Mechanical Vibrations, 6/e, Pearson Education, 2018.
2. G.K.Groover, Mechanical Vibrations, Nemchand & Bro, 8/e, 2009.

**Reference Books:**

1. L. Meirovich, Elements of Vibrations Analysis, Tata McGraw Hill, 1986.
2. S. Graham Kelly, Mechanical Vibrations, Tata McGraw Hill, 1996
3. William Thomson, Theory of Vibrations with Applications, 5/e, Pearson, 2008
4. William Weaver, Timeoshenko, and Young, Vibration Problems in Engineering, 5/e, John Wiley, 2013.
5. C. Nataraj, Vibration of Mechanical Systems, 1/e, Cenage Learning, 2012.

**Online Learning Resources:**

- <https://nptel.ac.in/courses/112107212>
- <https://nptel.ac.in/courses/112103111>
- <https://nptel.ac.in/courses/112103112>
- <https://nptel.ac.in/courses/101105081>
- <https://www.iare.ac.in/sites/default/files/PPT/MVSD%20PPT.pdf>
- [https://www.iare.ac.in/sites/default/files/lecture\\_notes/MV\\_LECTURE\\_NOTES.pdf](https://www.iare.ac.in/sites/default/files/lecture_notes/MV_LECTURE_NOTES.pdf)



## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– IV-I Sem

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**(20A03702c) REFRIGERATION AND AIR CONDITIONING**  
(Professional Elective-IV)

**Course Objectives:**

- Provides insights in how thermodynamic principles are applied within the refrigeration and air conditioning industry.
- Introduce the students how real systems used in commercial, industrial refrigeration and air conditioning industries are built-up.
- Expose the students on various refrigeration methods like VCR, VAR and latest developments.
- Know the various air conditioning methods like summer, winter and year round air conditioning and to make the student to understand the practical applications of refrigeration and air conditioning systems.

**Course Outcomes:** At the end the student will be able to

- Appraise the importance of humidifiers and dehumidifiers
- Select the requirements of temperature and humidity for human comfort
- Demonstrate the heat pump working and its components
- List the various air conditioning equipments

**UNIT I****Introduction to Refrigeration**

Necessity and Applications, Carnot Refrigerator, First and Second Law Applied to Refrigerating Machines, Unit of Refrigeration, COP, EER, Different Refrigeration Methods.

**Air Refrigeration:** Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems - Numerical Problems - Refrigeration Needs of Air Crafts.

**UNIT II Vapour Compression Refrigeration ( VCR ) System**

Vapour Compression Refrigeration ( VCR ) System - Basic Cycle - Working Principle and Essential Components of the Plant - COP - Representation of Cycle On T-S and P-h Charts - Expander Vs. Throttling, Effect of Sub Cooling and Super Heating - Cycle Analysis - Actual Cycle- Influence of Various Parameters on System Performance - Construction and Use of P-h Charts - Numerical Problems. Refrigerants - Desirable Properties - Classification of Refrigerants Used - Nomenclature- Secondary Refrigerants- Lubricants - Ozone Depletion - Global Warming- Newer Refrigerants.

**UNIT III Vapor Absorption Refrigeration ( VAR ) System**

**Vapor Absorption Refrigeration ( VAR ) System**-Description and Working of NH<sub>3</sub> - Water System and Li Br - Water ( Two Shell & Four Shell) System -Calculation of Max COP, Principle of Operation of Three Fluid Absorption System

**STEAM JET REFRIGERATION SYSTEM:** Working Principle and Basic Components-Estimation of Motive Steam Required Principle and Operation of: (I) Thermo-Electric Refrigerator (ii) Vortex Tube or Hilsch Tube.

**UNIT IV Introduction to Air Conditioning:**

Psychrometric Properties & Processes - Characterization of Sensible and Latent Heat Loads - Need For Ventilation, Consideration of Infiltrated Air - Heat Load Concepts. Air Cooler (Evaporative Cooling) ,Window, Split, Summer , Winter, Year Round, Central Air Conditioning Systems.

**UNIT V Air Conditioning Equipment**

Air Conditioning Equipment - Humidifiers - Dehumidifiers - Air Filters, Fans and Blowers.

**Human Comfort:** Requirements of Temperature, Humidity And Concept of Effective Temperature, Comfort Chart. Heat Pump - Heat Sources - Different Heat Pump Circuits.

**Textbooks:**

1. Refrigeration and Air Conditioning, C P Arora, TMH, 15/e, 2013.
2. S. C Arora & Domkundwar, A Course in Refrigeration and Air conditioning, Dhanpat rai & Co, 2018.

**Reference Books:**

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age, 2/e, 2013
2. Principles of Refrigeration - Dossat / Pearson Education, 4/e, 2007
3. Refrigeration and Air Conditioning-P.L.Ballaney, 2/e, 2012.
4. Basic Refrigeration and Air-Conditioning - P.N.Ananthanarayanan / TMH, 4/e, 2013.

**NOTE:** Tables/Codes: Thermal Engineering Data Book containing refrigerant and Psychrometric property Tables and charts are permitted in Exam

**Online Learning Resources:**

- [https://www.iare.ac.in/sites/default/files/lecture\\_notes/IARE\\_RAC\\_Lecture\\_Notes.pdf](https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_RAC_Lecture_Notes.pdf)
- <https://www.studocu.com/en-us/document/saint-louis-university/fluid-dynamics-laboratory/refrigeration-lecture-notes-1/3020577>
- <http://home.iitk.ac.in/~samkhan/ME340A.htm>
- <https://nptel.ac.in/courses/112105129>
- <http://dte.karnataka.gov.in/Institutes/gptkampli/GenericDocHandler/68-fc177b7d-f5d1-4580-b577-b1118df994f4.pdf>

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– IV-I Sem

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**(20A03703a) MECHATRONICS AND MEMS**  
**(Professional Elective-V)**

**Course Objectives:**

- Familiarize the technologies behind modern mechatronic systems.
- Explain fundamentals for the development of fully automated system.
- Develop a robotic or automated systems focusing on the hardware and software integration.
- Demonstrate the development of mechatronic system and MEMS.

**Course Outcomes:** At the end the student will be able to

- Demonstrate the knowledge of MEMS
- Classifying different fabrication techniques of MEMS
- Illustrate the application of MEMS in industry

**UNIT I Introduction**

Definition of Mechatronics, Need for Mechatronics in Industry, Objectives of mechatronics, mechatronics design process, Mechatronics key elements, mechatronics applications – Computer numerical control (CNC) machines, Tool monitoring systems, Flexible manufacturing system (FMS), Industrial Robots, Automatic packaging systems, Automatic inspection systems.

**UNIT II Sensors**

Static and dynamic characteristics of sensors, Displacement, Position and Proximity sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors.

**UNIT III Actuators**

Mechanical, Electrical, Hydraulic and Pneumatic Actuation systems, Characteristics and their limitations, Design of Hydraulic and Pneumatic circuits, Piezoelectric actuators, Shape memory alloys, Selection criteria for actuators.

**UNIT IV Microprocessors, Microcontrollers and Programmable Logic Controllers**

Architecture of Microprocessor, Microcontroller and Programmable Logic Controller, PLC Programming using ladder diagrams, logics, latching, sequencing, timers relays and counters, data handling, Analog input/output, selection of controllers.

**UNIT V Micro Electro Mechanical Systems (MEMS)**

History, Effect of scaling, Fabrication Techniques: Oxidation, Physical Vapor disposition, Chemical Vapor Deposition, Lithography, Etching, Wafer bonding, LIGA, DRIE, Applications: Lab on chip.

**Textbooks:**

1. W. Bolton, Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, 3/e, Pearson Education Press, 2005.
2. Devadas Shetty and Richard A Kolk, Mechatronic System Design, 2/e, Cengage learning, 2010.
3. N. Mahalik, MEMS, McGraw Hill Educations, 2017.

**Reference Books:**

1. Clarence W. de Silva, Mechatronics an Integrated Approach, CRC Press, 2004.
2. James J Allen, Micro Electro Mechanical Systems Design, CRC Press Taylor & Francis group, 2005.
3. Ganesh S Hedge, Mechatronics, Jones & Bartlett Learning, 2010.
4. Mohammed Gad, MEMS; Design and Fabrication, CRC Press, 2010.

**Online Learning Resources:**

- [https://onlinecourses.nptel.ac.in/noc22\\_me54/preview](https://onlinecourses.nptel.ac.in/noc22_me54/preview)
- <https://nptel.ac.in/courses/112108092>
- <https://nptel.ac.in/courses/112101304>
- [https://onlinecourses.nptel.ac.in/noc20\\_ee56/preview](https://onlinecourses.nptel.ac.in/noc20_ee56/preview)
- [https://www.cet.edu.in/noticefiles/259\\_Lecturer%20Note%20on%20Mechatronics-ilovepdf-compressed.pdf](https://www.cet.edu.in/noticefiles/259_Lecturer%20Note%20on%20Mechatronics-ilovepdf-compressed.pdf),  
<https://lecturenotes.in/subject/1176/mechatronics-and-mems>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– IV-I Sem**

**L T P C**

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**(20A03703b) DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS**

**(Professional Elective-V)**

**Course Objectives:**

- Familiarize on Fluid Power Engineering and Power Transmission System.
- Introduce the students, the basic concepts of hydraulic and pneumatic systems.
- Expose the students with various hydraulic and pneumatic actuators.
- Familiarize on fluid power systems and its applications to real time.
- Know the problem, which occur in fluid power systems and take necessary troubleshooting/ maintenance activities.
- Get practiced in designing hydraulic and pneumatic systems.
- Understand the design procedure available for Hydraulic and Pneumatic circuits.

**Course Outcomes:** At the end of the course, the student will be able to

- Compare the differences between hydraulic and pneumatic systems
- Identify the practical applications in automation
- Build the circuits for a given applications
- Develop hydraulic and pneumatic power packs
- Discuss the importance of PLC and microprocessor in hydraulic and pneumatic systems

**UNIT I Introduction**

Introduction to fluid power - Types, advantages and application of fluid power systems. Properties of hydraulic fluids – General types of fluids – Fluid power symbols as per ISO/ANSI. Basic Components of Hydraulic and Pneumatic Systems. Comparison of Mechanical, Electrical, Hydraulic & Pneumatic systems for force and motion analysis in automation.

**UNIT II**

**Hydraulic Pumps, Actuators:** Types of hydraulic pumps - construction and working principle - design considerations, selection, specifications and characteristics of pumps. Types of actuators-construction and working principle - design considerations, selection, specifications and characteristics of actuators.

**Control And Regulation Elements:** Direction control valves, Pressure control valves, Flow control valves, Non-return valves, Reservoirs, Accumulators, Heating & cooling devices, Hoses. Selection of valves for hydraulic circuits.

**UNIT – III Design Of Hydraulic Circuits**

Speed control circuits - Regenerative circuits- Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier–Intensifier circuit. - Reservoir design - Selection of components. Hydraulic circuits - Reciprocating - Quick return - Sequencing synchronizing - Safety circuits - Industrial circuits - Press - Milling Machine - Planner - Fork Lift.

**UNIT – IV Pneumatic Systems**

Pneumatic fundamentals - Properties of air – Compressors – Filter, Regulator, and Lubricator unit – Air control valves, Quick exhaust valves, and pneumatic actuators. Control Elements - Logic Circuits -Position - Pressure Sensing - Switching – Electro Pneumatic - Electro Hydraulic Circuits - Robotic Circuits.

**UNIT – V Design Of Pneumatic Circuits**

Classic-Cascade-Step counter - Combination -Methods - PLC-Microprocessors -Uses - Selection criteria for Pneumatic components - Installation and Maintenance of Hydraulic and Pneumatic power packs - Fault finding - Principles of Low Cost Automation - Case studies.

**Textbooks:**

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2000.
2. Majumdar S.R, “Oil Hydraulics”, Tata McGraw Hill, 2000.
3. Majumdar S.R, “Pneumatic Systems – Principles and Maintenance”, Tata McGraw Hill, 2001.

**Reference Books:**

1. Andrew Parr, Hydraulic & Pneumatics, 2/e, Jaico Publishing House Elsevier, 1999.
2. Harry L. Stevart D.B, “Practical Guide to Fluid Power”, Taraoeala Sons and Port Ltd. Broadey, 1976.
3. Dudelyt, A. Pease and John T. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.

**Online Learning Resources:**

- Chrome-extension://efaidnbmnnibpcaglcfindmkaj/viewer.htm?pdfurl=https%3A%2F%2Fwww.iare.ac.in%2Fsites%2Fdefault%2Ffiles%2FDHPS%2520LECTURER%2520NOTES%2520FINAL.pdf&chunk=true.
- chromeextension://efaidnbmnnibpcaglcfindmkaj/viewer.html?pdfurl=https%3A%2F%2Fwww.iare.ac.in%2Fsites%2Fdefault%2Ffiles%2FDHPS%2520PPT%2520%2520FINAL.pdf&chunk=true.
- <https://nptel.ac.in/courses/112/105/112105047/>



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– IV-I Sem**

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**(20A03703c) GEOMETRIC DIMENSIONING AND TOLERANCES**

**(Professional Elective-V)**

**Course Objectives:**

- Teach the basics of the geometric dimensioning and tolerances.
- Familiar with five groups of GD&T tolerances, form, orientation, location, runout and profile tolerances.
- Introduce tolerances of profiles of lines and surfaces with or without datums.
- Expose the students to various surface roughness parameters and their measurements in two dimensions.
- Understand the concepts of dimensional chains and inspection techniques.

**Course Outcomes:**

- This course systematically introduces the essentials of the language of geometric dimensioning and tolerancing (GD&T) based on ASME standards, as well as the essentials of surface roughness measurements in both 2D and 3D including filtering techniques.
- This course also introduces the related concepts of Vectorial dimensioning and tolerancing, dimensional chains, measurement uncertainty, etc.
- The knowledge gained by the students by learning the above topics will help them to perform very well in their profession as metrologists as well as product designers.

**UNIT I Basic Concepts**

General terms and definitions of geometrical features - General principle of sizes - System of limits and fits - Inspection of dimensional and geometrical deviations - Datums, datum systems, and selection of datums. Restraining degrees of freedom, DOF, Simulators. Rule #1(Boundary principle) and Rule #2.

**UNIT II Form and Orientation Tolerances**

Principles of dimensioning - Introduction to geometric dimensioning and tolerancing (GD&T); Form tolerances: types, specifications and interpretations - measurement and evaluation of straightness, flatness and roundness - Orientation tolerances: types, specifications and interpretations, and verification of orientation tolerances. Exercises on each group. RFS, MMC and LMC concepts.

**UNIT III Location, Runout and Profile Tolerances**

Tolerances of location: types, specifications and interpretations - verification techniques - Tolerances of profiles of lines and surfaces with or without datums - Tolerances of runout - Tolerancing of angles and cones. Exercises on each group. RFS, MMC and LMC concepts.

**UNIT IV Surface Roughness**

Various parameters and their measurements in two dimensions - filtering and filtering techniques - areal parameters, symbology

**UNIT V Inspection of GD&T call-outs**

Vectorial dimensioning and tolerancing - Statistical tolerancing of mechanical assemblies - Dimensional chains - Measurement uncertainty - Computer-aided tolerancing and verification. Inspection techniques- conventional and CMM.

**Textbooks:**

1. Drake, P. J., Dimensioning and Tolerance Handbook, McGraw-Hill, Inc., New York. 1999.
2. Meadows, J. D., Geometric Dimensioning and Tolerancing: Applications and Techniques for use in Design, Manufacturing and Inspection, Marcel Dekker, Inc., New York. 1995.
3. Gill, P. S., Geometric Dimensioning and Tolerancing, S. K. Kataria & Sons, New Delhi, 2/e, 2013.
4. ASME 14.5 - 2009 standards,
5. Alex Krulikowski, Fundamentals of geometric dimensioning and tolerancing, Cengage Learning, 3/e, 2012.
6. James D Meadows, —Measurement of Geometric Tolerances in Manufacturing, CRC Press, 1/e, 1998.

**Reference Books:**

1. Gupta, I. C., A Text book of Engineering Metrology, Dhanpat Rai Publications, New Delhi, 2018.
2. Galyer, J. F. W. and C. R. Shotbolt, Metrology for Engineers, Cassell Publishers, London, 5/e, 1990.
3. Henzold, G., Handbook of Geometrical Tolerancing: Design, Manufacturing and Inspection, John Wiley & Sons, Chichester, 2/e, 2006.

4. Muralikrishnan, B. and J. Raja, Computational Surface and Roundness Metrology, Springer USA, 1/e, 2010.
5. Relevant Indian and International Standards.
6. Whitehouse, D. J., Surfaces and their Measurement, Hermes Penton Science, London, 2002.

**Online Learning Resources:**

- <https://nptel.ac.in/courses/112/106/112106179/>
- [https://www.youtube.com/watch?v=X\\_VepJhq\\_vk](https://www.youtube.com/watch?v=X_VepJhq_vk)
- [https://www.youtube.com/watch?v=cjzSXPDBA\\_Q&t=1s](https://www.youtube.com/watch?v=cjzSXPDBA_Q&t=1s)
- <https://www.youtube.com/watch?v=-tLq1wXio0U>
- <https://digitaldefynd.com/best-gdt-courses/>

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– IV-I Sem

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3 0 0 3

20A52701a) ENTREPRENEURSHIP & INCUBATION  
(HUMANITIES ELECTIVE II)

**Course Objectives:**

- To make the student understand about Entrepreneurship
- To enable the student in knowing various sources of generating new ideas in setting up of New enterprise
- To facilitate the student in knowing various sources of finance in starting up of a business
- To impart knowledge about various government sources which provide financial assistance to entrepreneurs/ women entrepreneurs
- To encourage the student in creating and designing business plans

**Course Outcomes:**

- Understand the concept of Entrepreneurship and challenges in the world of competition.
- Apply the Knowledge in generating ideas for New Ventures.
- Analyze various sources of finance and subsidies to entrepreneur/women Entrepreneurs.
- Evaluate the role of central government and state government in promoting entrepreneurship.
- Create and design business plan structure through incubations.

**UNIT I**

Entrepreneurship - Concept, knowledge and skills requirement - Characteristics of successful entrepreneurs - Entrepreneurship process - Factors impacting emergence of entrepreneurship - Differences between Entrepreneur and Intrapreneur - Understanding individual entrepreneurial mindset and personality - Recent trends in Entrepreneurship.

**UNIT II**

Starting the New Venture - Generating business idea – Sources of new ideas & methods of generating ideas - Opportunity recognition - Feasibility study - Market feasibility, technical/operational feasibility - Financial feasibility - Drawing business plan - Preparing project report - Presenting business plan to investors.

**UNIT III**

Sources of finance - Various sources of Finance available - Long term sources - Short term sources - Institutional Finance – Commercial Banks, SFC's in India - NBFC's in India - their way of financing in India for small and medium business - Entrepreneurship development programs in India - The entrepreneurial journey- Institutions in aid of entrepreneurship development

**UNIT IV**

Women Entrepreneurship - Entrepreneurship Development and Government - Role of Central Government and State Government in promoting women Entrepreneurship - Introduction to various incentives, subsidies and grants – Export- oriented Units - Fiscal and Tax concessions available - Women entrepreneurship - Role and importance - Growth of women entrepreneurship in India - Issues & Challenges - Entrepreneurial motivations.

**UNIT V**

Fundamentals of Business Incubation - Principles and good practices of business incubation- Process of business incubation and the business incubator and how they operate and influence the Type/benefits of incubators - Corporate/educational / institutional incubators - Broader business incubation environment - Pre-Incubation and Post - Incubation process - Idea lab, Business plan structure - Value proposition

**Textbooks:**

1. D F Kuratko and T V Rao, “Entrepreneurship” - A South-Asian Perspective – Cengage Learning, 2012.  
(For PPT, Case Solutions Faculty may visit : [login.cengage.com](http://login.cengage.com))
2. Nandan H, “ Fundamentals of Entrepreneurship”, PHI, 2013

**References:**

1. Vasant Desai, “Small Scale Industries and Entrepreneurship”, Himalaya Publishing 2012.
2. Rajeev Roy “Entrepreneurship”, 2<sup>nd</sup> Edition, Oxford, 2012.
3. B.JanakiramandM.Rizwanal “Entrepreneurship Development: Text & Cases”, Excel Books, 2011.
4. Stuart Read, Effectual “Entrepreneurship”, Routledge, 2013.

**E-Resources**

1. Entrepreneurship-Through-the-Lens-of-enture Capital

2. <http://www.onlinevideolecture.com/?course=mba-programs&subject=entrepreneurship>
3. [http://nptel.ac.in/courses/122106032/Pdf/7\\_4.pdf](http://nptel.ac.in/courses/122106032/Pdf/7_4.pdf)
4. <http://freevideolectures.com/Course/3514/Economics--Management--Entrepreneurhip/50>

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)– III-II Sem

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(20A52701b) MANAGEMENT SCIENCE  
(HUMANITIES ELECTIVE-II)

**Course Objectives:**

- To provide fundamental knowledge on Management, Administration, Organization & its concepts.
- To make the students understand the role of management in Production
- To impart the concept of HRM in order to have an idea on Recruitment, Selection, Training & Development, job evaluation and Merit rating concepts
- To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management
- To make the students aware of the contemporary issues in management

**Course Outcomes:**

- Understand the concepts & principles of management and designs of organization in a practical world
- Apply the knowledge of Work-study principles & Quality Control techniques in industry
- Analyze the concepts of HRM in Recruitment, Selection and Training & Development.
- Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyze the business through SWOT.
- Create Modern technology in management science.

**UNIT I INTRODUCTION TO MANAGEMENT**

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor's Scientific Theory-Henry Fayol's principles - Eltan Mayo's Human relations - Systems Theory - **Organisational Designs** - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

**UNIT II OPERATIONS MANAGEMENT**

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control- Deming's contribution to Quality. **Material Management** - Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - Purchase Procedure and Stores Management - **Marketing Management** - Concept - Meaning - Nature-Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

**UNIT III HUMAN RESOURCES MANAGEMENT (HRM)**

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Evolution of HRM - Job Analysis - Human Resource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process and Tests in Employee Selection - Employee Training and Development - On-the- job & Off-the-job training methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration

**UNIT IV STRATEGIC & PROJECT MANAGEMENT**

Definition & Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis - **Project Management** - Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).

**UNIT V CONTEMPORARY ISSUES IN MANAGEMENT**

The concept of Management Information System(MIS) - Materials Requirement Planning (MRP) - Customer Relations Management(CRM) - Total Quality Management (TQM) - Six Sigma Concept - Supply Chain Management(SCM) - Enterprise Resource Planning (ERP) - Performance Management - Business Process Outsourcing (BPO) - Business Process Re-engineering and Bench Marking - Balanced Score Card - Knowledge Management.

**Textbooks:**

1. A.R Aryasri, "Management Science", TMH, 2013
2. Stoner, Freeman, Gilbert, Management, Pearson Education, New Delhi, 2012.

**References:**

1. Koontz & Wehrich, "Essentials of Management", 6<sup>th</sup> edition, TMH, 2005.
2. Thomas N. Duening & John M. Ivancevich, "Management Principles and Guidelines", Biztantra.
3. Kanishka Bedi, "Production and Operations Management", Oxford University Press, 2004.
4. Samuel C. Certo, "Modern Management", 9<sup>th</sup> edition, PHI, 2005

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)– III-II Sem**

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**(20A52701c) ENTERPRISE RESOURCE PLANNING  
(HUMANITIES ELECTIVE-II)**

**Course Objectives:**

- To provide a contemporary and forward-looking on the theory and practice of Enterprise Resource Planning
- To enable the students in knowing the Advantages of ERP
- To train the students to develop the basic understanding of how ERP enriches the Business organizations in achieving a multidimensional growth.
- Impart knowledge about the historical background of BPR
- To aim at preparing the students, technologically competitive and make them ready to self-upgrade with the higher technical skills.

**Course Outcomes:**

- Understand the basic use of ERP Package and its role in integrating business functions.
- Explain the challenges of ERP system in the organization
- Apply the knowledge in implementing ERP system for business
- Evaluate the role of IT in taking decisions with MIS
- Create reengineered business processes with process redesign

**UNIT I**

Introduction to ERP: Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM), Customer Relationship Management(CRM),

**UNIT II**

Benefits of ERP: Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design-making Capability

**UNIT III**

ERP Implementation Lifecycle: Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation Team Training, Testing, Going Live, End-user Training, Post-implementation (Maintenance mode)

**UNIT IV**

BPR: Historical background: Nature, significance and rationale of business process reengineering (BPR), Fundamentals of BPR. Major issues in process redesign: Business vision and process objectives, Processes to be redesigned, Measuring existing processes,

**UNIT V**

IT in ERP: Role of information technology (IT) and identifying IT levers. Designing and building a prototype of the new process: BPR phases, Relationship between BPR phases. MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System.

**Textbooks:**

1. Pankaj Sharma. “Enterprise Resource Planning”. Aph Publishing Corporation, New Delhi, 2004.
2. Alexis Leon, “Enterprise Resource Planning”, IV Edition, Mc.Graw Hill, 2019

**References:**

1. Marianne Bradford “Modern ERP”, 3rd edition.
2. “ERP making it happen Thomas f. Wallace and Michael
3. Directing the ERP Implementation Michael w pelphrey

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ME)– IV-I Sem** **L T P C**  
**3 0 0 3**  
**(20A03706) INDUSTRIAL AUTOMATION**  
**(Skill Oriented Course-V)**

**Course Objectives:**

- Introduce basic concepts and principles of Industrial Automation.
- Familiarize with fluid power systems circuits.
- Describe concepts of SCADA software
- Explain the principles of PLC and 8085 microprocessor.
- Expose the students on Mechatronics.

**Course Outcomes:** At the end of the course, student will be able to

- Summarizes the how fluid power system work
- Discuss about SCADA software
- Develop the skills related to predict the output for various programs.
- Explain the concepts of mechatronics

**List of Experiments:**

**Module 1:** Design and testing of fluid power circuits to control

Introduction to Fluid power systems, Symbolic representation of hydraulic and pneumatic components.

**Tasks:-**

1. Pneumatic trainer kit with FRL Unit, Single acting cylinder, push button.
2. Pneumatic training kit with FRL unit, Double acting cylinder, manually actuated DCV.
3. Pneumatic trainer kit with FRL unit, Double acting cylinder, Pilot actuated DCV.
4. Pneumatic trainer kit with FRL unit Double acting cylinder, Double solenoid actuated DCV, DCV with sensor / magnetic reed.
5. Hydraulic power pack with pumps and pressure relief valve.

**Module 2:**

- Open source SCADA software such as Free SCADA, Open SCADA,
- Indigo SCADA Code Sys Open source for PLC programming and interfacing with real time PLC
- Delta PLC software – free ware and corresponding PLC programming software.
- 8085 Microprocessor Trainer with Power Supply
- Traffic Light Control System

**Module 3:** Mechatronics

- Experiment on P, PI and PID Controller.
- Simulation of Hydraulic Actuation System.
- Simulation of Pneumatic Actuation System.
- Simulation on Stepper Motor.
- Simulation on Logic gates, decoders and flip-flops.

**References:**

1. B. Gavali, S. A. Patil and A. R. Koli, "Technology-Based Learning system in Programmable Logic Controller Education," 2016 IEEE Eighth International Conference on Technology for Education (T4E), Mumbai, 2016, pp. 264-265.
2. Groover, Mikell , Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 2014.
3. Lamb, Frank. Industrial Automation: Hands On (English Edition). NC, McGraw-Hill Education, 2013. ISBN 978-0071816458.

**Note:-** Trainer can use freeware simulation software's.

**Online Learning Resources/Virtual Labs:**

[http://iotmumbai.bharativedyapeeth.edu/media/pdf/lab\\_manuals/Manual\\_EE5I\\_EIA\\_22526.pdf](http://iotmumbai.bharativedyapeeth.edu/media/pdf/lab_manuals/Manual_EE5I_EIA_22526.pdf)

- [https://faculty.ksu.edu.sa/sites/default/files/lab-manual\\_v3.pdf](https://faculty.ksu.edu.sa/sites/default/files/lab-manual_v3.pdf)
- <https://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1494&context=eesp>



# OPEN ELECTIVES

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech III-I Sem** **L T P C**  
**3 0 0 3**

**(20A01505) BUILDING TECHNOLOGY**  
**(Open Elective-I)**

**Course Objectives:**

- To know different types of buildings, principles and planning of the buildings.
- To identify the termite control measure in buildings, and importance of grouping circulation, lighting and ventilation aspects in buildings.
- To know the different modes of vertical transportation in buildings.
- To know the utilization of prefabricated structural elements in buildings.
- To know the importance of acoustics in planning and designing of buildings.

**Course Outcomes (CO):**

- Understand the principles in planning and design the buildings
- To get different types of buildings, principles and planning of the buildings
- To know the different methods of termite proofing in buildings.
- Know the different methods of vertical transportation in buildings.
- Know the implementation of prefabricated units in buildings and effect of earthquake on buildings.
- Know the importance of acoustics in planning and designing of buildings.

**UNIT I**

Overview of the course, basic definitions, buildings-types-components-economy and design-principles of planning of buildings and their importance. Definitions and importance of grouping and circulation-lighting and ventilation-consideration of the above aspects during planning of building.

**UNIT II**

Termite proofing: Inspection-control measures and precautions-lighting protection of buildings-general principles of design of openings-various types of fire protection measures to be considered while planning a building.

**UNIT III**

Vertical transportation in a building: Types of vertical transportation-stairs-different forms of stairs-planning of stairs-other modes of vertical transportation –lifts-ramps-escalators.

**UNIT IV**

Prefabrication systems in residential buildings-walls-openings-cupboards-shelves etc., planning and modules and sizes of components in prefabrication. Planning and designing of residential buildings against the earthquake forces, principles, seismic forces and their effect on buildings.

**UNIT V**

Acoustics –effect of noise –properties of noise and its measurements, principles of acoustics of building. Sound insulation-importance and measures.

**Textbooks:**

1. Building construction by Varghese, PHI Learning Private Limited 2<sup>nd</sup> Edition 2015
2. Building construction by Punmia.B.C, Jain.A.K and Jain.A.K Laxmi Publications 11<sup>th</sup> edition 2016

**Reference Books:**

1. National Building Code of India, Bureau of Indian Standards
2. Building construction-Technical teachers training institute, Madras, Tata McGraw Hill.
3. Building construction by S.P.Arora and S.P.BrndraDhanpat Rai and Sons Publications, New Delh 2014 edition  
<https://nptel.ac.in/courses/105102206>  
<https://nptel.ac.in/courses/105103206>

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech III-I Sem

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**(20A02505) ELECTRIC VEHICLES**  
**(Open Elective-I)**

**Course Objectives:**

- To get exposed to new technologies of battery electric vehicles, fuel cell electric vehicles
- To get exposed to EV system configuration and parameters
- To know about electro mobility and environmental issues of EVs
- To understand about basic EV propulsion and dynamics
- To understand about fuel cell technologies for EV and HVEs
- To know about basic battery charging and control strategies used in electric vehicles

**Course Outcomes:**

- Understand and differentiate between conventional and latest trends in Electric Vehicles
- Analyze various EV resources, EV dynamics and Battery charging
- Apply basic concepts of EV to design complete EV system
- Design EV system with various fundamental concepts

**UNIT I INTRODUCTION TO EV SYSTEMS AND PARAMETERS**

Past, Present and Future EV, EV Concept, EV Technology, State-of-the Art EVs, EV configuration, EV system, Fixed and Variable gearing, single and multiple motor drive, in-wheel drives, EV parameters: Weight, size, force and energy, performance parameters.

**UNIT II EV AND ENERGY SOURCES**

Electro mobility and the environment, history of Electric power trains, carbon emissions from fuels, green houses and pollutants, comparison of conventional, battery, hybrid and fuel cell electric systems

**UNIT III EV PROPULSION AND DYNAMICS**

Choice of electric propulsion system, block diagram, concept of EV Motors, single and multi motor configurations, fixed and variable geared transmission, In-wheel motor configuration, classification, Electric motors used in current vehicle applications, Recent EV Motors, Vehicle load factors, vehicle acceleration.

**UNIT IV FUEL CELLS**

Introduction of fuel cells, basic operation, model, voltage, power and efficiency, power plant system – characteristics, sizing, Example of fuel cell electric vehicle.

Introduction to HEV, brake specific fuel consumption, comparison of series, series-parallel hybrid systems, examples

**UNIT V BATTERY CHARGING AND CONTROL**

**Battery charging:** Basic requirements, charger architecture, charger functions, wireless charging, power factor correction.

**Control:** Introduction, modelling of electromechanical system, feedback controller design approach, PI controllers designing, torque-loop, speed control loop compensation, acceleration of battery electric vehicle

**Textbooks:**

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

**Reference Books:**

1. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press 2005.
2. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2015.

**Online Learning Resources:**

1. [https://onlinecourses.nptel.ac.in/noc22\\_ee53/preview](https://onlinecourses.nptel.ac.in/noc22_ee53/preview)

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B.Tech III-I Sem

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(20A04505) DIGITAL ELECTRONICS  
(Open Elective Course- I)

**Course Objectives:**

- To provide the fundamental concepts associated with the digital logic and circuit design.
- To introduce the basic concepts and laws involved in the Boolean algebra and logic families and digital circuits.
- To familiarize with the different number systems, logic gates, and combinational and sequential circuits, memory elements utilized in the different digital circuits and systems.
- To introduce different digital logic families

**Course Outcomes:**

- Become familiar with the Boolean algebra, logic gates, logical variables, the truth table, number systems, codes, and their conversion from to others
- Learn the minimization techniques to simply the hardware requirements of digital circuits, implement it, design and apply for real time digital systems
- Understand the working mechanism and design guidelines of different combinational, sequential circuits, memory elements and their role in the digital system design.
- Understand different logic families and use the best combination of ICs during the design of a digital system

**UNIT 1**

DIGITAL FUNDAMENTALS: Number Systems - Decimal, binary, octal, Hexadecimal, 1's and 2's complements, Codes - Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems. Logic gates: Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization.

**UNIT II**

COMBINATIONAL CIRCUITS: Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

**UNIT III**

SYNCHRONOUS SEQUENTIAL CIRCUITS: Flip flops - SR, JK, T, D, Master/Slave FF- operation and excitation tables, Triggering of FF, conversion of FF. Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

**UNIT IV**

MEMORY DEVICES: Basic memory structure - ROM, PROM, EPROM, EEPROM, EAPROM, RAM, Static and dynamic RAM. Programmable Logic Devices: Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Arrays (FPGA).

**UNIT V**

Digital Logic Families: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, RTL, TTL, ECL, CMOS.

**Textbooks:**

1. Modern Digital Electronics (Edition III) : R. P. Jarn; TMH
2. Digital Fundamentals: Thomas I. Floyd
3. Digital circuits and design: S. Salivahanan, and S. Anvzzhagan

**References:**

1. Digital Integrated Electronics: Taub & Schilling; MGH
2. Digital Design: Morris Mano; PHI. Course

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**B.Tech III-I Sem**

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**(20A05505a) JAVA PROGRAMMING**  
**(Open Elective Course – I)**

**Course Objectives:**

- To understand object-oriented concepts and problem-solving techniques
- To obtain knowledge about the principles of inheritance and polymorphism
- To implement the concept of packages, interfaces, exception handling and concurrency mechanism.
- To design the GUIs using applets and swing controls.
- To understand the Java Database Connectivity Architecture

**Course Outcomes:**

- Solve real-world problems using OOP techniques.
- Apply code reusability through inheritance, packages and interfaces
- Solve problems using java collection framework and I/O classes.
- Develop applications by using parallel streams for better performance and develop applets for web applications.
- Build GUIs and handle events generated by user interactions and Use the JDBC API to access the database.

**UNIT I Introduction**

Introduction to Object Oriented Programming, The History and Evolution of Java, Introduction to Classes, Objects, Methods, Constructors, this keyword, Garbage Collection, Data Types, Variables, Type Conversion and Casting, Arrays, Operators, Control Statements, Method Overloading, Constructor Overloading, Parameter Passing, Recursion, String Class and String handling methods

**UNIT II Inheritance, Packages, Interfaces**

Inheritance: Basics, Using Super, Creating Multilevel hierarchy, Method overriding, Dynamic Method Dispatch, Using Abstract classes, Using final with inheritance, Object class,  
Packages: Basics, Finding packages and CLASSPATH, Access Protection, Importing packages.  
Interfaces: Definition, Implementing Interfaces, Extending Interfaces, Nested Interfaces, Applying Interfaces, Variables in Interfaces.

**UNIT III Exception handling, Stream based I/O**

Exception handling - Fundamentals, Exception types, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built-in exceptions, creating own exception subclasses.

Stream based I/O (java.io) – The Stream Classes-Byte streams and Character streams, Reading console Input and Writing Console Output, File class, Reading and Writing Files, Random access file operations, The Console class, Serialization, Enumerations, Autoboxing, Generics.

**UNIT IV Multithreading, The Collections Framework**

Multithreading: The Java thread model, creating threads, Thread priorities, Synchronizing threads, Interthread communication.

The Collections Framework (java.util): Collections overview, Collection Interfaces, The Collectionclasses- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque. Hashtable, Properties, Stack, Vector, String Tokenizer, Bit Set, Date, Calendar, Random, Formatter, Scanner.

**UNIT V Applet, GUI Programming with Swings, Accessing Databases with JDBC**

Applet: Basics, Architecture, Applet Skeleton, requesting repainting, using the status window, passing parameters to applets

GUI Programming with Swings – The origin and design philosophy of swing, components and containers, layout managers, event handling, using a push button, jtextfield, jlabel and image icon, the swing buttons, jtext field, jscrollpane, jlist, jcombobox, trees, jtable, An overview of jmenubar, jmenu and jmenutem,

creating a main menu, show message dialog, show confirmdialog, show input dialog, show option dialog, jdialog, create a modeless dialog.

Accessing Databases with JDBC:

Types of Drivers, JDBC Architecture, JDBC classes and Interfaces, Basic steps in developing JDBC applications, Creating a new database and table with JDBC.

**Textbooks:**

1. Java The complete reference, 9th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd.
2. Java How to Program, 10th Edition, Paul Dietel, Harvey Dietel, Pearson Education.

**Reference Books:**

1. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.
2. Core Java Volume – 1 Fundamentals, Cay S. Horstmann, Pearson Education.
3. Java Programming for core and advanced learners, Sagayaraj, Dennis, Karthik andGajalakshmi, University Press
4. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
5. Object Oriented Programming through Java, P. Radha Krishna, University Press.
6. Programming in Java, S. Malhotra, S. Chaudhary, 2nd edition, Oxford Univ. Press.
7. Java Programming and Object-oriented Application Development, R.A. Johnson, Cengage Learning.

**Online Learning Resources:**

[https://www.w3schools.com/java/java\\_oop.asp](https://www.w3schools.com/java/java_oop.asp)

<http://peterindia.net/JavaFiles.html>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech III-I Sem** **L T P C**  
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**(20A05502T) ARTIFICIAL INTELLIGENCE**  
**Open Elective Course - I**

**Course Objectives:**

This course is designed to:

- Introduce Artificial Intelligence
- Teach about the machine learning environment
- Present the searching Technique for Problem Solving
- Introduce Natural Language Processing and Robotics

**Course Outcomes:**

After completion of the course, students will be able to

- Apply searching techniques for solving a problem
- Design Intelligent Agents
- Develop Natural Language Interface for Machines
- Design mini robots
- Summarize past, present and future of Artificial Intelligence

**UNIT I Introduction** Lecture 9Hrs

**Introduction:** What is AI, Foundations of AI, History of AI, The State of Art.

**Intelligent Agents:** Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

**UNIT II Solving Problems by searching** Lecture 9 Hrs

Problem Solving Agents, Example problems, Searching for Solutions, Uninformed Search Strategies, Informed search strategies, Heuristic Functions, Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with partial observations, online search agents and unknown environments.

**UNIT III Reinforcement Learning & Natural Language Processing** Lecture 8Hrs

**Reinforcement Learning:** Introduction, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Policy Search, applications of RL

**Natural Language Processing:** Language Models, Text Classification, Information Retrieval, Information Extraction.

**UNIT IV Natural Language for Communication** Lecture 8 Hrs

**Natural Language for Communication:** Phrase structure grammars, Syntactic Analysis, Augmented Grammars and semantic Interpretation, Machine Translation, Speech Recognition

**Perception:** Image Formation, Early Image Processing Operations, Object Recognition by appearance, Reconstructing the 3D World, Object Recognition from Structural information, Using Vision.

**UNIT V Robotics** Lecture 10Hrs

**Robotics:** Introduction, Robot Hardware, Robotic Perception, planning to move, planning uncertain movements, Moving, Robotic software architectures, application domains

**Philosophical foundations:** Weak AI, Strong AI, Ethics and Risks of AI, Agent Components, Agent Architectures, Are we going in the right direction, What if AI does succeed.

**Textbooks:**

1. Stuart J.Russell, Peter Norvig, "Artificial Intelligence A Modern Approach", 3<sup>rd</sup> Edition, Pearson Education, 2019.

**Reference Books:**

1. Nilsson, Nils J., and Nils Johan Nilsson. *Artificial intelligence: a new synthesis*. Morgan Kaufmann, 1998.
2. Johnson, Benny G., Fred Phillips, and Linda G. Chase. "An intelligent tutoring system for the accounting cycle: Enhancing textbook homework with artificial intelligence." *Journal of Accounting Education* 27.1 (2009): 30-39.

**Online Learning Resources:**

<http://peterindia.net/AILinks.html>

<http://nptel.ac.in/courses/106106139/>

<https://nptel.ac.in/courses/106/105/106105152/>



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**B.Tech III-I Sem**

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**(20A05505c) MOBILE APPLICATION DEVELOPMENT USING ANDROID**

**(Open Elective-I)**

**Course Objectives:**

- Facilitate students to understand android SDK.
- Help students to gain a basic understanding of Android application development.
- Inculcate working knowledge of Android Studio development tool.

**Course Outcomes:**

- Identify various concepts of mobile programming that make it unique from programming for other platforms.
- Evaluate mobile applications on their design pros and cons.
- Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.
- Develop mobile applications for the Android operating system that use basic and advanced phone features.
- Demonstrate the deployment of applications to the Android marketplace for distribution.

**UNIT I Introduction and Mobile User Interface Design**

Introduction to Android: The Android Platform, Android SDK, Android Studio Installation, Android Installation, building your First Android application, Understanding Anatomy of Android Application, Android Manifest file.

**UNIT II Activities, Intents and Android User Interface**

Android Application Design Essentials: Anatomy of an Android application, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions

**UNIT III Advanced User Interface and Data Persistence**

Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.

**UNIT IV Android Services, Publishing Android Applications**

Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

**UNIT V Android Databases**

Using Common Android APIs: Using Android Data and Storage APIs, managing data using SQLite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

**Textbooks:**

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011).
2. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development," Wiley India, First Edition, 2012.

**Reference Books:**

1. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd
2. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
3. Android Application Development All in one for Dummies by Barry Burd, Edition: I

**Online Learning Resources:**

1. <https://developer.android.com/>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech III-I Sem**

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**(20A27505) COMPUTER APPLICATIONS IN FOOD TECHNOLOGY**  
**(Open Elective-1)**

**Course Objectives:**

- To know different software and applications in food technology.
- To understand the Chemical kinetics in food processing, Microbial distraction in thermal processing of food.
- To acquire knowledge on computer aided manufacturing and control of food machinery, inventory control, process control.

**Course Outcomes:**

- Students will gain knowledge on software in food technology, data analysis, Chemical kinetics, microbial distortion in thermal process
- Use of linear regression in analyzing sensory data, application of computer in some common food industries like, milk plant, bakery units & fruits vegetable plants.

**UNIT I**

Introduction to various software and their applications in food technology. Application of MS Excel to solve the problems of Food Technology, SPSS and JMP for data analysis, Pro-Engineering for design, Lab VIEW and SCADA for process control .

**UNIT II**

Chemical kinetics in food processing: Determining rate constant of zero order reaction First order rate constant and half-life of reactions. Determining energy of activation of vitamin degradation during food storage Rates of Enzymes catalyzed reaction. Microbial distraction in thermal processing of food. Determining decimal reduction time from microbial survival data, Thermal resistance factor, Z-values in thermal processing of food. Sampling to ensure that a lot is not contaminated with more than a given percentage Statistical quality control. Probability of occurrence in normal distribution. Using binomial distribution to determine probability of occurrence. Probability of defective items in a sample obtained from large lot

**UNIT III**

Sensory evaluation of food Statistical descriptors of a population estimated from sensory data obtained from a sample Analysis of variance. One factor, completely randomized design For two factor design without replication. Use of linear regression in analyzing sensory data. Mechanical transport of liquid food. Measuring viscosity of liquid food using a capillary tube viscometer . Solving simultaneous equations in designing multiple effect evaporator while using matrix algebra available in excel.

**UNIT IV**

Familiarization with the application of computer in some common food industries like, milk plant, bakery units & fruits vegetable plants, stating from the receiving of raw material up to the storage & dispatch of finished product.

**UNIT V**

Basic Introduction to computer aided manufacturing. Application of computers, instrumentation and control of food machinery, inventory control, process control etc.

**Recommended books:**

1. Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis by R. Paul Singh, AP.
2. Manuals of MS Office.

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech III-I Sem

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## (20A56501) MATERIALS CHARACTERIZATION TECHNIQUES

(Open Elective- I)

**Course Objectives:**

- To provide an exposure to different characterization techniques.
- To enlighten the basic principles and analysis of different spectroscopic techniques.
- To explain the basic principle of Scanning electron microscope along with its limitations and applications.
- To identify the Resolving power and Magnification of Transmission electron microscope and its applications.
- To educate the uses of advanced electric and magnetic instruments for characterization.

**Course Outcomes:** At the end of the course the student will be able

- To explain the structural analysis by X-ray diffraction.
- To understand the morphology of different materials using SEM and TEM.
- To recognize basic principles of various spectroscopic techniques.
- To study the electric and magnetic properties of the materials.
- To make out which technique can be used to analyse a material

**UNIT I**

Structure analysis by Powder X-Ray Diffraction: Introduction, Bragg's law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherrer and Williamson-Hall (W-H) Methods, Small angle X-ray scattering (SAXS) (in brief).

**UNIT II**

Microscopy technique -1 –Scanning Electron Microscopy (SEM)

Introduction, Principle, Construction and working principle of Scanning Electron Microscopy, Specimen preparation, Different types of modes used (Secondary Electron and Backscatter Electron), Advantages, limitations and applications of SEM.

**UNIT III**

Microscopy Technique -2 - Transmission Electron Microscopy (TEM): Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of Transmission Electron Microscopy, Difference between SEM and TEM, Advantage and Limitations of Transmission Electron Microscopy.

**UNIT IV**

Spectroscopy techniques – Principle, Experimental arrangement, Analysis and advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy (ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).

**UNIT V**

Electrical & Magnetic Characterization techniques: Electrical Properties analysis techniques (DC conductivity, AC conductivity) Activation Energy, Effect of Magnetic field on the electrical properties (Hall Effect). Magnetization measurement by induction method, Vibrating sample Magnetometer (VSM) and SQUID.

**Textbooks:**

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods –Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2008
2. Handbook of Materials Characterization -by Sharma S. K. - Springer

**References:**

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville Banwell and Elaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction – Bernard Dennis Cullity & Stuart R Stocks, Prentice Hall, 2001
3. Materials Characterization: Introduction to Microscopic and Spectroscopic Methods-[Yang Leng](#)- John Wiley & Sons
4. Characterization of Materials 2<sup>nd</sup> Edition, 3 Volumes-Kaufmann E N -John Wiley (Bp)

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**B.Tech III-I Sem** **L T P C**  
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**(20A51501) CHEMISTRY OF ENERGY MATERIALS**  
**(Open Elective- I)**

**Course Objectives:**

- To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
- To understand the basic concepts of processing and limitations of fossil fuels and Fuel cells & their applications.
- To impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification method
- Necessity of harnessing alternate energy resources such as solar energy and its basic concepts.
- To understand and apply the basics of calculations related to material and energy flow in the processes.

**Course Outcomes:**

- Ability to perform simultaneous material and energy balances.
- Student learn about various electrochemical and energy systems
- Knowledge of solid, liquid and gaseous fuels
- To know the energy demand of world, nation and available resources to fulfill the demand
- To know about the conventional energy resources and their effective utilization
- To acquire the knowledge of modern energy conversion technologies
- To be able to understand and perform the various characterization techniques of fuels
- To be able to identify available nonconventional (renewable) energy resources and techniques toutilize them effectively

**UNIT I: Electrochemical Systems:** Galvanic cell, standard electrode potential, application of EMF, electrical double layer, dipole moments, polarization, Batteries-Lead-acid and Lithium ion batteries.

**UNIT II: Fuel Cells:** Fuel cell working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency, Basic design of fuel cell,.

**UNIT III: Hydrogen Storage:** Hydrogen Storage, Chemical and Physical methods of hydrogen storage, Hydrogen Storage in metal hydrides, metal organic frame works (MOF), Carbon structures, metal oxide porous structures, hydrogen storage by high pressure methods. Liquification method.

**UNIT IV:Solar Energy:** Solar energy introduction and prospects, photo voltaic (PV) technology, concentrated solar power (CSP), Solar Fuels, Solar cells.

**UNIT V:** Photo and Photo electrochemical Conversions: Photochemical cells and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions.

**References:**

1. Physical chemistry by Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins
4. Fuel Cell Hand Book 7<sup>th</sup> Edition, by US Department of Energy (EG&G technical services and corporation)
5. Hand book of solar energy and applications by Arvind Tiwari and Shyam.
6. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
7. Hydrogen storage by Levine Klebonoff

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

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**(20A01605) ENVIRONMENTAL ECONOMICS**  
**(Open Elective Course - II)**

**Course Objectives:**

- To impart knowledge on sustainable development and economics of energy
- To teach regarding environmental degradation and economic analysis of degradation
- To inculcate the knowledge of economics of pollution and their management
- To demonstrate the understanding of cost benefit analysis of environmental resources
- To make the students to understand principles of economics of biodiversity

**Course Outcomes :**

- The information on sustainable development and economics of energy
- The information regarding environmental degradation and economic analysis of degradation
- The identification of economics of pollution and their management
- The cost benefit analysis of environmental resources
- The principles of economics of biodiversity

**UNIT I**

Sustainable Development: Introduction to sustainable development - Economy-Environment inter-linkages - Meaning of sustainable development - Limits to growth and the environmental Kuznets curve – The sustainability debate - Issues of energy and the economics of energy – Nonrenewable energy, scarcity, optimal resources, backstop technology, property research, externalities, and the conversion of uncertainty.

**UNIT II**

Environmental Degradation: Economic significance and causes of environmental degradation - The concepts of policy failure, externality and market failure - Economic analysis of environmental degradation – Equi –marginal principle.

**UNIT - III**

Economics of Pollution: Economics of Pollution - Economics of optimal pollution, regulation, monitoring and enforcement - Managing pollution using existing markets: Bargaining solutions – Managing pollution through market intervention: Taxes, subsidies and permits.

**UNIT IV**

Cost – Benefit Analysis: Economic value of environmental resources and environmental damage - Concept of Total Economic Value - Alternative approaches to valuation – Cost-benefit analysis and discounting.

**UNIT V**

Economics of biodiversity: Economics of biodiversity conservation - Valuing individual species and diversity of species -Policy responses at national and international levels. Economics of Climate Change – stern Report

**Textbooks:**

1. An Introduction to Environmental Economics by N. Hanley, J. Shogren and B. White Oxford University Press.(2001)
2. Blueprint for a Green Economy by D.W. Pearce, A. Markandya and E.B. Barbier Earthscan, London.(1989)

**Reference Books:**

1. Environmental Economics: An Elementary Introduction by R.K. Turner, D.W. Pearce and I. Bateman Harvester Wheatsheaf, London. (1994),
2. Economics of Natural Resources and the Environment by D.W. Pearce and R.K. Turner Harvester Wheat sheaf, London. (1990),
3. Environmental and Resource Economics: An Introduction by Michael S. Common and Michael Stuart 2<sup>nd</sup>Edition, Harlow: Longman.(1996),
4. Natural Resource and Environmental Economics by Roger Perman, Michael Common, Yue Ma and James Mc Gilvray 3<sup>rd</sup>Edition, Pearson Education.(2003),

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B.Tech III-II Sem

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(20A02605) SMART ELECTRIC GRID  
(Open Elective Course-II)

**Course Objectives:**

- Understand recent trends in grids, smart grid architecture and technologies
- Analyze smart substations
- Apply the concepts to design smart transmission systems
- Apply the concepts to design smart distribution systems

**Course Outcomes:**

- Understand trends in Smart grids, needs and roles of Smart substations
- Design and Analyze Smart Transmission systems
- Design and Analyze Smart Distribution systems
- Analyze SCADA and DSCADA systems in practical working environment

**UNIT I INTRODUCTION TO SMART GRID**

Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions – Traditional Power Grid and Smart Grid – New Technologies for Smart Grid – Advantages – Indian Smart Grid – Key Challenges for Smart Grid

**UNIT II SMART GRID TECHNOLOGIES**

Characteristics of Smart grid, Micro grids, Definitions, Drives, benefits, types of Micro grid, building blocks, Renewable energy resources, needs in smart grid, integration impact, integration standards, Load frequency control, reactive power control, case studies and test beds

**UNIT III SMART SUBSTATIONS**

Protection, Monitoring and control devices, sensors, SCADA, Master stations, Remote terminal unit, interoperability and IEC 61850, Process level, Bay level, Station level, Benefits, role of substations in smart grid, Volt/VAR control equipment inside substation

**UNIT IV SMART TRANSMISSION SYSTEMS**

Energy Management systems, History, current technology, EMS for the smart grid, Synchro Phasor Measurement Units (PMUs), Wide Area Monitoring Systems (WAMS), protection & Control (WAMPC), needs in smart grid, Role of WAMPC smart grid, Drivers and benefits, Role of transmission systems in smart grid

**UNIT V SMART DISTRIBUTION SYSTEMS**

DMS, DSCADA, trends in DSCADA and control, current and advanced DMSs, Voltage fluctuations, effect of voltage on customer load, Drivers, objectives and benefits, voltage-VAR control, VAR control equipment on distribution feeders, implementation and optimization, FDIR - Fault Detection Isolation and Service restoration (FDIR), faults, objectives and benefits, equipment, implementation

**Textbooks:**

1. Stuart Borlase, Smart Grids - Infrastructure, Technology and Solutions, CRC Press, 1e, 2013
2. Gil Masters, Renewable and Efficient Electric Power System, Wiley-IEEE Press, 2e, 2013.

**Reference Books:**

1. A.G. Phadke and J.S. Thorp, Synchronized Phasor Measurements and their Applications, Springer Edition, 2e, 2017.
2. T. Ackermann, Wind Power in Power Systems, Hoboken, NJ, USA, John Wiley, 2e, 2012.

**Online Learning Resources:**

1. [https://onlinecourses.nptel.ac.in/noc22\\_ee82/preview](https://onlinecourses.nptel.ac.in/noc22_ee82/preview)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech IV-I Sem**

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**(20A04605) SIGNAL PROCESSING**  
**(Open Elective Course –II)**

**Course objectives:**

- Understand, represent and classify continuous time and discrete time signals and systems, together with the representation of LTI systems.
- Ability to represent continuous time signals (both periodic and non-periodic) in the time domain, sdomain and the frequency domain
- Understand the properties of analog filters, and have the ability to design Butterworth filters
- Understand and apply sampling theorem and convert a signal from continuous time to discrete time or from discrete time to continuous time (without loss of information)
- Able to represent the discrete time signal in the frequency domain
- Able to design FIR and IIR filters to meet given specifications

**Course Outcomes:**

- Understand and explain continuous time and discrete time signals and systems, in time and frequency domain
- Apply the concepts of signals and systems to obtain the desired parameter/ representation
- Analyse the given system and classify the system/arrive at a suitable conclusion
- Design analog/digital filters to meet given specifications
- Design and implement the analog filter using components/ suitable simulation tools
- Design and implement the digital filter using suitable simulation tools, and record the input and output of the filter for the given audio signal

**UNIT I**

Signal Definition, Signal Classification, System definition, System classification, for both continuous time and discrete time. Definition of LTI systems

**UNIT II**

Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems

**UNIT III**

Frequency response of ideal analog filters, Salient features of Butterworth filters Design and implementation of Analog Butterworth filters to meet given specifications

**UNIT IV**

Sampling Theorem- Statement and proof, converting the analog signal to a digital signal. Practical sampling. The Discrete Fourier Transform, Properties of DFT. Comparing the frequency response of analog and digital systems.

**UNIT V**

Definition of FIR and IIR filters. Frequency response of ideal digital filters  
Transforming the Analog Butterworth filter to the Digital IIR Filter using suitable mapping techniques, to meet given specifications. Design of FIR Filters using the Window technique, and the frequency sampling technique to meet given specifications Comparing the designed filter with the desired filter frequency response

**Textbooks:**

1. 'Signals and Systems', by Simon Haykin and Barry Van Veen, Wiley.

**References:**

1. 'Theory and Application of Digital Signal Processing', Rabiner and Gold
2. 'Signals and Systems', Schaum's Outline series
3. 'Digital Signal Processing', Schaum's Outline series

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**B.Tech III-II Sem**

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**(20A04701b) INTRODUCTION TO INTERNET OF THINGS**

**(Open Elective Course-II)**

**Course Objectives:**

Students will understand the concepts of Internet of Things and can able to build IoT applications.

**Course Outcomes:**

- Understand the concepts of Internet of Things
- Identify hardware and software components of Internet of Things
- Analyze basic communication protocols
- Design IoT applications in different domain and be able to analyze their performance

**UNIT 1**

Introduction to IoT: Architectural overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals-Devices and gateways, Data management, Business processes in IoT, Role of cloud in IoT

**UNIT II**

Elements of IoT: Hardware components – computing (Arduino, Raspberry Pi), communication, Sensing, Actuation, I/O interfaces Software Components- Programming APIs (Using python/Arduino) for communication protocols-MQTT, Zigbee, Bluetooth, CoAP, UDP, TCP

**UNIT III**

Sensing and Actuation: Definition of Sensor, Sensor features, Resolution, Classes, Different types of sensors, Actuator, Different types of Actuators, purpose of Sensors and Actuators in IoT

**UNIT IV**

IoT Application Development: Solution frame work for IoT Applications-Implementation of Device integration, Data acquisition and Integration, Device data storage on cloud/local server, Authentication, authorization of Devices

**UNIT V**

IoT Case Studies: IoT Case studies and mini projects based on industrial Automation, Transportation, Agriculture, Healthcare, Home Automation.

**Textbooks:**

1. Vijay Madiseti, ArshdeepBahga, “Internet of Things a Hands-On- Approach”,2014.

**References:**

1. Dr SRN Reddy, RachitThukral and Manasi Mishra ,” Introduction to Internet of Things”: A practical Approach” ETI Labs
2. Raj Kamal , “ Internet of Things: Architecture and Design”, McGraw Hill
3. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013



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**B.Tech III-II Sem**

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**(20A05605a) PRINCIPLES OF OPERATING SYSTEMS**  
**(Open Elective Course – II)**

**Course Objectives:**

- Understand basic concepts and functions of operating systems
- Understand the processes, threads and scheduling algorithms.
- Expose the students with different techniques of handling deadlocks
- Provide good insight on various memory management techniques
- Explore the concept of file-system and its implementation issues

**Course Outcomes:**

- Demonstrate and understand of computer systems and operating systems functions
- Distinguish between process and thread and classify scheduling algorithms
- Solve synchronization and deadlock problems
- Compare various memory management schemes
- Explain file systems concepts and i/o management

**UNIT I Introduction to Computer and Operating system**

Computer Types, Functional Units, Basic Operational Concepts, Number Representation and Arithmetic Operations, Character Representation, Performance, Historical Perspective, Memory Locations and Addresses, Memory operations, Instructions and Instruction Sequencing, Addressing modes Architecture Operating System Structure, Operations Process, Memory, Storage Management, Protection and Security Computing Environments Operating System Services User Operating System Interface System Calls Types System Programs OS Structure OS Generation System Boot.

**UNIT II Process, Threads and Scheduling**

Process Concept Scheduling Operations on Processes Cooperating Processes Inter-Process Communication Threads - Multithreading Models -Thread Libraries- Threading Issues – Scheduling Criteria Scheduling Algorithms Algorithm Evaluation.

**UNIT III Process Synchronization and Deadlocks**

The Critical-Section Problem Synchronization Hardware Mutex Locks -Semaphores Classic Problems of Synchronization Critical Regions Monitors Deadlocks System Model Deadlock Characterization Methods for Handling Deadlocks Deadlock Prevention Deadlock Avoidance Deadlock Detection Recovery from Deadlock.

**UNIT IV Memory Management**

Introduction - Swapping Contiguous Memory Allocation Paging Segmentation- Structure of the Page Table - Virtual Memory- Background Demand Paging Copy on Write Page Replacement Allocation of Frames Thrashing.

**UNIT V Input/ Output and Files**

Overview of Mass Storage Structure - Disk Structure - Disk Scheduling and Management-File System Interface File Concept - Access Methods -Directory and Disk Structure- Directory Implementation - Allocation Methods- I/O Systems I/O Hardware- Application I/O Interface - Kernel I/O Subsystem.

**Textbooks:**

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.
2. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating Systems Concepts, Ninth Edition, Wiley, 2012.

**Reference Books:**

1. William Stallings, Operating Systems: Internals and Design Principles, Ninth Edition, Prentice-Hall, 2018.
2. Andrew Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall, 2009.

**Online Learning Resources:**

<https://nptel.ac.in/courses/106/106/106106144/>  
<http://peterindia.net/OperatingSystems.html>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B.Tech III-II Sem

**L T P C**  
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**(20A05605b) FOUNDATIONS OF MACHINE LEARNING**

**Open Elective Course– II**

**Course Objectives:**

- Acquire theoretical knowledge on setting hypothesis for pattern recognition.
- Apply suitable machine learning techniques for data handling and to gain knowledge from it.
- Evaluate the performance of algorithms and to provide solution for various real-world applications.

**Course Outcomes (CO):**

After completion of the course, students will be able to

- Understand the characteristics of machine learning strategies.
- Apply various supervised learning methods to appropriate problems.
- Identify and integrate more than one technique to enhance the performance of learning.
- Create probabilistic and unsupervised learning models for handling unknown pattern.
- Analyse the co-occurrence of data to find interesting frequent patterns.
- Pre-process the data before applying to any real-world problem and can evaluate its performance

**UNIT - I Introduction to Machine Learning Lecture 8Hrs**

What is machine learning, learning associations, classification, regression, unsupervised learning, reinforcement learning

Supervised Learning: learning a class from examples, learning multiple classes, model selection and generalization

**UNIT - II Parametric, Non-Parametric methods Lecture 9Hrs**

Parametric Methods: Introduction, maximum likelihood estimation, evaluating an estimator, parametric classification, regression, model selection procedures

Nonparametric Methods: Introduction, nonparametric density estimation: histogram estimator, kernel estimator, k-nearest neighbour estimator

**UNIT - III Multivariate Methods Lecture 9Hrs**

Multivariate Methods: Multivariate data, parameter estimation, estimation of missing values, multivariate normal distribution, multi variate classification

**UNIT - IV Dimensionality Reduction, Clustering Lecture 8Hrs**

Dimensionality Reduction: Introduction, subset selection, principal component analysis, singular value decomposition and matrix factorization

Clustering: Mixture densities, k-means clustering, expectation-maximization algorithm, mixtures of latent variables

**UNIT - V Deep Learning Lecture 8Hrs**

Deep Learning: Introduction, train multiple hidden layers, improving training convergence, regularization, convolution layers, tuning the network structure, learning sequences.

**Textbooks:**

1. EthemAlpaydin, Introduction to Machine Learning, Fourth Edition, MIT Press, Fourth Edition, 2020
2. MehryarMohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012

**Reference Books:**

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2019.
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, CRC Press, 2015.
3. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014.

**Online Learning Resources:**

1. <https://bloomberg.github.io/foml/>
2. [https://d1rkab7tlqy5f1.cloudfront.net/EWI/Over%20de%20faculteit/Afdelingen/Intelligent%20Systems/Pattern%20Recognition%20Laboratory/PR/Reading%20Group/Foundations\\_of\\_Machine\\_Learning.pdf](https://d1rkab7tlqy5f1.cloudfront.net/EWI/Over%20de%20faculteit/Afdelingen/Intelligent%20Systems/Pattern%20Recognition%20Laboratory/PR/Reading%20Group/Foundations_of_Machine_Learning.pdf)



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (IT)– III-II Sem**

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**(20A05605c) DATA ANALYTICS USING R**  
**(Open Elective-II)**

**Course Objectives:**

- Facilitate students to understand R programming
- Help students to gain a basic understanding of Data Analytics
- Inculcate working knowledge of plotting

**Course Outcomes:**

- Identify and execute basic syntax and programs in R
- Perform the Matrix operations using R built in functions
- Apply nonnumeric values in vectors
- Create the list and data frames
- Exploit the graph using ggplot2.

**UNIT I Introduction to R Programming**

History and Overview of R- Basic Features of R-Design of the R System- Installation of R- Console and Editor Panes- Comments- Installing and Loading R Packages- Help Files and Function Documentation-Saving Work and Exiting R- Conventions- R for Basic Math-Arithmetic- Logarithms and Exponentials - E-Notation - Assigning Objects – Vectors - Creating a Vector-Sequences, Repetition, Sorting and Lengths – Subsetting and Element Extraction -Vector – Oriented Behavior.

**UNIT II Matrices and Arrays**

Defining a Matrix – Defining a Matrix- Filling Direction- Row and Column Bindings- Matrix Dimensions-Subsetting- Row, Column, and Diagonal Extractions- Omitting and Overwriting- Matrix Operations and Algebra- Matrix Transpose- Identity Matrix- Matrix Addition and Subtraction- Matrix Multiplication-Matrix Inversion-Multidimensional Arrays-Subsets, Extractions and Replacements.

**UNIT III Non-Numeric values**

Logical Values- Relational Operators- Characters- Creating a String- Concatenation- Escape Sequences-Substrings and Matching- Factors- Identifying Categories- Defining and Ordering Levels- Combining and Cutting.

**UNIT IV Lists and Data frames**

List of Objects - Component Access – Naming – Nesting - Data Frames - Adding Data Columns and Combining Data Frames – Logical Record Subsets – Some Special Values – Infinity – NaN – NA - NULL – Attributes – Object - Class-Is-Dot Object-Checking Functions-As-Dot Coercion Functions

**UNIT V Basic Plotting**

Using plot with Coordinate Vectors-Graphical Parameters-Automatic Plot Types-Title and Axis Labels-Color-Line and Point Appearances-Plotting Region Limits-Adding Points, Lines, and Text to an ExistingPlot-ggplot2 Package-Quick Plot with qplot-Setting Appearance Constants with Geoms—Reading and Writing Files- R-Ready Data Sets- Contributed Data Sets- Reading in External Data Files- Writing Out Data Files and Plots-AdHoc Object Read/Write Operations

**Textbooks:**

1. Tilman M. Davies, “The Book of R-A First Programming, Statistics” Library of Congress Cataloging-in-Publication Data, 2016.

**Reference Books:**

1. Hadley Wickham, Garrett Grolemund, ”R for Data Science”, Oreilly Publication, 2017.
2. Roger D. Peng, “R Programming for Data Science” Lean Publishing, 2016.
3. Steven Keller, “R Programming for Beginners”, CreateSpace Independent Publishing Platform 2016.

**Online Learning Resources:**

1. <https://www.coursera.org/learn/data-analysis-r>
2. <https://www.careers360.com/courses-certifications/data-analysis-with-r-courses-brpg>

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech III-II Sem

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3 0 0 3

(20A27605) FOOD REFRIGERATION AND COLD CHAIN MANAGEMENT

OPEN ELECTIVE II

**Course Objectives:**

- To know the equipment available to store perishable items for a long time
- To understand to increase the storage life of food items

**Course Outcomes**

By the end of the course, the students will

- Understand various principles and theories involved in refrigeration systems
- Understand the different equipment useful to store the food items for a long period.
- Understand how to increase the storage life of food items

**UNIT I**

Principles of refrigeration: Definition, background with second law of thermodynamics, unit of refrigerating capacity, coefficient of performance; Production of low temperatures: Expansion of a liquid with flashing, reversible/ irreversible adiabatic expansion of a gas/ real gas, thermoelectric cooling, adiabatic demagnetization; Air refrigerators working on reverse Carnot cycle: Carnot cycle, reversed Carnot cycle, selection of operating temperatures;

**UNIT II**

Air refrigerators working on Bell Coleman cycle: Reversed Brayton or Joule or Bell Coleman cycle, analysis of gas cycle, polytropic and multistage compression; Vapour refrigeration: Vapor as a refrigerant in reversed Carnot cycle with p-V and T-s diagrams, limitations of reversed Carnot cycle; Vapour compression system: Modifications in reverse Carnot cycle with vapour as a refrigerant (dry vs wet compression, throttling vs isentropic expansion), representation of vapor compression cycle on pressure- enthalpy diagram, super heating, sub cooling;

**UNIT III**

Liquid-vapour regenerative heat exchanger for vapour compression system, effect of suction vapour super heat and liquid sub cooling, actual vapour compression cycle; Vapour-absorption refrigeration system: Process, calculations, maximum coefficient of performance of a heat operated refrigerating machine, Common refrigerants and their properties: classification, nomenclature, desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical; Azeotropes; Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve;

**UNIT IV**

Ice manufacture, principles and systems of ice production, Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice; Cold storage: Cold store, design of cold storage for different categories of food resources, size and shape, construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fitting, evaporators, automated cold stores, security of operations; Refrigerated transport: Handling and distribution, cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display;

**UNIT V**

Air-conditioning: Meaning, factors affecting comfort air-conditioning, classification, sensible heat factor, industrial air-conditioning, problems on sensible heat factor; Winter/summer/year round air-conditioning, unitary air-conditioning systems, central air-conditioning, physiological principles in air-conditioning, air distribution and duct design methods; design of complete air-conditioning systems; humidifiers and dehumidifiers; Cooling load calculations: Load sources, product cooling, conducted heat, convected heat, internal heat sources, heat of respiration, peak load; etc.

**Textbooks:**

1. Arora, C. P. "Refrigeration and Air Conditioning". Tata MC Graw Hill Publishing Co.Ltd., New Delhi. 1993.

**References:**

1. Adithan, M. and Laroia, S. C. "Practical Refrigeration and Air Conditioning". Wiley Eastern Ltd., New Delhi 1991

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech III-II Sem** **L T P C**  
**3 0 0 3**  
**(20A54701) WAVELET TRANSFORMS AND ITS APPLICATIONS**  
**(Open Elective-II)**

**Course Objectives:**

This course provides the students to understand Wavelet transforms and its applications.

**Course Outcomes:**

- Understand wavelets and wavelet expansion systems.
- Illustrate the multi resolution analysis and scaling functions.
- Form fine scale to coarse scale analysis.
- Find the lattices and lifting.
- Perform numerical complexity of discrete wavelet transforms.
- Find the frames and tight frames using fourier series.

**UNIT I** Wavelets

Wavelets and Wavelet Expansion Systems - Wavelet Expansion- Wavelet Transform- Wavelet System- More Specific Characteristics of Wavelet Systems -Haar Scaling Functions and Wavelets - effectiveness of Wavelet Analysis -The Discrete Wavelet Transform the Discrete-Time and Continuous Wavelet Transforms.

**UNIT II** A Multiresolution Formulation of Wavelet Systems

Signal Spaces -The Scaling Function -Multiresolution Analysis - The Wavelet Functions - The Discrete Wavelet Transform- A Parseval's Theorem - Display of the Discrete Wavelet Transform and the Wavelet Expansion.

**UNIT III** Filter Banks and the Discrete Wavelet Transform

Analysis - From Fine Scale to Coarse Scale- Filtering and Down-Sampling or Decimating -Synthesis - From Coarse Scale to Fine Scale -Filtering and Up-Sampling or Stretching - Input Coefficients - Lattices and Lifting - -Different Points of View.

**UNIT IV** Time-Frequency and Complexity

Multiresolution versus Time-Frequency Analysis- Periodic versus Nonperiodic Discrete Wavelet Transforms -The Discrete Wavelet Transform versus the Discrete-Time Wavelet Transform- Numerical Complexity of the Discrete Wavelet Transform.

**UNIT V** Bases and Matrix Examples

Bases, Orthogonal Bases, and Biorthogonal Bases -Matrix Examples - Fourier Series Example - Sine Expansion Example - Frames and Tight Frames - Matrix Examples -Sine Expansion as a Tight Frame Example.

**Textbooks:**

1. C. Sidney Burrus, Ramesh A. Gopinath, "Introduction to Wavelets and Wavelets Transforms", Prentice Hall, (1997).
2. James S. Walker, "A Primer on Wavelets and their Scientific Applications", CRC Press, (1999).

**Reference Books:**

1. Raghuveer Rao, "Wavelet Transforms", Pearson Education, Asia.

## Online Learning Resources:

<https://www.slideshare.net/RajEndiran1/introduction-to-wavelet-transform-51504915>

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech III-II Sem

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3 0 0 3

## (20A56701) PHYSICS OF ELECTRONIC MATERIALS AND DEVICES

(Open Elective-II)

**Course Objectives:**

- To impart the fundamental knowledge on various materials, their properties and applications.
- To provide insight into various semiconducting materials, and their properties.
- To enlighten the characteristic behavior of various semiconductor devices.
- To provide the basics of dielectric and piezoelectric materials and their properties.
- To explain different categories of magnetic materials, mechanism and their advanced applications.

**Course Outcome:** At the end of the course the student will be able

- To understand the fundamentals of various materials.
- To exploit the physics of semiconducting materials
- To familiarize with the working principles of semiconductor-based devices.
- To understand the behaviour of dielectric and piezoelectric materials.
- To identify the magnetic materials and their advanced applications.

**UNIT I Fundamentals of Materials Science**

Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. Basic idea of point, line and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RT and glow discharge).

**UNIT II Semiconductors**

Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, Diffusion and recombination, Diffusion length. The Fermi level & Fermi-Dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration- Qualitative analysis, Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects.

**UNIT III Physics of Semiconductor devices**

Introduction, Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Construction and working principles of: Light emitting diodes, Heterojunctions, Transistors, FET and MOSFETs.

**UNIT IV Dielectric Materials and their applications:**

Introduction, Dielectric properties, Electronic polarizability and susceptibility, Dielectric constant and frequency dependence of polarization, Dielectric strength and dielectric loss, Piezoelectric properties.

**UNIT V Magnetic Materials and their applications**

Introduction, Magnetism & various contributions to para and dia magnetism, Ferro and Ferri magnetism and ferrites, Concepts of Spin waves and Magnons, Anti-ferromagnetism, Domains and domain walls, Coercive force, Hysteresis, Nano-magnetism, Super-paramagnetism – Properties and applications.

**Textbooks**

1. Principles of Electronic Materials and Devices- S.O. Kasap, McGraw-Hill Education (India) Pvt. Ltd., 3rd edition, 2007.
2. Electronic Components and Materials- Grover and Jamwal, Dhanpat Rai and Co.

**Reference Books:**

1. Solid State Electronic Devices -B.G. Streetman and S. Banerjee, PHI Learning, 6th edition
2. Electronic Materials Science- Eugene A. Irene, , Wiley, 2005
3. An Introduction to Electronic Materials for Engineers-Wei Gao, Zhengwei Li, Nigel Sammes, World Scientific Publishing Co. Pvt. Ltd., , 2nd Edition,2011
4. A First Course In Material Science- by Raghvan, McGraw Hill Pub.
5. The Science and Engineering of materials- Donald R.Askeland, Chapman& Hall Pub.

**NPTEL courses links:** <https://nptel.ac.in/courses/113/106/113106062/>,
[https://onlinecourses.nptel.ac.in/noc20\\_mm02/preview](https://onlinecourses.nptel.ac.in/noc20_mm02/preview), <https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-mm07>



## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech III-II Sem

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## (20A51701) CHEMISTRY OF POLYMERS AND ITS APPLICATIONS

**Course Objectives:**

- To understand the basic principles of polymers
- To synthesize the different polymeric materials and their characterization by various instrumental methods.
- To impart knowledge to the students about fundamental concepts of Hydro gels of polymer networks, surface phenomenon by micelles
- To enumerate the applications of polymers in engineering

**Course Outcome**

- At the end of the course, the student will be able to:
- Understand the state of art synthesis of Polymeric materials
- Understand the hydro gels preparation, properties and applications in drug delivery system.
- Characterize polymers materials using IR, NMR, XRD.
- Analyze surface phenomenon fo micelles and characterise using photoelectron spectroscopy, ESCA and Auger spectroscopy

**UNIT I : Polymers-Basics and Characterization**

Basic concepts: monomers, repeat units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: condensation, addition, radical chain, ionic and coordination and copolymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution Measurement of molecular weight: end group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

**Unit II : Synthetic Polymers**

Addition and condensation polymerization processes – Bulk, Solution, Suspension and Emulsion polymerization.

Preparation and significance, classification of polymers based on physical properties, Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications.

Preparation of Polymers based on different types of monomers, Olefin polymers, Diene polymers, nylons, Urea - formaldehyde, phenol - formaldehyde and melamine Epoxy and Ion exchange resins. Characterization of polymers by IR, NMR, XRD.

**UNIT III : Natural Polymers & Modified cellulotics**

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.

Modified cellulotics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEAK.

Learning Outcomes:

**UNIT IV: Hydrogels of Polymer networks and Drug delivery**

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.

Introduction to drug systems including, drug development, regulation, absorption and disposition, routes of administration and dosage forms. Advanced drug delivery systems and controlled release.

**UNIT V : Surface phenomena**

Surface tension, adsorption on solids, electrical phenomena at interfaces including electrokinetics, micelles, reverse micelles, solubilization. Application of photoelectron spectroscopy, ESCA and Auger spectroscopy to the study of surfaces.

**References :**

1. A Text book of Polymer science, Billmayer

2. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
3. Advanced Organic Chemistry, B.Miller, Prentice Hall
4. Polymer Chemistry – G.S.Mishra
5. Polymer Chemistry – Gowarikar
6. Physical Chemistry –Galston
7. Drug Delivery- Ashim K. Misra

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech IV-I Sem**

**L T P C**  
**3 0 0 3**

**(20A01704) COST EFFECTIVE HOUSING TECHNIQUES**  
**(Open Elective Course - III)**

**Course Objectives:**

- To understand the requirements of structural safety for future construction.
- To know about the housing scenario, housing financial systems land use and physical planning for housing and housing the urban poor
- To know the traditional practices of rural housing
- To know the different innovative cost effective construction techniques
- To know the alternative building materials for low cost housing.

**Course Outcomes :**

- To know the repair and restore action of earthquake damaged non engineered buildings and ability to understand the requirements of structural safety for future construction
- To know about the housing scenario, housing financial systems land use and physical planning for housing and housing the urban poor
- Apply the traditional practices of rural housing
- Understand the different innovative cost effective construction techniques
- Suggest the alternative building materials for low cost housing

**UNIT I**

- a) **Housing Scenario** :Introducing - Status of urban housing - Status of Rural Housing
- b) **Housing Finance**: Introducing - Existing finance system in India - Government role as facilitator - Status at Rural Housing Finance - Impedimently in housing finance and related issues
- c) **Land use and physical planning for housing** :Introduction - Planning of urban land - Urban land ceiling and regulation act - Efficiency of building bye lass - Residential Densities
- d) **Housing the urban poor** :Introduction - Living conditions in slums - Approaches and strategies for housing urban poor

**UNIT II**

**Development and adoption of low cost housing technology**

Introduction - Adoption of innovative cost effective construction techniques - Adoption of precast elements in partial prefatroids - Adopting of total prefabrication of mass housing in India- General remarks on pre cast roofing/flooring systems -Economical wall system - Single Brick thick loading bearing wall - 19cm thick load bearing masonry walls - Half brick thick load bearing wall – Fly-ash gypsum thick for masonry - Stone Block masonry - Adoption of precast R.C. plank and join system for roof/floor in the building

**UNIT III**

**Alternative building materials for low cost housing**

Introduction - Substitute for scarce materials – Ferro-cement - Gypsum boards - Timber substitutions - Industrial wastes - Agricultural wastes - alternative building maintenance

**Low cost Infrastructure services:**

Introduce - Present status - Technological options - Low cost sanitation - Domestic wall - Water supply, energy

**UNIT IV**

**Rural Housing:** Introduction traditional practice of rural housing continuous - Mud Housing technology Mud roofs - Characteristics of mud - Fire treatment for thatch roof - Soil stabilization - Rural Housing programs

**UNIT V**

**Housing in Disaster prone areas:**

Introduction – Earthquake - Damages to houses - Traditional prone areas - Type of Damages and Repairs of non-engineered buildings - Repair and restore action of earthquake Damaged non-engineered buildings recommendations for future constructions. Requirement's of structural safety of thin precast roofing units against Earthquake forces Status of R& D in earthquake strengthening measures - Floods, cyclone, future safety

**Textbooks:**

1. Building materials for low – income houses – International council for building research studies and documentation.
2. Hand book of low cost housing by A.K.Lal – Newage international publishers.
3. Low cost Housing – G.C. Mathur by South Asia Books

**Reference Books:**

1. Properties of concrete – Neville A.m. Pitman Publishing Limited, London.
2. Light weight concrete, Academic Kiado, Rudhai.G – Publishing home of Hungarian Academy of Sciences 1963.
3. Modern trends in housing in developing countries – A.G. Madhava Rao, D.S. Rama chandra Murthy &G.Annamalai. E. & F. N. Spon Publishers

**Online Learning Resources:**

<https://nptel.ac.in/courses/124107001>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem**

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**3 0 0 3**

**(20A02704) IoT APPLICATIONS IN ELECTRICAL ENGINEERING**

**(Open Elective Course – III)**

**Course Objectives:**

- Understand basics of Internet of Things and Micro Electro Mechanical Systems (MEMS) fundamentals in design and fabrication process
- Analyze motion less and motion detectors in IoT applications
- Understand about Analyze applications of IoT in smart grid
- Apply the concept of Internet of Energy for various applications

**Course Outcomes:**

- Understand the concept of IoT in Electrical Engineering
- Analyze various types of motionless sensors and various types of motion detectors
- Apply various applications of IoT in smart grid
- Design future working environment with Energy internet

**UNIT I                      SENSORS**

Definitions, Terminology, Classification, Temperature sensors, Thermoresistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflectometer, Pressure and Force sensors: Piezoresistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric

**UNIT II                      OCCUPANCY AND MOTION DETECTORS**

Capacitive occupancy, Inductive and magnetic, potentiometric - Position, displacement and level sensors, Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, Capacitive, Piezoresistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors - Resistive microphones, Piezoelectric, Photo resistors

**UNIT III                      MEMS**

Basic concepts of MEMS design, Beam/diaphragm mechanics, electrostatic actuation and fabrication, Process design of MEMS based sensors and actuators, Touch sensor, Pressure sensor, RF MEMS switches, Electric and Magnetic field sensors

**UNIT IV                      IoT FOR SMART GRID**

Driving factors, Generation level, Transmission level, Distribution level, Applications, Metering and monitoring applications, Standardization and interoperability, Smart home

**UNIT V                      INTERNET of ENERGY (IoE)**

Concept of Internet of Energy, Evaluation of IoE concept, Vision and motivation of IoE, Architecture, Energy routines, information sensing and processing issues, Energy internet as smart grid

**Textbooks:**

1. Jon S. Wilson, Sensor Technology Hand book, Newnes Publisher, 2004
2. Tai Ran Hsu, MEMS and Microsystems: Design and manufacture, 1<sup>st</sup> Edition, Mc Grawhill Education, 2017
3. Ersan Kabalci and Yasin Kabalci, From Smart grid to Internet of Energy, 1<sup>st</sup> Edition, Academic Press, 2019

**Reference Books:**

1. Raj Kumar Buyya and Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Kindle Edition, Morgan Kaufmann Publisher, 2016
2. Yen Kheng Tan and Mark Wong, Energy Harvesting Systems for IoT Applications: Generation, Storage and Power Management, 1<sup>st</sup> Edition, CRC Press, 2019
3. RMD Sundaram Shriram, K. Vasudevan and Abhishek S. Nagarajan, Internet of Things, Wiley, 2019

**Online Learning Resources:**

1. [https://onlinecourses.nptel.ac.in/noc22\\_cs96/preview](https://onlinecourses.nptel.ac.in/noc22_cs96/preview)
2. <https://nptel.ac.in/courses/108108123>
3. <https://nptel.ac.in/courses/108108179>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech IV-I Sem**

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**3 0 0 3**

**(20A04704) ELECTRONIC SENSORS**  
**(Open Elective Course –III)**

**Course Objectives:**

- Learn the characterization of sensors.
- Known the working of Electromechanical, Thermal, Magnetic and radiation sensors
- Understand the concepts of Electro analytic and smart sensors
- Able to use sensors in different applications

**Course Outcomes:**

- Learn about sensor Principle, Classification and Characterization.
- Explore the working of Electromechanical, Thermal, Magnetic, radiation and Electro analytic sensors
- Understand the basic concepts of Smart Sensors
- Design a system with sensors

**UNIT I**

**Sensors / Transducers:** Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization

**Electromechanical Sensors:** Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges -Inductive Sensors: Sensitivity and Linearity of the Sensor – Types-Capacitive Sensors: Electrostatic Transducer, Force/Stress Sensors Using Quartz Resonators, Ultrasonic Sensors

**UNIT II**

**Thermal Sensors:** Introduction, Gas thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor ,Dielectric Constant and Refractive Index thermo sensors, Helium Low Temperature Thermometer ,Nuclear Thermometer ,Magnetic Thermometer ,Resistance Change Type Thermometric Sensors, Thermo emf Sensors, Junction Semiconductor Types, Thermal Radiation Sensors, Quartz Crystal Thermoelectric Sensors, NQR Thermometry, Spectroscopic Thermometry, Noise Thermometry, Heat Flux Sensors

**UNIT III**

**Magnetic sensors:** Introduction, Sensors and the Principles Behind, Magneto-resistive Sensors, Anisotropic Magneto resistive Sensing, Semiconductor Magneto resistors, Hall Effect and Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers, Synchros.

**UNIT IV**

**Radiation Sensors:** Introduction, Basic Characteristics, Types of Photo resistors/ Photo detectors, Xray and Nuclear Radiation Sensors, Fibre Optic Sensors

**Electro analytical Sensors:** The Electrochemical Cell, The Cell Potential - Standard Hydrogen Electrode (SHE), Liquid Junction and Other Potentials, Polarization, Concentration Polarization, Reference Electrodes, Sensor Electrodes, Electro ceramics in Gas Media.

**UNIT V**

**Smart Sensors:** Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing - Data Communication, Standards for Smart Sensor Interface, the Automation Sensors –Applications: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing –Sensors for environmental Monitoring

**Textbooks:**

1. “Sensors and Transducers - D. Patranabis” –PHI Learning Private Limited., 2003.
2. Introduction to sensors- John veteline, aravindraghu, CRC press, 2011

**References:** 1. Make sensors: Terokarvinen, kemo, karvinen and villeyvaltokari, 1st edition, maker media,2014.

Sensors handbook- Sabriesoloman, 2nd Ed. TMH, 2009

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

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**(20A05704a) WEB TECHNOLOGIES**  
**(Open Elective-III)**

**Course Objectives:**

The course is designed to Introduce the key technologies that have been developed as part of the birth and maturation of the World Wide Web.

**Course Outcomes:**

- Understand the Web essentials.
- Develop web pages using XHTML
- Apply style to web pages using CSS
- Write scripts for client side
- Develop and transform XML documents.

**UNIT I            Web Essentials: Clients, Servers, and Communication**

The Internet, Basic Internet protocols, WWW, HTTP request message, HTTP response message, Web clients, Web Servers, Case study.

**UNIT II            Markup Languages: XHTML 1.0**

An introduction to HTML, Basic XHTML syntax and semantics, fundamental HTML elements, Relative URLs, Lists, Tables, Frames, Forms, Defining XHTML's abstract syntax, Creating HTML documents.

**UNIT III            Cascading Style Sheets**

Introduction, features, core syntax, style sheets and HTML, style rule cascading and inheritance, text properties, Box model, normal flow box layout, beyond the normal flow, lists, tables, cursor styles.

**UNIT IV            Client-side programming: JavaScript**

Basic syntax, variables and data types, statements, operators, literals, functions, objects, Arrays, built-in objects, JavaScript debuggers.

**UNIT V            Representing Web Data: XML**

Documents and vocabularies, Versions and declaration, Namespaces, Ajax, DOM and SAX parsers, transforming XML documents, XPath, XSLT, Displaying XML documents in Web browsers.

**Textbooks:**

1. J.C. Jackson, Web technologies: A computer science perspective, Pearson.

**Reference Books:**

1. Sebesta, Programming world wide web, Pearson.
2. Dietel and Nieto , Internet and World Wide Web – How to program, Pearson Education
3. Chris Bates , Web Programming, building internet applications, 2nd edition, WILEY, Dreamtech

**Online Learning Resources:**

<http://getbootstrap.com/>

<https://www.w3schools.com/whatis/>

<https://nptel.ac.in/courses/106105084>



## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

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**(20A05704b) VR & AR FOR ENGINEERS**  
**(Open Elective Course – III)**

**Course Objectives:**

- Introduce to the design of visualization tools
- Demonstrate Virtual reality
- Learn Virtual reality animation and 3D Art optimization
- Understand the foundational principles describing how hardware, computer vision algorithms function
- Explore the history of spatial computing and design interactions

**Course Outcomes:**

- Apply VR/MR/AR in various fields in industry
- Design Data visualization tools
- Design audio and video interaction paradigms
- Apply technical and creative approaches to make successful applications and experiences.
- Explain how the humans interact with computers

**UNIT I****Computer generated worlds:** what is augmented reality? what is virtual reality?**Understanding virtual space:** defining visual space and content, defining position and orientation in three dimensions, navigation**The Mechanics of Sight:** the visual path way, spatial vision, and Depth Cues.**Component Technologies of Head mounted Displays:** Display fundamentals, related terminology and concepts, optical Architectures.**UNIT II****Augmented Displays:** Binocular augmenting displays, Monocular augmenting displays.**Fully immersive Displays:** PC-Console driven displays, smartphone based displays, CAVES and Walls, Hemispheres and Domes.**The Mechanics of hearing:** Defining sound, the auditory pathway, sound cues and localization, the vestibular system.**Audio displays:** Conventional audio**UNIT III****The Mechanics of Feeling:** The Science of feeling, Anatomy and Composition of the skin.**Tactile and force feedback Devices:**Haptic illusions, tactile feedback devices, Force feedback devices.**Sensors for tracking Position, and orientation and motion:** introduction to sensor technologies, optical trackers, beacon trackers,electromagnetic trackers, inertial sensors, acoustic sensors.**Devices to enable navigation and interaction:** 2D vs 3D interaction and navigation, the importance of a manual interface, hand and gesture tracking, whole body tracking, gaming and entertainment interfaces, navigating with your mind.**UNIT IV****Gaming and Entertainment:**Virtual reality and the arts, gaming, immersive video/ cinematic virtual reality.**Architecture and Construction:**Artificial spaces, architectural design: Manage group architectures, Construction management, real estate sales applications, architectural acoustics.**Science and engineering:** Simulate and innovate, naval architecture and marine engineering, automotive engineering, aerospace engineering, nuclear engineering and manufacturing.**Health and medicine:** advancing the field of medicine, training applications, treatment applications.

## UNIT V

**Aerospace and Defence:** Flight simulation and training, mission planning and rehearsal, dismounted soldier situational awareness, advanced cockpit avionics, space operations.

**Education:** Tangible skills education, theory, knowledge acquisition and concept formation.

**Information control and big data visualization:** What is big data?, big data analytics and human vision.

**Telerobotics and Telepresence:** Defining Telerobotics and Telepresence, space applications and robonaut, undersea applications, Terrestrial and airborne applications.

### Textbooks:

1. Steve Aukstakalnis, “Practical Augmented Reality”, Pearson Education, 2017.

### Reference Books:

1. Erin Pangilinan, Steve lukas, and Vasanth Mohan, “Creating Augmented& Virtual Realities”, O'REILLY

### Online Learning Resources:

1. <https://www.coursera.org/learn/intro-augmented-virtual-mixed-extended-reality-technologies-applications-issues>
2. <https://www.coursera.org/learn/ar>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B.Tech IV-I Sem**

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**(20A05704c) SOFTWARE ENGINEERING  
(Open Elective Course – III)**

**Course Objectives:**

0. To learn the basic concepts of software engineering and life cycle models
1. To explore the issues in software requirements specification and enable to write SRS documents for software development problems
2. To elucidate the basic concepts of software design and enable to carry out procedural and object oriented design of software development problems
3. To understand the basic concepts of black box and white box software testing and enable to design test cases for unit, integration, and system testing
4. To reveal the basic concepts in software project management

**Course Outcomes (CO):**

After completion of the course, students will be able to

- Obtain basic software life cycle activity skills.
- Design software requirements specifications for given problems.
- Implement structure, object oriented analysis and design for given problems.
- Design test cases for given problems.
- Apply quality management concepts at the application level.

**UNIT - I                      Basic concepts in software engineering and software project management                      Lecture 8Hrs**

Basic concepts: abstraction versus decomposition, evolution of software engineering techniques, Software development life cycle (SDLC) models: Iterative waterfall model, Prototype model, Evolutionary model, Spiral model, RAD model, Agile models, software project management: project planning, project estimation, COCOMO, Halstead's Software Science, project scheduling, staffing, Organization and team structure, risk management, configuration management.

**UNIT - II                      Requirements analysis and specification                      Lecture 8Hrs**

The nature of software, The Unique nature of Webapps, Software Myths, Requirements gathering and analysis, software requirements specification, Traceability, Characteristics of a Good SRS Document, IEEE 830 guidelines, representing complex requirements using decision tables and decision trees, overview of formal system development techniques, axiomatic specification, algebraic specification.

**UNIT - III                      Software Design                      Lecture 9Hrs**

Good Software Design, Cohesion and coupling, Control Hierarchy: Layering, Control Abstraction, Depth and width, Fan-out, Fan-in, Software design approaches, object oriented vs. function oriented design. Overview of SA/SD methodology, structured analysis, Data flow diagram, Extending DFD

technique to real life systems, Basic Object oriented concepts, UML Diagrams, Structured design, Detailed design, Design review, Characteristics of a good user interface, User Guidance and Online Help, Mode-based vs Mode-less Interface, Types of user interfaces, Component-based GUI development, User interface design methodology: GUI design methodology.

UNIT - IV

**Coding and Testing**

Lecture 9Hrs

Coding standards and guidelines, code review, software documentation, Testing, Black Box Testing, White Box Testing, debugging, integration testing, Program Analysis Tools, system testing, performance testing, regression testing, Testing Object Oriented Programs.

UNIT - V

**Software quality, reliability, and other issues**

Lecture 9Hrs

Software reliability, Statistical testing, Software quality and management, ISO 9000, SEI capability maturity model (CMM), Personal software process (PSP), Six sigma, Software quality metrics, CASE and its scope, CASE environment, CASE support in software life cycle, Characteristics of software maintenance, Software reverse engineering, Software maintenance processes model, Estimation maintenance cost. Basic issues in any reuse program, Reuse approach, Reuse at organization level.

Textbooks:

1. Rajib Mall, "Fundamentals of Software Engineering", 5th Edition, PHI, 2018.
2. Pressman R, "Software Engineering- Practioner Approach", McGraw Hill.

Reference Books:

1. Somerville, "Software Engineering", Pearson 2.
2. Richard Fairley, "Software Engineering Concepts", Tata McGraw Hill.
3. JalotePankaj, "An integrated approach to Software Engineering", Narosa

Online Learning Resources:

<https://nptel.ac.in/courses/106/105/106105182/>

<http://peterindia.net/SoftwareDevelopment.html>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem**

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**(20A27704) HUMAN NUTRITION**  
**(OPEN ELECTIVE-III)**

**Course Objectives:**

- To get knowledge on Concepts and content of nutrition source and metabolic functions.
- To know about Balanced diets for various groups; Diets and disorders, recommended dietary allowances
- To learn about Epidemiology of under nutrition and over nutrition.
- To understand Nutrition and immunity.

**Course Outcomes:**

- To study the Salient features of Concepts and content of nutrition, Malnutrition, Nutrition education
- Assessment of nutritional status, disorders Food fad and faddism.

**UNIT I**

Concepts and content of nutrition: Nutrition agencies; Nutrition of community; Nutritional policies and their implementation; Metabolic function of nutrients. Nutrients: Sources, functions, digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings;

**UNIT II**

Water and energy balance: Water intake and losses; Basal metabolism- BMR; Body surface area and factors affecting BMR Formulation of diets: Classification of balanced diet; Balanced diets for various groups; Diets and disorders. Recommended dietary allowances (RDA); For various age group; According physiological status; Athletic and sports man; Geriatric persons

**UNIT III**

Malnutrition: Type of Malnutrition; Multi-factorial causes; Epidemiology of under nutrition and over nutrition; Nutrition and immunity.

**UNIT IV**

Nutrition education Assessment of nutritional status: Diet surveys; Anthropometry; Clinical examination; Biochemical assessment; Additional medical information

**UNIT V**

Blood constituents; Hormone types; Miscellaneous disorders Food fad and faddism. Potentially toxic substances in human food.

**Textbooks:**

1. Swaminathan M, Advanced Text Book on Food & Nutrition (Volume I and II) , The Bangalore Printing and Publishing Co.Ltd, Bangalore. 2006
2. Stewart Truswell, ABC of Nutrition (4th edition) , BMJ Publishing Group 2003, ISBN 0727916645.
3. Martin Eastwood, Principles of Human Nutrition , Blackwell Publishing, Boca Rotan

**Reference:**

1. Mike Lean and E. Combet ,Barasi's Human Nutrition – A Health Perspective , Second Edition CRC Press, London
2. Introduction to Human Nutrition, Micheal J. G., Susan A.L. Aedin C. and Hester H.V, Wiley-Blackwell Publication, UK 2009 , ISBN 9781405168076
3. Bogert L.J., Goerge M.B, Doris H.C., Nutrition and Physical Fitness, W.B. Saunders Company, Toronto, Canada

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

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(20A54702) NUMERICAL METHODS FOR ENGINEERS  
(OPEN ELECTIVE-III)

**Course Objectives:**

This course aims at providing the student with the knowledge on various numerical methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations.

**Course Outcomes:**

- Apply numerical methods to solve algebraic and transcendental equations.
- Understand fitting of several kinds of curves.
- Derive interpolating polynomials using interpolation formulae.
- Solve differential and integral equations numerically.

**UNIT I Solution of Algebraic & Transcendental Equations**

Introduction-Bisection Method-Iterative method-Regula falsi method-Newton Raphson method.  
System of Algebraic equations: Gauss Jordan method-Gauss Siedal method.

**UNIT II Curve Fitting**

Principle of Least squares- Fitting of curves- Fitting of linear, quadratic and exponential curves.

**UNIT III Interpolation**

Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae  
Gauss forward and backward formula, Stirling's formula, Bessel's formula

**UNIT IV Numerical Integration**

Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule

**UNIT V Solution of Initial value problems to Ordinary differential equations**

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method-Runge-Kutta Methods.

**Textbooks:**

3. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
4. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole,PNIE.
5. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India

**Reference Books:**

3. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
4. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.

**Online Learning Resources:**

<https://slideplayer.com/slide/8588078/>

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

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(20A56702) SENSORS AND ACTUATORS FOR ENGINEERING APPLICATIONS  
(OPEN ELECTIVE-III)

**Course Objectives:**

- To provide exposure to various kinds of sensors and actuators and their engineering applications.
- To impart knowledge on the basic laws and phenomenon behind the working of sensors and actuators
- To enlighten the operating principles of various sensors and actuators
- To educate the fabrication of sensors
- To identify the required sensor and actuator for interdisciplinary application

**Course Outcomes:**

- To recognize the need of sensors and actuators
- To understand working principles of various sensors and actuators
- To identify different type of sensors and actuators used in real life applications
- To exploit basics in common methods for converting a physical parameter into an electrical quantity
- To make use of sensors and actuators for different applications

**UNIT I Introduction to Sensors and Actuators**

**Sensors:** Types of sensors: temperature, pressure, strain, active and passive sensors, General characteristics of sensors (Principles only), Materials used and their fabrication process: Deposition: Chemical Vapor Deposition, Pattern: photolithography and Etching: Dry and Wet Etching.

**Actuators:** Functional diagram of actuators, Types of actuators and their basic principle of working: Hydraulic, Pneumatic, Mechanical, Electrical, Magnetic, Electromagnetic, piezo-electric and piezo-resistive actuators, Simple applications of Actuators.

**UNIT II Temperature and Mechanical Sensors**

**Temperature Sensors:** Types of temperature sensors and their basic principle of working: Thermo-resistive sensors: Thermistors, Resistance temperature sensors, Silicon resistive sensors, Thermo-electric sensors: Thermocouples, PN junction temperature sensors

**Mechanical Sensors:** Types of Mechanical sensors and their basic principle of working: Force sensors: strain gauges, tactile sensors, Pressure sensors: semiconductor, piezoresistive, capacitive, VRP.

**UNIT III Optical and Acoustic Sensors**

**Optical Sensors:** Basic principle and working of: Photodiodes, Phototransistors and Photo-resistors based sensors, Photomultipliers, Infrared sensors: thermal, PIR, thermopiles

**Acoustic Sensors:** Principle and working of Ultrasonic sensors, Piezo-electric resonators, Microphones.

**UNIT IV Magnetic, Electromagnetic Sensors and Actuators**

Motors as actuators (linear, rotational, stepping motors), magnetic valves, inductive sensors (LVDT, RVDT, and Proximity), Hall Effect sensors, Magneto-resistive sensors, Magneto-strictive sensors and actuators, Voice coil actuators (speakers and speaker-like actuators).

**UNIT V Chemical and Radiation Sensors**

**Chemical Sensors:** Principle and working of Electro-chemical, Thermo-chemical, Gas, pH, Humidity and moisture sensors.

**Radiation Sensors:** Principle and working of Ionization detectors, Scintillation detectors, Geiger-Mueller counters, Semiconductor radiation detectors and Microwave sensors (resonant, reflection, transmission)

**Textbooks:**

1. Sensors and Actuators – Clarence W. de Silva, CRC Press, 2<sup>nd</sup> Edition, 2015
2. Sensors and Actuators, D.A.Hall and C.E.Millar, CRC Press, 1999

**Reference Books:**

1. Sensors and Transducers- D.Patranabis, Prentice Hall of India (Pvt) Ltd. 2003
2. Measurement, Instrumentation, and Sensors Handbook-John G.Webster, CRC press 1999
3. Sensors – A Comprehensive Sensors- Henry Bolte, John Wiley.
4. Handbook of modern sensors, Springer, Stefan Johann Rupitsch.



5. Principles of Industrial Instrumentation By D. Patranabhis

**NPTEL courses links**

[https://onlinecourses.nptel.ac.in/noc21\\_ee32/preview](https://onlinecourses.nptel.ac.in/noc21_ee32/preview)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

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(20A51702) CHEMISTRY OF NANOMATERIALS AND APPLICATIONS

(OPEN ELECTIVE-III)

**Course Objectives:**

- To understand synthetic principles of Nanomaterials by various methods
- To characterize the synthetic nanomaterials by various instrumental methods
- To enumerate the applications of nanomaterials in engineering

**Course Outcomes:**

- Understand the state of art synthesis of nano materials
- Characterize nano materials using ion beam, scanning probe methodologies, position sensitive atom probe and spectroscopic ellipsometry.
- Analyze nanoscale structure in metals, polymers and ceramics
- Analyze structure-property relationship in coarser scale structures
- Understand structures of carbon nano tubes

**UNIT I**

Introduction: Scope of nanoscience and nanotechnology, nanoscience in nature, classification of nanostructured materials, importance of nano materials.

Synthetic Methods: Bottom-Up approach: Sol-gel synthesis, microemulsions or reverse micelles, co-precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and sonochemical synthesis.

**UNIT II**

Top-Down approach: Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapour deposition method, electrodeposition method, high energy ball milling.

**UNIT III**

Techniques for characterization: Diffraction technique, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterials, BET method for surface area analysis, dynamic light scattering for particle size determination.

**UNIT IV**

Studies of Nano-structured Materials: Synthesis, properties and applications of the following nanomaterials, fullerenes, carbon nanotubes, core-shell nanoparticles, nanoshells, self- assembled monolayers, and monolayer protected metal nanoparticles, nanocrystalline materials, magnetic nanoparticles and important properties in relation to nanomagnetic materials, thermoelectric materials, non-linear optical materials, liquid crystals.

**UNIT V**

Engineering Applications of Nanomaterials

**Textbooks:**

1. NANO: The Essentials: T Pradeep, McGraw-Hill, 2007.
2. Textbook of Nanoscience and nanotechnology: B S Murty, P Shankar, BaldevRai, BB Rath and James Murday, Univ. Press, 2012.

**References:**

1. Concepts of Nanochemistry; Ludovico Cademrtiri and Geoffrey A. Ozin & Geoffrey A. Ozin, Wiley-VCH, 2011.
2. Nanostructures & Nanomaterials; Synthesis, Properties & Applications: Guozhong Cao, Imperial College Press, 2007.
3. Nanomaterials Chemistry, C. N. R. Rao, Achim Muller, K.Cheetham, Wiley-VCH, 2007.

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

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**(20A01705) HEALTH, SAFETY AND ENVIRONMENTAL MANAGEMENT PRACTICES  
(Open Elective Course-IV)**

**Course Objectives:**

- To understand safety, health and environmental management.
- To be familiar with hazard classification and assessment, hazard evaluation and hazard control, environmental issues and management
- To get exposed to accidents modeling, accident investigation and reporting, concepts of HAZOP and PHA
- To be familiar with safety measures in design and process operations.
- To get exposed to risk assessment and management, principles and methods

**Course Outcomes :**

- To understand safety, health and environmental management.
- To be familiar with hazard classification and assessment, hazard evaluation and hazard control, environmental issues and management
- To get concepts of HAZOP and PHA.
- To be familiar with safety measures in design and process operations.

**UNIT I**

Introduction to safety, health and environmental management - Basic terms and their definitions - Importance of safety - Safety assurance and assessment - Safety in design and operation - Organizing for safety.

**UNIT II**

Hazard classification and assessment - Hazard evaluation and hazard control. Environmental issues and Management - Atmospheric pollution - Flaring and fugitive release - Water pollution - Environmental monitoring - Environmental management.

**UNIT III**

Accidents modelling - Release modelling - Fire and explosion modelling - Toxic release and dispersion Modelling

**UNIT IV**

Accident investigation and reporting - concepts of HAZOP and PHA. Safety measures in design and process operations - Inserting, explosion, fire prevention, sprinkler systems.

**UNIT V**

Risk assessment and management - Risk picture - Definition and characteristics - Risk acceptance criteria - Quantified risk assessment - Hazard assessment - Fatality risk assessment - Risk management principles and methods.

**Textbooks:**

1. Process Safety Analysis, by Skelton. B, Gulf Publishing Company, Houston, 210pp., 1997.
2. Risk Management with Applications from Offshore Petroleum Industry, by Terje Aven and Jan Erik Vinnem, Springer, 200pp., 2007.

**Reference Books:**

1. Introduction to Safety and Reliability of Structures, by Jorg Schneider
2. Structural Engineering Documents Vol. 5, International Association for Bridge and Structural Engineering (IABSE), 138pp., 1997.
3. Safety and Health for Engineers, by Roger L. Brauer, John Wiley and Sons Inc. pp. 645-663, 2006.

4. Health, Safety and Environmental Management in Offshore and Petroleum Engineering, Srinivasan Chandrasekaran, John Wiley and Sons, 2016.

**Online Learning Resources:**

<https://nptel.ac.in/courses/114106017>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem**

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**(20A02705) RENEWABLE ENERGY SYSTEMS**  
**(Open Elective Course – IV)**

**Course Objectives:**

- Understand various sources of Energy and the need of Renewable Energy Systems.
- Understand the concepts of Solar Radiation, Wind energy and its applications.
- Analyze solar thermal and solar PV systems
- Understand the concept of geothermal energy and its applications, biomass energy, the concept of Ocean energy and fuel cells.

**Course Outcomes:**

- Understand various alternate sources of energy for different suitable application requirements
- Understand the concepts of solar energy generation strategies and wind energy system
- Analyze Solar and Wind energy systems
- Understand the basics of Geothermal Energy Systems, various diversified energy scenarios of ocean, biomass and fuel cells

**UNIT I SOLAR ENERGY**

Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.

**UNIT II PV ENERGY SYSTEMS**

Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Electrical characteristics of silicon PV cells and modules, PV systems for remote power, Grid connected PV systems.

**UNIT III WIND ENERGY**

Principle of wind energy conversion; Basic components of wind energy conversion systems; windmill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.

**UNIT IV GEOTHERMAL ENERGY**

Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

**UNIT V MISCELLANEOUS ENERGY TECHNOLOGIES**

**Ocean Energy:** Tidal Energy-Principle of working, performance and limitations. Wave Energy-Principle of working, performance and limitations.

**Bio mass Energy:** Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration

**Fuel cell:** Principle of working of various types of fuel cells and their working, performance and limitations.

**Textbooks:**

1. Stephen Peake, “Renewable Energy Power for a Sustainable Future”, Oxford International Edition, 2018.
2. G. D. Rai, “Non-Conventional Energy Sources”, 4<sup>th</sup> Edition, Khanna Publishers, 2000.

**Reference Books:**

1. S. P. Sukhatme, “Solar Energy”,3<sup>rd</sup> Edition, Tata Mc Graw Hill Education Pvt. Ltd, 2008.
2. B H Khan , “ Non-Conventional Energy Resources”, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.
3. S. Hasan Saeed and D.K.Sharma,“Non-Conventional Energy Resources”,3<sup>rd</sup> Edition, S.K.Kataria& Sons, 2012.
4. G. N. Tiwari and M.K.Ghosal, “Renewable Energy Resource: Basic Principles and Applications”, Narosa Publishing House, 2004.

**Online Learning Resources:**

1. <https://nptel.ac.in/courses/103103206>
2. <https://nptel.ac.in/courses/108108078>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech IV-I Sem**

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**(20A04705) MICROCONTROLLERS & APPLICATIONS**  
**(Open Elective Course –IV)**

**Course Objectives:**

- Describe the Architecture of 8051 Microcontroller and Interfacing of 8051 to external memory.
- Write 8051 Assembly level programs using 8051 instruction set.
- Describe the Interrupt system, operation of Timers/Counters and Serial port of 8051.
- Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to 8051.

**Course Outcomes:**

- Understand the importance of Microcontroller and Acquire the knowledge of Architecture of 8051 Microcontroller.
- Apply and Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to using 8051 I/O ports.
- Develop the 8051 Assembly level programs using 8051 Instruction set
- Design the Interrupt system, operation of Timers/Counters and Serial port of 8051

**UNIT 1** 8051 Microcontroller:

Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture-Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.

**UNIT II**

Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples to use these instructions.

**UNIT III**

8051 Stack, Stack and Subroutine instructions. Simple Assembly language program examples to use subroutine instructions. 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin.

**UNIT IV**

8051 Serial Communication- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially. 8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch.

**UNIT V**

8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to ADC-0804, DAC, LCD and Interfacing with relays and opto isolators, Stepper Motor Interfacing, DC motor interfacing, PWM generation using 8051.

**Textbooks:**

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; “The 8051 Microcontroller and Embedded Systems – using assembly and C”, PHI, 2006 / Pearson, 2006.
2. Kenneth J. Ayala, “The 8051 Microcontroller”, 3rd Edition, Thomson/Cengage Learning.

**References:**

1. Manish K Patel, “The 8051 Microcontroller Based Embedded Systems”, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
2. Raj Kamal, “Microcontrollers: Architecture, Programming, Interfacing and System Design”, Pearson Education, 2005.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem**

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**(20A05705a) CYBER SECURITY**  
**(Open Elective-IV)**

**Course Objectives:**

The course is designed to provide awareness on different cyber crimes, cyber offenses, tools and methods used in cybercrime.

**Course Outcomes:**

- Classify the cybercrimes and understand the Indian ITA 2000
- Analyse the vulnerabilities in any computing system and find the solutions
- Predict the security threats of the future
- Investigate the protection mechanisms
- Design security solutions for organizations

**UNIT I Introduction to Cybercrime**

Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

**UNIT II Cyber Offenses: How Criminals Plan Them**

Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber Cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing

**UNIT III Cybercrime: Mobile and Wireless Devices**

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

**UNIT IV Tools and Methods Used in Cybercrime**

Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

**UNIT V Cyber Security: Organizational Implications**

Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

**Textbooks:**



1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.

**Reference Books:**

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J.David Irwin. CRC Press T&F Group

**Online Learning Resources:**

<http://nptel.ac.in/courses/106105031/40>

<http://nptel.ac.in/courses/106105031/39>

<http://nptel.ac.in/courses/106105031/38>

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

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3 0 0 3

(20A05705b) INTRODUCTION TO FULL STACK DEVELOPMENT

(Open Elective Course – IV)

**Course Objectives:**

- To build foundation on HTML this will help developer to use HTML concepts for building responsive web application.
- To Develop HTML based Single application for Browsers.
- To Understand OOPs concepts and its applications by building competency in object –oriented Programming.
- To implement frontend and backend scenarios using Web Sockets.
- To become proficient in Bootstrap concepts.

**Course Outcomes:**

- Able to how to program a browser like using JavaScript, jQuery, Angular, or Vue.
- Distinguishing trends in multi-device implementation.
- Create webpages that function using external data.
- Disambiguate the different structures that a no SQL database may represent.
- Derive information from data and implement data into applications.

**UNIT I**

**e The Modern Web:** Rise of the Web, Mobile Web, The State of HTML, Applications vs Web Sites, Keeping Up.

**Planning Your Work: Identifying** Requirements, Defining the Work, Tracking the Work Continuous Improvement, Prioritization & Estimation, Managing Bugs, Continuous Delivery

**User Experience:** Information Architecture, Getting the User Experience Right, Polishing the User Experience, Implementing the User Experience.

**UNIT II**

**Designing Systems:** System Architectures, Identifying Concepts, Identifying User Interactions, Handling Commonalities, Working with Legacy and External Dependencies, Component Interactions, Applications vs. Modules, Cross-Functional Requirements, Caching, Designing for Failure, Designing Modules, Refactoring, Tools, Changing Your Architecture.

**Ethics:** Privacy, Cognitive Load, Energy Usage, Trust.

**Front End:** HTML, From Server to Browser, Styling, Components, Responsive Design, Progressive Enhancement to Progressively Enhance, or Not? Mobile First, Feature Detection, Progressive Enhancement of Style, When Not Using Progressive Enhancement, Search Engine Optimization, Build Tools.

**UNIT III**

**Testing:** Test-Driven Development, Test Pyramid, Behaviour-Driven Development, Three Amigos, Manual Testing, Visual Testing, Cross-Functional Testing,

**JavaScript:** Asynchronicity, JavaScript in the Browser, Offline-First Development, Document Object Model, Server-Side JavaScript, Table of Contents viii JavaScript Modules, Structuring Your JavaScript, JavaScript Types, Object-Oriented Programming, Functional Programming, Communicating Between Components, Connecting Components Together, Testing, Build Tools.

**Accessibility:** Accessible from the Start, Working with Assistive Technologies, Dealing with Interactive UI, Testing for Accessibility, Avoiding Common Mistakes.

#### UNIT IV

**APIs:** API Responsibilities, designing a REST API, Securing Your API, Event-Based APIs, Discovering APIs, Using APIs

**Storing Data:** Types of Databases, To SQL, or NoSQL?, Where to Store Your Data, Accessing Data from Your App, Managing Your Data, Protecting Your Data.

**Security:** Trust, Responding to Incidents, The Golden Rule, Threats, Security Checklists, Passwords, Indirect Attacks.

#### UNIT V

**Deployment:** Twelve Factor Apps, Developer Machines, Production Environments, Moving Code into Production, Configuring Your Box, Infrastructure, Immutable Infrastructure, Continuous Delivery & Continuous Deployment.

**In Production:** Fire Drills, Run Books, Monitoring, Responding to Incidents

**Constant Learning:** Collecting, Experiments, Analysing Results, Hypothesis-Driven.

#### Textbook:

1. Chris Northwood, The full Stack Developer, Apress, 2018.

#### Reference Books:

1. Modern Full-Stack Development: Using TypeScript, React, Node.js, Webpack, and Docker, Frank Zammetti.
2. Full Stack Web Development for Beginners, Riaz Ahmed.

#### Online Learning Resources:

1. Learn Full Stack Web Development with 40+ Projects and Exercises | Udemy

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

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(20A05705c) INDUSTRIAL IOT

(Open Elective-IV)

**Course Objectives:**

- Acquire theoretical knowledge on Industrial Internet of Things.
- Apply suitable machine learning techniques for data handling and to gain knowledge from it.
- Evaluate the performance of algorithms for sensors and data transmission.

**Course Outcomes:**

- Understand the characteristics of Internet of Things and its industry strategies.
- Apply various Internet of Things models to appropriate problems.
- Identify and integrate more than one technology to enhance the performance.
- Understand the sensors and data transmission used in Internet of Things.
- Analyse the co-occurrence of data to find interesting frequent patterns.
- Pre-process the data before applying to any real-world problem and can evaluate its performance.

**UNIT I Overview of Internet of Things**

Introduction, IOT Architecture, Application –based IOT protocols, Cloud Computing, Fog Computing, Sensor Cloud, Big Data.

Overview of Industry 4.0 and Industrial Internet of Things: IIoT- Prerequisites of IIOT, Basics of CPS, CPS and IIOT, Applications of IIoT.

**UNIT II Industrial Internet of Things**

Introduction, Industrial Internet Systems, Industrial sensing, Industrial sensing, Industrial Processes.

Business Models and Reference Architecture of IIoT: Definition of a business model, Business models of IOT, Business models of IIOT.

**UNIT III Key and On-site Technologies**

Key Technologies: Off-site Technologies- Introduction, Cloud Computing- Necessity, Cloud Computing and IIoT, Industrial Cloud Platform Providers, SLA, Requirements of Industry 4.0, Fog Computing.

On-site Technologies- Introduction, Augmented Reality- History, Categorization, Applications, Virtual Reality- History, Categorization, Applications.

**UNIT IV                      Sensors and Data Transmission**

Sensors: Introduction to Sensors, Characteristics-Sensor calibration, Sensor profile, Operating voltage, Sensor Categories. Actuators:Introduction, Thermal Actuators, Hydraulic Actuators, Pneumatic Actuators, Electromechanical Actuators.

Industrial Data Transmission:Foundation fieldbus, Profibus, HART, Interbus, Bitbus.

**UNIT V                      Machine learning and Data science, applications in healthcare**

Machine Learning and Data Science in Industries:Introduction, Machine Learning, Categorization on ML, Applications and Data Science of ML in industries, Deep Learning, Applications of Deep Learning in industries.

Applications of Healthcare in Industries: Smart Devices, Advanced Technologies using in Healthcare, Open Research Issues to be Addressed.

**Textbooks:**

1. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

**Reference Books:**

1. Industrial IoT. Available online: <https://medium.com/iotforall/whatproduct-managers-need-to-know-about-industrial-iot-8c92eec1d9d2>
2. IIoT Cloud Platforms. Available online: <https://fr.farnell.com/willthere-be-a-dominant-iiot-cloud-platform>.
3. Kajima, T. and Kawamura, Y., 1995. Development of a high-speed solenoid valve: Investigation of solenoids. IEEE Transactions on industrial electronics, 42(1), pp.1-8.

**Online Learning Resources:**

1. <https://www.coursera.org/learn/industrial-internet-of-things>
2. <https://www.coursera.org/specializations/developing-industrial-iiot>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech IV-I Sem** **L T P C**  
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**(20A27705) WASTE AND EFFLUENT MANAGEMENT**  
**(OPEN ELECTIVE-IV)**

**Course Objectives:**

- To understand the wastewater treatment process.
- To gain knowledge on waste disposal in various ways.
- To know about advances in wastewater treatment.

**Course Outcomes:**

- Acquires knowledge on technologies used for chemical and biological methods of waste water and effluent treatment

**UNIT I**

Wastewater Treatment an Overview: Terminology – Regulations – Health and Environment Concerns in waste water management – Constituents in waste water inorganic – Organic and metallic constituents. Process Analysis and Selection: Components of waste water flows – Analysis of Data – Reactors used in waste water treatment – Mass Balance Analysis – Modeling of ideal and non ideal flow in Reactors – Process Selection

**UNIT II**

Waste disposal methods – Physical, Chemical & Biological; Economical aspects of waste treatment and disposal. Treatment methods of solid wastes: Biological composting, drying and incineration; Design of Solid Waste Management System: Landfill Digester, Vermicomposting Pit.

**UNIT III**

Introduction: Classification and characterization of food industrial wastes from Fruit and Vegetable processing industry, Beverage industry; Fish, Meat & Poultry industry, Sugar industry and Dairy industry.

Chemical Unit Processes: Role of unit processes in waste water treatment chemical coagulation – Chemical precipitation for improved plant performance chemical oxidation – Neutralization – Chemical Storage

**UNIT IV**

Biological Treatment: Overview of biological Treatment – Microbial metabolism – Bacterial growth and energetics – Aerobic biological oxidation – Anaerobic fermentation and oxidation – Trickling filters – Rotating biological contractors – Combined aerobic processes – Activated sludge film packing.

**UNIT V**

Advanced Wastewater Treatment: Technologies used in advanced treatment – Classification of technologies. Removal of Colloids and suspended particles – Depth Filtration – Surface Filtration – Membrane Filtration-Absorption – Ion Exchange – Advanced oxidation process.

**Textbooks:**

1. Herzka A & Booth RG; “Food Industry Wastes: Disposal and Recovery”; Applied Science Pub Ltd. 1981,
2. Fair GM, Geyer JC & Okun DA; “Water & Wastewater Engineering”; John Wiley & Sons, Inc. 1986,

**References:**

1. GE; “Symposium: Processing Agricultural & Municipal Wastes”; AVI. 1973,
2. Inglett Green JH & Kramer A; “Food Processing Waste Management”; AVI. 1979,
3. Rittmann BE & McCarty PL; “Environmental Biotechnology: Principles and Applications”; Mc-Graw-Hill International editions 2001,.
4. Bhattacharyya B C & Banerjee R; “Environmental Biotechnology”; Oxford University Pre
5. Bartlett RE; “Wastewater Treatment; Applied Science” Pub Ltd.
6. G. Tchobanoglous, FI Biston, “Waste water Engineering Treatment and Reuse”: Mc Graw Hill, 2002.
7. “Industrial Waste Water Management Treatment and Disposal by Waste Water” 3<sup>rd</sup> Edition Mc Graw Hill 2008

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

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3 0 0 3

(20A54703) NUMBER THEORY AND ITS APPLICATIONS  
(OPEN ELECTIVE-IV)**Course Objectives:**

This course enables the students to learn the concepts of number theory and its applications to information security.

**Course Outcomes:**

- Understand number theory and its properties.
- Understand principles on congruences
- Develop the knowledge to apply various applications
- Develop various encryption methods and its applications.

**UNIT I Integers, Greatest common divisors and prime Factorization**

The well-ordering property-Divisibility-Representation of integers-Computer operations with integers-Prime numbers-Greatest common divisors-The Euclidean algorithm -The fundamental theorem of arithmetic-Factorization of integers and the Fermat numbers-Linear Diophantine equations

**UNIT II Congruences**

Introduction to congruences -Linear congruences-The Chinese remainder theorem-Systems of linear congruences

**UNIT III Applications of Congruences**

Divisibility tests-The perpetual calendar-Round-robin tournaments-Computer file storage and hashing functions. Wilson's theorem and Fermat's little theorem- Pseudo primes- Euler's theorem- Euler's  $\phi$ -function- The sum and number of divisors- Perfect numbers and Mersenne primes.

**UNIT IV Finite fields & Primality, factoring**

Finite fields- quadratic residues and reciprocity-Pseudo primes-rho method-fermat factorization and factor bases.

**UNIT V Cryptology**

Basic terminology-complexity theorem-Character ciphers-Block ciphers-Exponentiation ciphers-Public-key cryptography-Discrete logarithm-Knapsack ciphers- RSA algorithm-Some applications to computer science.

**Textbooks:**

1. Elementary number theory and its applications, Kenneth H Rosen, AT & T Information systems & Bell laboratories.
2. A course in Number theory & Cryptography, Neal Koblitz, Springer.

**Reference Books:**

1. An Introduction To The Theory Of Numbers, Herbert S. Zuckerman, Hugh L. Montgomery, Ivan Niven, wiley publishers
2. Introduction to Analytic number theory-Tom M Apostol, springer
3. Elementary number theory, VK Krishnan, Universities press

Online Learning Resources:

<https://www.slideshare.net/ItishreeDash3/a-study-on-number-theory-and-its-applications>



## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

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(20A56703) SMART MATERIALS AND DEVICES  
(OPEN ELECTIVE-IV)**Course Objectives:**

- To provide exposure to smart materials and their engineering applications.
- To impart knowledge on the basics and phenomenon behind the working of smart materials
- To enlighten the properties exhibited by smart materials
- To educate various techniques used to synthesize and characterize smart materials
- To identify the required smart material for distinct applications/devices

**Course Outcomes:**

- to recognize the need of smart materials
- to understand the working principles of smart materials
- to know different techniques used to synthesize and characterize smart materials
- to exploit the properties of smart materials
- to make use of smart materials for different applications

**UNIT I**

**Introduction:** Historical account of the discovery and development of smart materials, Two phases: Austenite and Martensite, Temperature induced phase changes, Shape memory effect, Pseudoelasticity, One-way shape memory effect, Two-way shape memory effect.

**UNIT II: Properties of Smart Materials:** Physical principles of optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magnetic properties of smart materials

**UNIT III: Synthesis of smart materials:** Solid state reaction technique, Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method, Co-precipitation. Green synthesis, Mechanical alloying and Thin film deposition techniques: Chemical etching, Sol-gel, spray pyrolysis.

**UNIT IV: Characterization techniques:** X-ray diffraction, Raman spectroscopy (RS), Fourier-transform infrared reflection (FTIR), UV-Visible spectroscopy, Scanning electron microscopy (SEM), Transmission electron microscopy, Atomic force microscopy (AFM) and Differential Scanning Calorimetry (DSC).

**UNIT V: Materials and Devices:** Characteristics of shape memory alloys, Magnetostrictive, Optoelectronic, Piezoelectric, Metamaterials, Electro-rheological and Magneto-rheological materials and Composite materials.

Devices based on smart materials: Sensors & Actuators, MEMS and intelligent devices, Future scope of the smart materials.

**Textbooks:**

1. Encyclopaedia of Smart Materials- Mel Schwartz, John Wiley & Sons, Inc.2002
2. Smart Materials and Structures - M. V. Gandhi and B.S. Thompson, Chapman and Hall, 1992

**References:**

1. Smart Materials and Technologies- M. Addington and D. L. Schodek, , Elsevier, 2005.
2. Characterization and Application of smart Materials -R. Rai, Synthesis, , Nova Science, 2011.
3. Electroceramics: Materials, Properties, Applications -A.J. Moulson and J.M. Herbert, 2<sup>nd</sup>Edn., John Wiley & Sons, 2003.
4. Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic 1. Emission Sensors, Materials and Amplifiers, G. Gautschi, Springer, 2002.
5. Optical Metamaterials: Fundamentals and Applications -W. Cai and V. Shalaev, springer,2010.
6. Smart Materials and Structures - P. L Reece, New Research, Nova Science, 2007

**NPTEL courses links**

<https://nptel.ac.in/courses/112/104/112104173/>

<https://nptel.ac.in/courses/112/104/112104251/>

[https://nptel.ac.in/content/storage2/courses/112104173/Mod\\_1\\_smart\\_mat\\_lec](https://nptel.ac.in/content/storage2/courses/112104173/Mod_1_smart_mat_lec)

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem

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**(20A51703) GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT (OPEN ELECTIVE-IV)****Course Objectives:**

- Learn an interdisciplinary approach to the scientific and societal issues arising from industrial chemical production, including the facets of chemistry and environmental health sciences that can be integrated to promote green chemistry and the redesign of chemicals, industrial processes and products.
- Understand the use of alternatives assessments that combine chemical, environmental health, regulatory, and business considerations to develop safer products.

**Course Outcomes:**

- Recognize and acquire green chemistry concepts and apply these ideas to develop respect for the inter connectedness of our world and an ethic of environmental care and sustainability.

**UNIT I: PRINCIPLES AND CONCEPTS OF GREEN CHEMISTRY**

Introduction, Green chemistry Principles, sustainable development and green chemistry, atom economy, atom economic: Rearrangement and addition reactions and un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation, Polymer recycling.

**UNIT II: CATALYSIS AND GREEN CHEMISTRY**

Introduction to catalysis, Heterogeneous catalysts: Basics of Heterogeneous Catalysis, Zeolites and the Bulk Chemical Industry, Heterogeneous Catalysis in the Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Homogeneous catalysis: Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, Asymmetric Catalysis, Heterogenising the Homogenous catalysts, Phase transfer catalysis: Hazard Reduction, C-C Bond Formation, Oxidation Using Hydrogen Peroxide, Bio-catalysis and photo-catalysis with examples.

**UNIT III: ORGANIC SOLVENTS: ENVIRONMENTALLY BENIGN SOLUTIONS**

Organic solvents and volatile organic compounds, solvent free systems, supercritical fluids: Super critical carbon dioxide, super critical water and water as a reaction solvent: water-based coatings, Ionic liquids as catalyst and solvent

**UNIT IV: EMERGING GREENER TECHNOLOGIES AND ALTERNATIVE ENERGY SOURCES**

Biomass as renewable resource, Energy: Fossil Fuels, Energy from Biomass, Solar Power, Other Forms of Renewable Energy, Fuel Cells, Chemicals from Renewable feedstocks: Chemicals from Renewable Feedstocks: Chemicals from Fatty Acids, Polymers from Renewable Resources, Some Other Chemicals from Natural Resources, Alternative Economies: The Syngas Economy, The Biorefinery, Design for energy efficiency: Photochemical Reactions: Advantages of and Challenges Faced by Photochemical Processes, Examples of Photochemical Reactions, Chemistry Using Microwaves: Microwave Heating, Microwave-assisted Reactions, Sonochemistry: Sonochemistry and Green Chemistry, Electrochemical Synthesis: Examples of Electrochemical Synthesis. Industrial applications of alternative environmentally benign catalytic systems for carrying out the important reactions such as selective oxidation, reduction and C-C bond formations (specific reactions).

**UNIT V: GREEN PROCESSES FOR GREEN NANOSCIENCE**

Introduction and traditional methods in the nanomaterials synthesis, Translating green chemistry principles for practicing Green Nanoscience. Green Synthesis of Nanophase Inorganic Materials and Metal Oxide Nanoparticles: Hydrothermal Synthesis, Reflux Synthesis, Microwave-Assisted Synthesis, Other methods for Green synthesis of metal and metal oxide nanoparticles, Green chemistry applications of Inorganic nanomaterials

**Textbooks:**

1. M. Lancaster, Green Chemistry an introductory text, Royal Society of Chemistry, 2002.
2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, 4<sup>th</sup> Edition, Oxford University Press, USA

**References:**

1. Green Chemistry for Environmental Sustainability, First Edition, Sanjay K. Sharma and AckmezMudhoo, CRC Press, 2010.
2. Edited by AlvisePerosa and Maurizio Selva , Hand Book of Green chemistry Volume 8:Green Nanoscience, wiley-VCH, 2013.

# HONORS

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)

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## (20A03H01) MECHANICS AND MANUFACTURING OF COMPOSITE MATERIALS

**Course Objectives:**

- Understand the properties of composite materials.
- Familiarize the manufacturing methods for composites.
- Teach the practical requirements associated with joining and manufacturing

**Course Outcomes:**

At the end of the course, the student will be able to

- Design and manufacture composite materials for various applications.
- Conduct mechanical testing of composite structures and analyse failure modes.
- Synthesize structures for environmental effects.
- Analyse economic aspects of using composites.

**UNIT I Introduction To Composite Materials**

Introduction To Composite Materials: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites. **Applications:** Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.

**Fiber Reinforced Plastic Processing:** Lay-up and curing, fabricating process, open and closed mould process, hand lay-up techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.

**UNIT II Micro & Macro Mechanics of Materials****Micro Mechanical Analysis of a Lamina:**

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems.

**Macro Mechanics of a Lamina:** Hooke's law for different types of materials, Number of elastic constants, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.

**UNIT III Biaxial Strength****Biaxial Strength Theories**

Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems.

**Macro Mechanical Analysis of Laminate**

Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) , Special cases of laminates, Numerical problems.

**UNIT IV Metal Matrix Composite**

**Metal Matrix Composites:** Metal Matrix Composites: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC's and its application.

**Fabrication Process For MMC's:** Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.

**Study Properties Of MMC's:** Physical Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties.

**UNIT V Failure Theories**

Micromechanics of Failure of Unidirectional Lamina, Anisotropic Strength and Failure Theories, Importance of Shear Strength, Choice of Failure Criteria, Examples.

**Textbooks:**

1. K.K. Chawla, Composite Materials, Springer-Verlag, New York, 1998.
2. B.T. Astrom, Manufacturing of Polymer Composites, Chapman & Hall, 1997.
3. Stuart M Lee, J. Ian Gray, Miltz, Reference Book for Composites Technology, CRC press, 1989.

**Reference Books:**

1. Frank L Matthews and R D Rawlings, Composite Materials: Engineering and Science, Taylor and Francis, 2006.
2. D. Hull and T.W. Clyne, Introduction to Composite Materials, Cambridge University Press, 1996.
3. M.R. Piggott, Load Bearing Fibre Composites, Pergamon press, Oxford, 1998.
4. F. Ashby and D.R.H. Jones, Engineering Materials, Pergamon press, 1999.
5. R.W. Davidge and A. Kelly, Mechanical behavior of ceramics, Cambridge university press, 1999.
6. Andrew C. Marshall, Composite Basics, Marshall Consulting. Mode of Evaluation Quiz/Assignment/ Seminar/Written Examination, 1998.

**Online Learning Resources:**

- <https://nptel.ac.in/courses/112104221>
- <https://nptel.ac.in/courses/112104229>
- <https://nptel.ac.in/courses/112104161>
- [https://onlinecourses.nptel.ac.in/noc22\\_me40/preview](https://onlinecourses.nptel.ac.in/noc22_me40/preview)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ME)**

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**(20A03H02) APPLICATIONS OF COMPUTATIONAL FLUID DYNAMICS**

**Course Objectives:**

- Teach the basics of the major theories, approaches and methodologies used in CFD.
- Familiar with the differential equations for flow phenomena and numerical methods for their solutions.
- Introduce explicit and implicit schemes in hyperbolic equations.
- Expose the students to solve the problems through finite volume method.
- Understand the concepts of linear fluid flow problems, steady state problems and transient problems.

**Course Outcomes:**

At the end of the course, the student will be able to

- Summarize the major theories, approaches and methodologies used in CFD.
- formulate finite volume method for two and three dimensional fluid flow problems.
- apply numerical models to fluid flow and heat transfer calculations

**UNIT I** Introduction and Solution methods

**Introduction:** Finite difference method, finite volume method, finite element method, governing equations and boundary conditions, Derivation of finite difference equations.

**Solution methods:** Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

**UNIT II** **Hyperbolic equations:**

explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

**UNIT III** **Formulations Of Incompressible Viscous Flows**

**Formulations Of Incompressible Viscous Flows:** Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

**Treatment of compressible flows:** potential equation, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

**UNIT IV** **Finite Volume Method:**

Finite volume method via finite difference method, formulations for two and three-dimensional problems.

**UNIT V** **Standard Variational Methods:**

Linear fluid flow problems, steady state problems, Transient problems.

**Textbooks:**

1. T. J. C'hung, Computational fluid dynamics, Cambridge University press,2002.
2. John D. Anderson, Computational Fluid Dynamics: Basics with applications, Mc Graw Hill. 2017

**Reference Books:**

1. Frank Choriton, Text book of fluid dynamics, CBS Publishers & distributors, 1985.
2. Suhas V. Patankar, Numerical heat transfer and fluid flow, Hema shava Publishers corporation & Mc Graw Hill, 1990.
3. Muralidaran, Computational Fluid Flow and Heat Transfer, Narosa Publications, 2003.
4. Tapan K. Sengupta, Fundamentals of Computational Fluid Dynamics, Universities Press,

2004.

5. C. Pozrikidis, Introduction to Theoretical and Computational Fluid Dynamics, Oxford University press, 2/e, 2012.

**Online Learning Resources:**

- <https://nptel.ac.in/courses/112107079>
- <https://www.youtube.com/watch?v=3QFT7pGx03I>
- [https://www.youtube.com/watch?v=t7jS7V\\_6TGQ](https://www.youtube.com/watch?v=t7jS7V_6TGQ)
- <https://nptel.ac.in/courses/112107080>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B.Tech (ME)

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**(20A03H03) ADVANCED AUTOMOTIVE ELECTRONICS****Course Objectives:**

- Explain the use of electronics in the automobile.
- Explain the importance of various types of sensors and actuators in automotive electronics.
- Demonstrate the various control elements in Engine Management system.
- Familiarize with Vehicle management systems
- Identify various electronic and the instrumentation systems used in automobile.

**Course Outcomes:**

After completion of this course the student can be able to:

- Obtain an overview of automotive components, like sensors, actuators, communication protocols and safety systems employed in today's automotive industry.
- Interface automotive sensors and actuators with microcontrollers.
- Know, the various display devices that are used in automobiles.
- Identify the elements in the engine management and vehicle management system.

**UNIT I Introduction to microcomputer**

Microcomputer: Buses, memory, timing, CPU registers; Microprocessor architecture: Initialization, operation codes, program counter, branch and jump instructions, subroutine. Analog to digital converters and Digital to analog converters, sampling, polling and interrupts, digital filters, lookup table.

**UNIT II Sensors and actuators**

Speedsensors, Pressuresensors: Manifold Absolute Pressure sensor, knock sensor, Temperature sensors: Coolant and Exhaust gas temperature, Exhaust Oxygen level sensor, Position sensors: Throttle position sensor, accelerator pedal position sensor and crankshaft position sensor, Air mass flow sensor. Solenoids, stepper motors and relays.

**UNIT III Electronic engine management system**

Electronic engine control: Input, output and control strategies, electronic fuel control system, fuel control modes: open loop and closed loop control at various modes, EGR control, Electronic ignition systems – Spark advance correction schemes, fuel injection timing control.

**UNIT IV Electronic vehicle management system**

Cruise control system, Anti-lock braking system, electronics suspension system, electronic steering control, traction control system, Transmission control, Safety: Airbags, collision avoidance system, low tire pressure warning system.

**UNIT V Automotive instrumentation system**

Input and output signal conversion, multiplexing, fuel quantity measurement, coolant temperature and oil pressure measurement, display devices-LED, LCD, VFD and CRT, Onboard diagnostics (OBD), OBD-II, offboard diagnostics.

**Textbooks:**

1. Understanding Automotive Electronics, William B Ribbens, Newne Butterworth-Heinemann, 6/e, 2003.
2. Crouse W H, Automobile Electrical Equipment, McGraw Hill Book Co. Inc, Newyork, 2005.

**Reference Books:**

1. Bechhold "Understanding Automotive Electronics", SAE, 1998.
2. Robert Bosch "Automotive Hand Book", SAE, 5/e, 2000.
3. Tom Denton, "Automobile Electrical and Electronic Systems" 3/e, Edward Arnold, London, 2004.
4. Eric Chowanietz- 'Automotive Electronics' - SAE International USA, 1995.

**Online Learning Resources:**

- <https://nptel.ac.in/courses/107106088>
- <https://www.youtube.com/watch?v=BOP8qLQzhDc>
- <https://nptel.ac.in/courses/108104140>
- <https://intranet.cb.amrita.edu/sites/default/files/164-AutomotiveElectronics.pdf>
- <http://digimat.in/nptel/courses/video/108108147/L01.html>



- [https://jssstuniv.in/wp-content/uploads/2020/09/M.Tech-Automotive-Electronics-\\_Final.pdf](https://jssstuniv.in/wp-content/uploads/2020/09/M.Tech-Automotive-Electronics-_Final.pdf)

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ME)

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**(20A03H04) APPLICATIONS OF OPTIMIZATION TECHNIQUES****Course Objectives:**

- Explain principles of optimization and its need.
- Familiarization with theory of optimization methods and algorithms developed for solving various types of optimization problems.
- Understand the mathematical foundations for Genetic Algorithm, Operators.
- Know fundamental theory and concepts of neural networks, neuro – modelling, several neural network paradigms and its applications.
- Identify the application of optimization to design of machine elements.

**Course Outcomes:**

At the end of the course, the student will be able to

- Know the principles of optimization and its need
- Identify optimization methods and algorithms developed for solving various types of optimization problems
- Understand and appreciate the basic concepts of Genetic Algorithms and results of applying various genetic operators
- Solve the concepts of Neural Networks for training and validation of neural network models

**UNIT I Introduction**

**Classical Optimization Techniques:** Single variable optimization with and without Constraints, Multi – Variable Optimization without constraints, Multi – Variable Optimization with Constraints – Method of Lagrange Multipliers, Kuhn-Tucker Conditions.

**Numerical Methods for Optimization:** Interval Halving Method, Fibonacci Method, Quadratic Interpolation Method, Newton Method, Quasi Newton Method, Secant Method.

**UNIT II Genetic Algorithm (GA):**

Differences and Similarities between Conventional and Evolutionary Algorithms, Working Principle, Reproduction, Crossover, Mutation, Termination Criteria, Different Reproduction and Crossover Operators, GA for Constrained Optimization, Draw Backs of GA.

**UNIT III Genetic Programming (GP):**

Principles of Genetic Programming, Terminal Sets, Functional Sets, Differences between GA & GP, Random Population Generation, Solving Differential Equations using GP.

**UNIT IV Neural networks**

**Introduction to Neural networks:** Knowledge base information processing, General View of Knowledge Based Algorithm, Neural Information Processing, Hybrid Intelligence and Artificial Neurons.

**Characteristics of Artificial Neural Networks:** Single Neural Networks, Multi – Layer Neural Networks, Training of ANN – Objective, Supervise Training, Unsupervised Training, Overview of training.

**UNIT V Applications of Optimization in Design and Manufacturing Systems:**

Some typical applications like Optimization of Path Synthesis of a Four – bar Mechanism, Minimization of Weight of a Cantilever Beam, Optimization of Springs and Gears, General Optimization model of a Machining Process, Optimization of Arc Welding Parameters and General Procedure in Optimizing Machining Operations Sequence.

**Textbooks:**

1. Singiresu S. Rao, Engineering Optimization, 3/e, New Age Publishers, 2010.
2. Bart Kosko, Neural Networks and Fuzzy System, 2/e, Prentice Hall of India, 2001.
3. Goldberg D.E., Genetic algorithms in Search, Optimization, and Machine learning, 4/e, Pearson, 2009.
4. Kalyanmoy Deb, Optimization for Engineering Design: Algorithms and Examples, 2/e, PHI Learning Pvt. Ltd., 2012.

**Reference Books:**

1. Kalyanmoy Deb, Multi Objective Optimization using Evolutionary Algorithms, 1/e, John Wiley and Sons, 2001.
2. Jasbir S. Arora, Introduction to Optimum Design, 4/e, Academic Press, 2016.
3. Ravindran A., Engineering Optimization Methods and Applications, 2/e, John Wiley and Sons, 2006.
4. Fox R.L., Optimization Methods for Engineering Design, 1/e, Addison Wesley Publication Co., 1971.

**Online Learning Resources:**

- <https://nptel.ac.in/courses/111105039>
- <https://nptel.ac.in/courses/105108127>
- <https://nptel.ac.in/courses/111105100>
- <https://nptel.ac.in/courses/112105235>
- <https://nptel.ac.in/courses/106108056>
- <https://nptel.ac.in/courses/112101298>