JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR ANANTHAPURAMU-515002 (A.P) INDIA

ACADEMIC REGULATIONS COURSE STRUCTURE AND DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN THERMAL SCIENCES AND ENERGY SYSTEMS

Regular Two Year P.G. Degree Course (Applicable for the batches admitted from 2013-14)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
Academic Regulations For The Award Of Full Time M.Tech. P.G. Degree
(WITH EFFECT FROM THE ACADEMIC YEAR 2013-14)

The Jawaharlal Nehru Technological University Anantapur shall confer M.Tech. Post Graduate degree to candidates who are admitted to the Master of Technology Programs and fulfill all the requirements for the award of the degree.

1.0 ELIGIBILITY FOR ADMISSIONS:

Admission to the above programme shall be made subject to the eligibility, qualifications and specialization prescribed by the University for each programme, from time to time.

Admissions shall be made either on the basis of merit rank obtained by the qualified candidates at an Entrance Test conducted by the University or on the basis of GATE / PGECET score, subject to reservations prescribed by the University or Government policies from time to time.

2.0 **COURSE WORK:**

2.1 A Candidate after securing admission must pursue the M.Tech. course of study for Four semesters duration.

2.2 Each semester shall be of 20 weeks duration including all examinations.

2.3 A candidate admitted to a programme should complete it within a period equal to twice the prescribed duration of the programme from the date of admission.

3.0 ATTENDANCE:

3.1 A candidate shall be deemed to have eligibility to write end semester examinations if he has put in atleast 75% of attendance on cumulative basis of all subjects/courses in the semester.

3.2 Condonation of shortage of attendance up to 10% i.e., from 65% and above and less than 75% may be given by the college on the recommendation of the Principal.

3.3 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence.

3.4 If the candidate does not satisfy the attendance requirement he is detained for want of attendance and shall reregister for that semester. He / she shall not be promoted to the next semester.

4.0. EVALUATION:

The performance of the candidate in each semester shall be evaluated subject wise, with a maximum of 100 marks for Theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

4.1 For the theory subjects 60% of the marks will be for the External End Examination. While 40% of the marks will be for Internal Evaluation, based on the better of the marks secured in the two Mid Term-Examinations held, one in the middle of the Semester (I-IV units) and another immediately after the completion of instruction (V-VIII) units with Three questions to be answered out of four in 2hours, evaluated* for 40 marks.

*****Note: All the Questions shall be of equal weightage of 10 marks and the marks obtained for 3questions shall be extrapolated to 40 marks, any fraction rounded off to the next higher mark

4.2 For practical subjects, 60 marks shall be for the End Semester Examinations and 40 marks will be for internal evaluation based on the day to day performance.

4.3 For Seminar there will be an internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful. The assessment will be made by a board consisting of HOD and two internal experts at the end of IV semester instruction.

4.4 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

4.5 In case the candidate does not secure the minimum academic requirement in any of the subjects (as specified in 4.4.) he has to reappear for the Semester Examination either supplementary or regular in that subject, or repeat the course when next offered or do any other specified subject as may be required.

5.0 RE-REGISTRATION FOR IMPROVEMENT OF INTERNAL EVALUATION MARKS:

Following are the conditions to avail the benefit of improvement of internal evaluation marks.

5.1 The candidate should have completed the course work and obtained examinations results for I & II semesters.

5.2 He should have passed all the subjects for which the Internal evaluation marks secured are more than 50%.

5.3 Out of the subjects the candidate has failed in the examination due to Internal evaluation marks secured being less than 50%, the candidate shall be given one chance for each Theory subject and for a maximum of **three** Theory subjects for Improvement of Internal evaluation marks.

5.4 The candidate has to re-register for the chosen subjects and fulfill the academic requirements.

5.5 For each subject, the candidate has to pay a fee equivalent to one third of the semester tuition fee and the amount is to be remitted in the form of D.D. in favour of the

Registrar, JNTUA payable at Anantapur along with the requisition through the Principal of the respective college.

5.6 In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

6.0 EVALUATION OF PROJECT WORK:

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the college/ institute.

6.1 Registration of Project work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses (theory and practical courses of I & II Sem)

6.2 An Internal Departmental Committee (I.D.C) consisting of HOD, Supervisor and one internal senior expert shall monitor the progress of the project work.

6.3 The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project thesis with the approval of I.D.C. after 36 weeks from the date of registration at the earliest and one calendar year from the date of registration for the project work. Extension of time within the total permissible limit for completing the programme is to be obtained from the Head of the Institution.

6.4 The student must submit status report at least in three different phases during the project work period. These reports must be approved by the I.D.C before submission of the Project Report.

6.5 A candidate shall be allowed to submit the thesis / dissertation only after passing in all the prescribed subjects (both theory and practical) and then take viva voce examination of the project. The viva-voce examination may be conducted once in two months for all the candidates submitted during that period.

6.6 Three copies of the Thesis / Dissertation certified in the prescribed from by the supervisor & HOD shall be presented to the HOD One copy is to be forwarded to the University and one copy to be sent to the examiner.

6.7 The college shall submit a panel of three experts for a maximum of 5 students at a time. However, the thesis / dissertation will be adjudicated by one examiner nominated by the University.

6.8 If the report of the examiner is favorable viva-voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the thesis / dissertation. The board shall jointly report candidates work as:

1.	Very Good	Grade A
2.	Good	Grade B
3.	Satisfactory	Grade C
4.	Not satisfactory	Grade D

If the report of the viva-voce is not satisfactory (Grade D) the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination he will not be eligible for the award of the degree unless the candidate is permitted to revise and resubmit the thesis.

7.0 AWARD OF DEGREE AND CLASS:

A candidate shall be eligible for the award of respective degree if he satisfies the minimum academic requirements in every subject and secures 'satisfactory' or higher grade report on his thesis/dissertation and viva-voce. Based on overall percentage of marks obtained, the following class is awarded.

First class with Distinction:	70% or more
First class	below 70% but not less than 60%
Second class	below 60% but not less than 50%

8.0 WITH – HOLDING OF RESULTS:

If the candidate has not paid dues to the university or if any case of in-discipline is pending against him, the result of the candidate shall be withheld and he will not be allowed/ promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

9.0 TRANSITORY REGULATIONS:

Candidates who have discontinued or have been detained for want of attendance or who have failed after having undergone the course in earlier regulations and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to 4.5 and 2.3 sections. Whereas they continue to be in the academic regulations they were first admitted.

10.0 GENERAL:

i. **The academic regulations should be read as a whole for purpose of any interpretation**.
ii. **Disciplinary action for Malpractice / improper conduct in examinations is appended**.
iii. **There shall be no places transfer within the constituent colleges and affiliated colleges of Jawaharlal Nehru Technological University Anantapur.**
iv. **Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".**
v. **In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.**
vi. **The University may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the University.**

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APPROVED REVISION OF RULES FOR DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	**Punishment**
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	**The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred for four consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.** **The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared**

		and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for four consecutive semesters from class work and all University examinations, if his involvement is established. Otherwise, The candidate is debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. **If the imposter is an outsider, he will be handed over to the police and a case is registered against him.**
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject only.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or	**In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. If the candidate physically assaults the invigilator/ officer-in-charge of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against**

	indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	**them.**
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the

		remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	**Cancellation of the performance in that subject only or in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations, depending on the recommendation of the committee.**
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
   (i) A show cause notice shall be issued to the college.
   (ii) Impose a suitable fine on the college.
   (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.

<u>Note:</u> Whenever the performance of a student is cancelled in any subject/subjects due to Malpractice, he has to register for End Examinations in that subject/subjects consequently and has to fulfill all the norms required for the award of Degree.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
Course Structure and syllabi for
M.Tech- Thermal Sciences and Energy Systems
Offered by Department of Mechanical Engineering
for affiliated Engineering Colleges 2013-14

I YEAR I Semester

S. No	Course code	Subject	Theory	Lab.	Credits
1.	13D11101	Probability and Mathematical Analysis	4		4
2.	13D11102	Advanced Thermodynamics	4		4
3.	13D11103	Refrigeration & Cryogenics	4		4
4.	13D11104	Renewable Energy Sources	4		4
5.	13D11105	Fuels & Combustion Technology	4		4
	13D11106 13D11107 13D11108	Elective-I a) Design of Air-Conditioning Systems b) Energy Conversion Technologies C) Solar Passive Architecture	4		4
6.	13D11109	Thermal Science Laboratory		3	2
	Total Credits				26

I YEAR II Semester

S. No	Course code	Subject	Theory	Lab	credits
1.	12D88102	Advanced Heat and Mass Transfer	4		4
2.	13D11201	Advanced Energy Technologies	4		4
3.	13D11202	Energy Auditing and Management	4		4
4.	13D11203	Design of Heat Transfer Equipment	4		4
5.	12D88203	Computational Fluid Dynamics			
	13D11204 12D88108 13D11205	Elective-II a) Energy Systems & Modeling Analysis b) Optimization Techniques and its applications c) Energy Storage Systems	4		4
6.	13D11201	Manufacturing Simulation Laboratory	4		4
		Total Credits			26

II YEAR (III & IV Semesters)

S. No	Course code	Subject		credits
1	13D11401	Seminar		2
2	13D11402	Project work		16

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- I Sem (TSES) **Th 4** **C 4**

(13D11101) PROBABILITY AND MATHEMATICAL ANALYSIS (PMA)

Unit-I

PARTIAL DIFFERENTIAL EQUATIONS :

Homogeneous linear equations with constant coefficients,Rules for finding the complementary functions, Rules for finding the particular integral.

Unit-II

Non-homogeneous linear equations, Two dimensional heat flow solution of Laplace equations only-Solution of Two dimensional wave equation.

Unit-III

SPECIAL FUNCTIONS:

Besssel's equation. Series solution for Bessel's equation, Recurrence formulae for $J_n(x)$, Generating function, Jacobi series, orthogonality of Bessel's function.

Unit-IV

Legendre's equation, Series solution for Legendre's equation, Rodrigues formula, Legendre's polynomials generation function for $P_n(x)$, Recurrence relations for $P_n(x)$, Orthoganality of Legendre polynomials.

Unit-V

NUMERICAL ANALYSIS :

Numerical Integration- Trapezoidal Rule, Simpson's one third rule, Simpson's three eighth rule, Solution of ordinary differential equations, Taylor's Method, Range-kutta Method (Second and Fourth order).

Unit-VI

Predictor-Corrector Methods, Milne's Method and Adam's Method, Solution of Partial differential equations, solution of Laplace equation and Poisson's equation.

Unit-VII

PROBABILITY

Bayes theorem, concept of Random variables, discrete and continuous variables. Distribution function of discrete and continuous random variables. Mean and variance of a random variable.

Unit-VIII

Linear co-relation coefficient, Linear Regression correlation coefficient for a Bivarate frequencies Distribution.

Text Books/Reference Books:

1. N.P.Bali & Iyengar ,*Engineering Mathematics* ,Laxmi publications.
2. Kreyszig, *Advanced Engineering Mathematics* ,John Wiley Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- I Sem (TSES) **Th 4** **C 4**

(13D11102) ADVANCED THERMODYNAMICS (ATD)

Unit-I

INTRODUCTION

First law, Second law, Combined 1st and 2nd law, Entropy, 3rd Law, Absolute Temperature Scale , Availability, Availability in chemical reactions, Irreversibility, Guy-stadola theorem, second law efficiency, Maxwell's relations

Unit-II

REACTIVE SYSTEMS

Degree of reaction, Reaction equilibrium, Heat of reaction, Temperature dependence, Gibbs function change, Fugacity and activity, Heat capacity of reactions gases.

Unit-III

Combustion, Enthalpy of formation, Adiabatic flame temperature, First law and second law for reactive systems.

Unit-IV

PHASE AND CHEMICAL EQUILIBRIUM

Gibbs-Duhem relation, Equilibrium in non-reacting systems, Equilibrium in systems with chemical reaction, General equilibrium.

Unit-V

REAL GASES

Introduction to real gasses, Inter molecular forces and their effects, Shape factor and its effect, Vander waal's equation.

Unit-VI

Redlich kwong equation, Beattie-bridgeman equation, Virial equation of state, Compressibility factor and Compressibility chart.

Unit-VII

PROPERTIES OF NON –REACTIVE MIXTURES OF IDEAL GASES

Introduction, Gibb's Dalton law, The Amagat's Leduc law, Molecular weight and gas constant of a mixture, Gravimetric and volumetric proportions, Internal energy, Enthalpy.

Unit-VIII

Specific heats and Entropy of mixture, Process of gaseous mixture,General Thermodynamic relation: Maxwell relation –&Classius claperyon equation

TEXT BOOKS:

1. Y.V.C. Rao, *An Introduction to Thermodynamics* ,Wiley Easern Ltd
2. P.K. Nag, *Engineering Thermodynamics;* Tata Mc Graw Hill Publications

REFERENCE BOOKS :

1. John R. Howell&Richard O.Buckius *Fundamentals of Engineering Thermodynamics,* Mc Graw Hill Publications.
2. Vanwylan, *Engineering Thermodynamics, ,* Wiley & Sons.
3. Bejan, *A Advanced Engineering Thermodynamics*, , Wiley & Sons
4. *V.M. Domkunduwar,Thermal Engineering by ,* Dhanapat Rai & Sons

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- I Sem (TSES) **Th 4** **C 4**

(13D11103) REFRIGERATION AND CRYOGENICS (RCG)

Unit-I: VAPOUR COMPRESSION REFRIGERATION SYSTEMS:
Analysis of vapour compression refrigeration cycle – effect of suction temperature and condensing temperature on cycle performance – actual refrigeration cycle – effect of sub cooling the liquid – the effect of super heating the suction vapour- the effect of wet suction

Unit-II: COMPOUND VAPOUR COMPRESSION SYSTEM
Removing of flash gas – inter cooling – compound compression ultra water inter cooler-liquid flash cooler – flash inlet cooler.

Unit-III: MULTIPLE EVAPORATOR AND COMPRESSION SYSTEMS
One compressor system – individual compressors – compound compression – cascade systems.

Unit-IV: ABSORPTION REFRIGERATION SYSTEMS
Elementary properties of binary mixtures – simple theoretical absorption refrigeration systems – the practical ammonia absorption system- Three fluid absorption systems – the lithium bromide water absorption system.

Unit-V: ABSOPTION SYSTEM WITH MULTIPLE EVOPARATORS
Three fluid absorption systems-the Lithium Bromide water absorption system.

Unit-VI: OTHER REFRIGERATION SYSTEMS:
Steam jet water vapour systems – thermoelectric refrigeration systems – vortex refrigeration system – pulse tube refrigeration.

Unit-VII: REFRIGERANTS:
Desirable properties – designation of refrigerants – inorganic, halo carbon refrigerants – inorganic halo carbon reactions- secondary refrigerants – reaction of refrigerants with moisture and oil – properties of mixtures of refrigerants – ozone depletion potential and global warming potential of CFC refrigerants – substitutes for CFC refrigerants.

Unit-VIII: CRYOGENIC

Cryogenic liquefaction and refrigeration systems- low temperature insulations-typical applications of refrigeration and cryogenics.

TEXT BOOKS:

1. C.P. Arora, *Refrigeration & Air-Conditioning by* , TMH
2. R.F Barron ,*Cryogenic Systems* , Oxford University Press .

REFERENCE BOOKS:

1. Stoecker W.F.*Refrigeration & Air-Conditioning, and Jones*, J.W., McGraw Hill
2. Manohar Prasad, *Refrigeration & Air-Conditioning* , New Age .
3. Domkunduwar, *Refrigeration & Air-Conditioning and Arora* , Dhanpatrai & Sons

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- I Sem (TSES) **Th 4** **C 4**

(13D11104) RENEWABLE ENERGY SOURCES (RES)

Unit-I

SOLAR RADIATION AND COLLECTING DEVICES:

Solar Incident Flux ,Extraterrestrial Radiation, Clear Sky Irradiation, Solar Radiation Measurement, Monthly Average Radiation on Tilted Surfaces.

Unit-II

Cover plates, Collector Plate Surfaces, Collector Performance, Collector Improvement, Effect of Incident Angle, Heat Transfer to Fluids, Heat Transfer Factors, Concentrating Collectors, Reflectors.

Unit-III

SOLAR SYSTEM DESIGN AND ECONOMIC EVALUATION

Hot water heating , heating and hot water systems , pumps and fans, sizing pipe and duct work, fundamentals of economic analysis, systems optimization

Unit-IV

WIND ENERGY SYSTEMS:

Orientation systems and Regulating devices, Types of Wind Turbines, Operating Characteristics, Basics of Airfoil Theory, Wind energy for water pumping and generation of electricity, Installation operation and maintenance of small wind energy conversion systems.

Unit-V

ENERGY FROM WATER:

OTEC–Principle of operation, Open and Closed OTEC cycles,
Wave energy: Wave energy conversion machines and recent advances

Unit-VI

Tidal Energy: Single basin and double basin tidal systems
Small-Mini-Micro hydro system: Concepts, Types of turbines, Hydrological analysis

Unit-VII

GEOTHERMAL ENERGY:

Introduction, Classification of Geo-thermal areas, Applications of Geo-thermal energy for power generation, Economics of Geo-thermal energy.

Unit-VIII

MHD POWER GENERATION:

Principles of MHD Power Generation, Ideal MHD–Generator Performance, Practical MHD Generator: Faraday and Hall Configurations, MHD Technology.

TEXT BOOK:

1. Peter J.Lunde *Solar Thermal Engineering* , John Wiley & Sons

REFERENCE BOOKS :

1. G.N Tewar*i ,"Solar Thrmal Engineerng , TMH*
2. H.P Garg, *Solar Energy Fundamentals and Applications, ,* TMH
3. S.P sukhatme, *Solar Energy Principles of thermal storage,*TMH

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- I Sem (TSES) **Th 4** **C 4**

(13D11105) FUELS AND COMBUSTION TECHNOLOGY (FCT)

Unit-I: SOLID FUELS:

General – Biomass – Peat- Lignite or brown coal- Sub-bituminous coal or black lignite-Semi anthracite-Anthracite-Cannel coal and boghead coal-Natural coke/SLV fuel – Origin of coal – Composition of coal – Analysis and properties of coal – Action of heat on coal – Oxidation of coal – Hydrogenation of coal – Classification of coal

Unit-II: PROCESSING OF SOLID FUELS:

Coal preparation – Storage of coal – Coal carbonization – Briquetting of solid fuels – Gasification of solid fuels – Liquefaction of solid fuels

Unit-III: LIQUID FUELS:

Petroleum – Origin of petroleum – Petroleum production – Composition of petroleum – Classification of petroleum – Nature of Indian crudes – Petroleum processing - Important petroleum products – Properties and testing of petroleum and petroleum products – Liquid fuels from sources other than petroleum – Gasification of liquid fuels – Storage and handling of liquid fuels

Unit-IV: GASEOUS FUELS:

Types of gaseous fuels – Natural gas – Methane from coal mines –Producer gas – water gas – Carbureted water gas – Complete gasification of coal – Underground gasification of coal – Coal gas – Blast furnace gas – Gases from biomass – Refinery gases – Liquefied petroleum gases(LPG) – Oil gasification – Cleaning and purification of gaseous fuels

Unit-V: THEORY OF COMBUSTION PROCESS

Stoichiometry and thermodynamics; Combustion stoichiometry: Combustion thermodynamics, burners; Fluidized bed combustion process

Unit-VI: STOICHIOMETRY

Stoichiometry relations; Estimation of air required for complete combustion; Estimation of minimum amount of air required for a fuel of known composition; Estimation of dry flue gases for known fuel composition; Calculation of the composition of fuel & excess air supplied, from exhaust gas analysis; Dew point of products; Flue gas analysis (O_2, CO_2, CO, NO_x, SO_x).

Unit-VII: BURNER DESIGN AND FURNACES

Ignition: Concept, auto ignition, ignition temperature; Burners: Propagation, various methods of flame stabilization; Basic features and design of burners for solid, liquid, and

gaseous fuels; **Furnaces**: Industrial furnaces, process furnaces, batch & continuous furnaces; Advantages of ceramic coating; Heat source.

Unit-VIII: Distributions of heat source in furnaces; Blast furnace; Open hearth furnace, Kilns; Pot & crucible furnaces; Waste heat recovery in furnaces: Recuperators and regenerators; Furnace insulation; Furnace heat balance computations; Efficiency considerations

TEXT BOOKS:

1. Samir Sarkar, *Fuels and combustion,* Orient Longman Limited

REFERENCE BOOKS :

1. *D.A. Williams and G. Jones, Liquid fuels,* Pergamon
2. E. Giffen and A. Muraszew*, The atomization of liquid fuels,* Chapman and Hall.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- I Sem (TSES) **Th 4** **C 4**

(13D11106) DESIGN OF AIR CONDITIONING SYSTEMS (DACS)
(Elective-1)

Unit-I

PSYCHROMETRY:

Psychrometry and psychrometric properties – Psychrometric relations – Psychrometric processes

Unit-II

HEATING AND COOLING LOAD CALCULATIONS:

Introduction – Thermal comfort – Estimation of heat loss and heat gain – Design conditions – Infiltration and ventilation loads.

Unit-III

Procedure for estimating heating loads and cooling loads.

Unit-IV

AIR CONDITIONING SYSTEMS:

Thermal distribution systems – Single zone system – Design calculations.

Unit-V

Multi zone system – Water systems – Variable air volume systems – Unitary system.

Unit-VI

FAN AND DUCT SYSTEMS:

Pressure drop in straight and rectangular ducts – Sudden enlarge and contraction – Design of duct systems – Velocity method – Equi-friction method – Fan laws – Air distribution in rooms

Uint-VII

COOLING AND DEHUMIDIFYING COILS:

Types of cooling and dehumidifying coils – Calculating the surface area of the coil – Actual coil condition curves – Solving for outlet conditions

Unit-VIII

AIR CONDITIONING CONTROLS:

Pneumatic control hardware, Direct and reverse acting thermostat – Temperature transmitter with receiver controller – Dampers – Out door air control –Summer, winter changeover – Humidistat and humidifiers

TEXT BOOKS:

1. C.P.Arora, *Refrigeration & Air-Conditioning , TMH* .
2. Stoecker W.F., and Jones, *J.W., Refrigeration & Air-Conditioning,* McGraw Hill

REFERENCE BOOKS:

1. Manohar Prasad, *Refrigeration, Air-Conditioning* , New Age
2. Domkunduwar and Arora, *Refrigeration & Air-Conditioning,* Dhanpatrai & Sons

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- I Sem (TSES) **Th 4** **C 4**

(13D11107) ENERGY CONVERSION TECHNOLOGIES (ECT)

(Elective-1)

Unit-I

ENERGY CLASSIFICATION, SOURCES, UTILIZATION, ECONOMICS AND TERMINOLOGY:

Introduction , Mass-Energy Dependence , Energy , Mass and Power Units , Energy Types and Classifications , Energy Sources , Energy Reserves.

Unit-II

Energy Utilization , Energy Economics , Power Generation Terminology.

Unit-III

PRINCIPAL FUELS FOR ENERGY CONVERSION :

Introduction , Biomass Fuels , Fossil Fuels , Nuclear Fuels , Solar Energy .

Unit-IV

PRODUCTION OF THERMAL ENERGY :

Introduction , Conversion of Mechanical Energy , Conversion of Electrical Energy , Conversion of Electromagnetic Energy , Conversion of Chemical Energy ,Conversion of Nuclear Energy .

Unit-V

PRODUCTION OF MECHANICAL ENERGY :

Introduction , Conversion of Thermal Energy , Turbines , Electromechemical Conversion

Unit-VI

PRODUCTION OF ELECTRICAL ENERGY :

Introduction , Conversion of Thermal Energy into Electricity , Conversion of Chemical Energy into Electricity.

Unit-VII

Conversion of Electromagnetic energy into Electricity , Conversion of Nuclear Energy into Electricity , Conversion of Mechanical Energy into Electricity .

Unit-VIII

ENERGY STORAGE :

Introduction , Storage of Mechanical Energy , Storage of Electrical Energy, Storage of Chemical Energy , Storage of Nuclear Energy , Storage of Thermal Energy .

TEXT BOOK :

1. Archie W.Culp , Jr, *Principles of Energy Conversion* , Tata McGraw –Hill

REFERENCE BOOKS:

1. H.A.Sorenson , *Energy Conversion Systems* , John Willey & sons.
2. Bansal, K.Leeman, Renewable Energy sources & Conversion Technology, & Meliss.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- I Sem (TSES) **Th 4** **C 4**

(13D11108) SOLAR PASSIVE ARCHITECTURE (SPA)

(Elective-1)

Unit-I

Introduction

Introduction to architecture; Architecture as the art of science of designing buildings; Building science and its significance; Energy management concept in building

Thermal Analysis And Design For Human Comfort

Thermal comfort; Criteria and various parameters; Psychometric chart; Thermal indices, climate and comfort zones; Concept of sol-air temperature and its significance; Calculation of instantaneous heat gain through building envelope; Calculation of solar radiation on buildings; building orientation.

Unit-II

Introduction to design of shading devices; Overhangs; Factors that effects energy use in buildings; Ventilation and its significance; Air-conditioning systems; Energy conservation techniques in air-conditioning systems

Unit-III

Passive Cooling And Heating Concepts

Passive heating concepts: Direct heat gain, indirect heat gain, isolated gain and sunspaces.

Unit-IV

Passive cooling concepts: Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air-tunnel.

Unit-V

Heat Transmission In Buildings

Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Solar temperature; Decrement factor; Phase lag.

Unit-VI

Design of daylighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computer packages for carrying out thermal design of buildings and predicting performance.

Unit-VII

Bioclimatic Classification

Bioclimatic classification of India; Passive concepts appropriate for the various climatic zones in India; Typical design of selected buildings in various climatic zones; Thumb rules for design of buildings and building codes.

Unit-VIII

Energy Efficient Landscape Design

Modification of microclimatic through landscape element for energy conservation; Energy conservation through site selection, planning, and design; Siting and orientation

Text books:

1. M.S.Sodha, N.K. Bansal, P.K. Bansal, A. Kumar and M.A.S. Malik(1986), *Solar Passive Building, Science and Design*, Pergamon Press,.
2. J.R. Williams(1983), *Passive Solar Heating*, Ann Arbar Science,

References:

1. R.W.Jones, J.D. Balcomb, C.E. Kosiewiez, G.S. Lazarus, R.D. McFarland and W.O.Wray(1982), *Passive Solar Design Handbook, Vol. 3*, Report of U.S. Department of Energy(DOE/CS-0127/3),.
2. J Krieder and A Rabi (1994), *Heating and Cooling of Buildings : Design for Efficiency*, McGraw-Hill
3. 3.R D Brwon, T J Gillespie (1990), *Microclimatic Landscape Design*, John Wiley & Sons, NewYork,
4. D.S. Lal(2003), *Climatology*, Sharda Pustak Bhawan, Allahabad,
5. Majumder Milli, *Energy Efficient Buildings*, TERI, New Delhi
6. T A Markus, E N Morris(1980)Building, Climate and Energy, Spott woode Ballantype Ltd.London,
7. Sanjay Prakash (et al.)(1991), *Solar architecture and earth construction in the*
8. *NorthWest Himalaya*, Vikas, New Delhi,
9. *Solar Bioclimatic Architecture*, Energy Research Group, CD Rom Version 2 , LIOR

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- I Sem (TSES) **L C**

3 2

(13D11109) THERMAL SCIENCE LABORATORY

1. To find the exhaust emissions of an automobile (HC, CO, NO_X) .
2. Analysis of exhaust gases on IC engine.
3. Combustion analysis of CI engine
4. To find Octane number of given blends of fuel.
5. Performance analysis of Heat Pipe
6. Two Phase flow heat transfer estimation.
7. To estimate the COP of a vapour compression refrigeration system (Refrigerator).
8. To find the solar flat plate collector efficiency.
9. To find direct solar incident flux absorbed by using Pyranometer or concentratic parabolic collector.
10. Case study for energy audit.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- II Sem (TSES) **Th C**
4 4

(12D88102) ADVANCED HEAT AND MASS TRANSFER

UNIT- I:
Brief Introduction to different **modes of heat transfer**; Conduction: General heat conduction equation-Initial and Boundary conditions
Steady State Heat Transfer: Simplified heat transfer in 1D and 2D – Fins

UNIT-II
Transient heat conduction; Lumped system analysis- Heisler's charts-semi infinite solid-use of shape factors in conduction - 2D transient heat conduction – problem solutions
Forced Convection: Equations of Fluid Flow – Concepts of Continuity, momentum equations – Derivation of Energy equation – Dimensional Analysis and Similitude

UNIT - III:
External flows: Flow over a flat plate: Critical Reynolds Number - - Methods to determine heat transfer coefficient: Analogy between heat and momentum transfer - Similarity Parameters - Analytical Methods - Exact and Integral methods - Integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to various geometries for Laminar and Turbulent flows.

UNIT - IV:
Internal flows: Fully developed flow: Laminar heat transfer coefficient for Constant Wall Temperature and Constant Heat Flux Boundary Conditions - Hydrodynamic and thermal entry lengths; use of empirical correlations. Reylolds – Colburn Analogy - Application of empirical relations to various geometries for Laminar and Turbulent flows.
Free convection: Integral analysis on laminar free convective heat transfer - Different geometries – combined free and forced convection

UNIT - V:

Boiling and condensation: Pool Boiling–Boiling regimes-Correlations. Nusselt's theory of film condensation on a vertical plate – Assumptions and correlations of film condensation for different geometrics.

UNIT-VI

Heat Exchangers: Design - LMTD and NTU methods – Boiler and Condenser – Cross flow and 1 shell 2,4,6,8 pass heat exchangers – Use of charts and empirical correlations

Recent Advancements in Heat transfer applications

UNIT - VII:

Radiation Heat Transfer: Radiant heat exchange in grey, non-grey bodies, with transmitting, reflecting and absorbing media, specular surfaces, gas radiation – radiation from flames.

UNIT-VIII

Mass Transfer: Concepts of mass transfer – Diffusion and convective mass transfer Analogies – Significance of non-dimensional numbers.

TEXT BOOKS :

1. Heat Transfer, Necati Ozisik (TMH)
2. Introduction to Heat Transfer, Frank P. Incropera, David P. Dewitt, Wiley, 4th Edition
3. Heat and Mass Transfer, O P Single (Macmillan India Ltd)

REFERENCE BOOKS :

1. Heat Transfer, P.S. Ghoshdastidar (Oxford Press)
2. Heat Transfer, A basic approach – Yunus Cangel (MH)
3. Heat and Mass Transfer, D.S. Kumar
4. Heat Transfer, P.K. Nag(TMH)
5. Principle of Heat Transfer,Frank Kreith & Mark.Bohn.
6. Convective Heat and Mass Transfer, W.M.Kays & M.E.Crawford(TMH)
7. Radiation Heat Transfer,G.M.Sparrow & R.D.Cess

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- II Sem (TSES) **Th C**
4 4

(13D11201) ADVANCED ENERGY TECHNOLOGIES (AET)

Unit-I

HIGH PRESSURE BOILERS

Introduction , Advantages of High Pressure Boilers, LaMont Boiler , Benson Boiler, Loeffler Boiler , Supercharged Boilers , Waste Heat Boilers , Corrosion in Boilers and its Prevention , Causes of Boiler Tube Failures and Prevention

Unit-II

FLUIDIZED BED COMBUSTION (FBC)

Introduction , Principle of FBC , Types of FBC , FBC for low grade fuels , Corrosion of FBC system , Control of FBC system , Starting of Fluid-Bed Firing system.

Uint-III

Erosion and Corrosion and its prevention in FBC Boilers , Advantages of Fluidized Bed Systems

Unit-IV

COMBINED CYCLE TECHNOLOGY

Introduction , Arrangement of Combined Cycles , Combined Cycle with Gas Production from coal , Combined cycles using PFBC system.

Unit-V

Optimum design of Gas Turbine Unit for Combined cycle plant , Advantages of Combined Cycle , Performance of Combined Cycle , Economics of Combined Cycle

Unit-VI

COGENERATION

Concepts, Types of Co generating Systems , Performance Evaluation of Co generating System

Unit-VII

WASTE HEAT RECOVERY SYSTEM

Introduction , Sources of Waste Heat and their Grading , Thermodynamic Cycles for Waste Heat Recovery.

Unit-VIII

Heat Recovery Forms and Methods , Other Uses of Heat , Heat Pump Systems , Different Wastes for Power Generation .

TEXT BOOKS:

1. 1.S.Rao &B.B. Parulekar, *Energy Technology* Khanna Publishers

REFERENC*E BOOKS:*

1. D.A. Reay, *Waste heat recovery systems*,Pergmon Press
2. Arora and Domukundwar, *Power Plant Engineering* ,Dhanapat Rai & Co .,

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- II Sem (TSES) **Th 4** **C 4**

(13D11202) ENERGY AUDITING AND MANAGEMENT (EAM)

Unit-I: ENERGY CONSERVATION

Rules for efficient energy conservation, Technologies for energy conservation, Load management, Energy use patterns, Necessary steps of energy management programme, Concepts of energy management, General principles of energy management, Energy management in manufacturing and process industries – Qualities and functions of energy managers

Unit-II: ENERGY AUDITING

Definition &objectives, level of responsibility, Control of energy , Check lists, Energy conservation schemes, Energy index, Cost index, Pie charts, Sankey diagrams, Load profiles.

Unit-III: Types of energy audits – Questionnaire ,Energy audit of industries, General energy audit , Detailed energy audit ,Energy saving potential

Unit-IV: THERMAL INSULATION & REFRACTORS

Heat loss through un insulated surfaces effect of insulation on current carrying wires- economic thickness of insulation – critical radius of insulation –properties of thermal insulators – classification of insulation materials.

Unit-V: classification of refractors – properties of refractors- criteria of good refractory material – applications of insulating & refractory materials.

Unit-VI: ENGINEERING ECONOMICS

Steps in planning- efficiency of organization – capital budgeting – classification of cost– interest- types – time value of money – cash flow diagrams – present worth factor, capital recovery factor, equal annual payments – nominal and effective interest rates- discrete and continuous compounding- equivalent between cash flows.

Unit-VII: PROJECT MANAGEMENT

Method of investment appraisal – rate of return method, pay back method, net present value method(NPV) – adoption of the methods in energy conservation campaign – types of

projects – types of budgets –propose of project management – managerial objectives – Classification – role and qualities of project manager – budget committee – budgeting – capital budgeting

Unit-VIII: ENERGY CONSERVATION IN ELECTRIC UTILITY

Energy conservation in utility by improving load factor, Load curve analysis, Energy efficient motors, Energy conservation in illumination systems, Importance of Power factor in energy conservation - Power factor improvement method

TEXT BOOKS:

1. W.R. Murphy & G. Mickay, *Energy Management,* Butterworths
2. P.W.O' Callghan, *Energy Conservation,* Pargamon Press 1981

REFERENCE BOOKS:

1. D.A. Reay, Waste heat recovery systems, Pergmon Press
2. Albert Thumann, Hand book of energy audits-
3. Craig B. Smithm, Energy Management Prinicples,Pergarmon Press
4. S.C.Tripathy, "Electric Energy Utilization and onservation", TMGDelhi,1991

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech- II Sem (TSES) **Th 4** **C 4**

(13D11203) DESIGN OF HEAT TRANSFER EQUIPMENT

Unit-I

DESIGN OF HEAT EXCHANGERS

Heat Exchangers-mean temperature differences for parallel and counter flow-effectiveness method(NTU).

Unit-II

DESGIN OF CONDERSERS

Overall heat transfer co-efficient –temperature distribution and heat flow in a condenser-pressure drop in a condenser-extended fin surfaces-consideration of fouling factors-LMTD correction factor.

Unit-III

DESIGN OF EVOPORATORS

Temperature distribution and heat flow in an evaporator – pressure drop-factor to be consider in the design of heat transfer equipment – types of heat consideration of fouling factor-correction factor.

Unit-IV

DESIGN OF COMPRESSORS

Types – equivalent shaft work- volume metric efficiency- factors affection total volume metric efficiency – compound compression with inter cooling – rotary compressors surging.

Unit-V

DESIGN OF COOLING TOWERS AND SPRAY PONDS

Classification-performance of cooling towers-analysis of counter flow cooling towers – enthalpy – temperature diagram of air and water- cooling ponds- types of cooling ponds- cross flow cooling towers – procedure for calculation of outlet conditions

Unit-VI

DESIGN OF DUCTS

Continuity equation – Bernoulli's equation – pressure losses – frictional charts – co efficient of resistance for fillings – duct sizing methods.

Unit-VII

DESIGN OF FANS

Standard air –fan horse power – fan efficiency – similarity laws-fan laws – performance co efficient –theoretical expressions for total pressure drop by a fan-centrifugal fan- axial flow fan – system resistance.

Unit-VIII

PIPING SYSTEM

Requirements of a good piping system- pressure drop in pipe-Moody chart-refrigerant piping – discharge line- liquid line-suction line – piping arrangement

Reference Books

1. Heat and Mass Transfer by - Arora and Domkundwar.
2. Refrigeration and Air conditioning – PL Ballaney.
3. Refrigeration and Air conditioning – CP Arora.
4. Refrigeration and Air conditioning- Stoecker.

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M.Tech- II Sem (TSES) **Th 4** **C 4**

(12D88203) COMPUTATIONAL FLUID DYNAMICS

UNIT - I: Introduction to Numerical Methods - Finite Difference, Finite Element and Finite Volume Methods – Classification of Partial Differential Equations – Solution of Linear Algebraic Equations – Direct and Iterative Approaches

Finite difference methods: Taylor's series – FDE formulation for 1D and 2D steady state heat transfer problems – Cartesian, cylindrical and spherical co-ordinate systems – boundary conditions – Un steady state heat conduction – Errors associated with FDE - Explicit Method – Stability criteria – Implicit Method – Crank Nickolson method – 2-D FDE formulation – ADI – ADE

UNIT-II: **Finite Volume Method**: Formation of Basic rules for control volume approach using 1D steady heat conduction equation – Interface Thermal Conductivity

UNIT-III: Extension of General Nodal Equation to 2D and 3D Steady heat conduction and Unsteady heat conduction

UNIT -IV: **FVM to Convection and Diffusion**: Concept of Elliptic, Parabolic and Hyperbolic Equations applied to fluid flow – Governing Equations of Flow and Heat transfer – Steady 1D Convection Diffusion – Discretization Schemes and their assessment – Treatment of Boundary Conditions

UNIT - V: **Calculation of Flow Field**: Vorticity and Stream Function Method - Staggered Grid as Remedy for representation of Flow Field

UNIT-VI: Pressure and Velocity Corrections – Pressure Velocity Coupling - SIMPLE and SIMPLER (revised algorithm) Algorithm.

UNIT - VII: **Turbulent Flows**: Direct Numerical Simulation, Large Eddy Simulation and RANS Models

UNIT-VIII:

Compressible Flows: Introduction - Pressure, Velocity and Density Coupling.

TEXT BOOKS:

1. Numerical heat transfer and fluid flow, S.V. Patankar (Hemisphere Pub. House)
2. An Introduction to Computational Fluid Dynamics, FVM Method , H.K. Versteeg, W. Malalasekhara (PHI)
3. Computational Fluid Flow and Heat Transfer , Muralidharan & Sundararajan (Narosa Pub)

REFERENCE BOOKS:

1. Computational Fluid Dynamics, Hoffman and Chiang, Engg Education System
2. Computational Fluid Dynamics, Anderson (TMH)
3. Computational Methods for Fluid Dynamics, Ferziger, Peric (Springer)
4. Computational Fluid Dynamics, T.J. Chung, Cambridge University
5. Computational Fluid Dynamics, A Practical Approach, Tu, Yeoh, Liu (Elsevier)
6. Text Book of Fluid Dynamics, Frank Chorlton, CBS Publishers

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M.Tech- II Sem (TSES) **Th C**

4 4

(13D11204) ENERGY SYSTEMS MODELING AND ANALYSIS (ESMA)

(Elective-II)

Unit-I

INTRODUCTION:

Overview of various technologies and conventional methods of energy conversion, Designing a Workable System: Workable and optimum systems, Steps in arriving a workable system, Creativity in concept selection, Workable Vs Optimum system

Unit-II

EQUATION FITTING:

Mathematical modeling, Polynomial representation, Functions of two variables, Exponential forms, Best fit Method of least squares

Unit-III

MODELING OF THERMAL EQUIPMENT:

Counter flow heat exchanger, Evaporators and Condensers, Heat exchanger effectiveness, Effectiveness of a counter flow heat exchanger, NTU, Pressure drop and pumping power

Unit-IV

SYSTEM SIMULATION:

Classes of simulation, Information flow diagrams, Sequential and simultaneous calculations, Successive substitution, Newton Raphson method

Unit-V

OPTIMIZATION TECHNIQUES:

Mathematical representation of optimization problems, A water chilling system, Optimization procedure, Setting up the mathematical statement of the optimization problem, Dynamic Programming: Characteristic of the Dynamic programming solution, Apparently constrained problem, Application of Dynamic programming to energy system problems, Geometric Programming: One independent variable unconstrained, Multivariable optimization, Constrained optimization with zero degree of difficulty ,Linear Programming: Simplex method, Big-M method, Application of LP to thermal systems

Unit-VI

LAGRANGE MULTIPLIER'S METHOD: The Lagrange multiplier equations, Unconstrained optimization, Constrained optimization, Sensitivity coefficients

Unit-VII

SEARCH METHODS: Single variable – Exhaustive, Dichotomous and Fibonacci, Multivariable unconstrained - Lattice, Univariable and Steepest ascent

Unit-VIII

MATHEMATICAL MODELING:

Thermodynamic properties-Need for mathematical modeling, Criteria for fidelity of representation, Linear regression analysis, Internal energy and enthalpy, Pressure temperature relationship at saturated conditions, Specific heat, P-V-T equations

Tex Books / References :

1) W.F.Stoecker (1989)*, "Design of Thermal Systems"* McGraw Hill, 3rd Ed.
2) B.K.Hodg(1990)*,"Analysis and Design of Thermal Systems",*Prentice Hall Inc.,.
3) I.J.Nagrath & M.Gopal, *"Systems Modelling and Analysis",* Tata McGraw Hill.
4) D.J. Wide(1978), *"Globally Optimal Design",* Wiley- Interscience,

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M.Tech- II Sem (TSES) **Th 4** **C 4**

(12D88108) OPTIMIZATION TECHNIQUES AND ITS APPLICATIONS
(Elective-II)

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UNIT- I*:*

Introduction: Engineering Applications of optimization- statement of an optimization problem – Classification of optimization problems.

UNIT-II

Single Variable Non-Linear Unconstrained Optimization: One dimensional Optimization methods:- Uni-modal function, elimination methods, Fibonacci method, golden section method, interpolation methods – quadratic and cubic interpolation methods.

UNIT- III:

Multi variable non-linear unconstrained optimization: Direct search method – Univariant method - pattern search methods – Powell's- Hook -Jeeves, Rosenbrock search methods- gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.

UNIT- IV:

Linear Programming – Graphical method-Simplex method- Dual simplex method-Revised simplex method- Parametric linear programming- Goal Programming
Simulation- types of simulations- Applications of simulations to inventory, queuing and thermal systems.

UNIT- V:

Integer Programming- Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method

UNIT-VI

Stochastic Programming: Basic concepts of probability theory, random variables-distributions-mean, variance, correlation, co variance, joint probability distribution-stochastic linear, dynamic programming.

UNIT- VII:

Geometric Programming: Posynomials – arithmetic - geometric inequality – unconstrained G.P- constrained G.P

UNIT- VIII

Non Traditional Optimization Algorithms: Genetics Algorithm-Working Principles, Similarities and Differences between Genetic Algorithm and Traditional Methods. Simulated Annealing- Working Principle-Simple Problems. Application in production problems.

TEXT BOOKS:

1. Optimization theory and Applications,S.S.Rao,New Age International.
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI

REFERENCE BOOKS:

1. Operations Research, S.D.Sharma,
2. Operation Research, H.A.Taha ,TMH
3. Optimization in operations research, R.LRardin
4. Optimization Techniques, Belagundu & Chandraputla, Pearson Asia.
5. Optimization Techniques theory and practice, M.C.Joshi, K.M.Moudgalya, Narosa Publications

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M.Tech- II Sem (TSES) **Th 4** **C 4**

(13D11205) ENERGY STORAGE SYSTEMS (ESS)

(Elective-II)

Unit-I

INTRODUCTION:

Need of Energy Storage, Different modes of Energy Storage.

Unit-II

ENERGY STORAGE:

Potential Energy: Pumped Hydro Storage, KE and Compressed gas system: Flywheel Storage, Compressed air energy Storage, Electrical and magnetic energy storage: Capacitors, Electromagnets and battery storage systems.

Unit-III

Chemical Energy Storage: Thermo-Chemical, Bio-Chemical, Electro-Chemical, Fossil fuels and synthetic fuels and Hydrogen storage.

Unit-IV

SENSIBLE HEAT STORAGE:

SHS mediums, Stratified storage systems, Rock-bed storage systems, Thermal storage in buildings, Earth storage, Energy storage in aquifers, Heat storage in SHS systems, Aquifers storage.

Unit-V

LATENT HEAT THERMAL ENERGY STORAGE:

Phase Change Materials(PCMs), Selection Criteria Of PCMs, Stefan Problem, Solar Thermal LHTES Systems, Energy Conservation Through LHTES Systems, LHTES Systems in Refrigeration and Air Conditioning Systems.

Unit-VI

Enthalpy formulation, Numerical heat transfer in melting and freezing process.

Unit-VII

SOME AREAS OF APPLICATION OF ENERGY STORAGE:

Food Preservation, Waste Heat Recovery, Solar Energy Storage, Green House Heating,

Unit-VIII

Power Plant Applications, Drying and Heating for Process Industries.

Text Books / References:

1. H.P.Garg et al, D Reidel (1885)*"Solar Thermal Energy Storage",* Publishing Co.
2. V Alexiades & A.D.Solomon(1993) *"Mathematical Modeling of Melting and Freezing Proces",* Hemisphere Publishing Corporation,
3. WashingtonNarayan R, Viswanath B(1998), *Chemical and Electro Chemical Energy System*, Universities Press
4. A. Ter-Gazarian(1994)*, "Energy Storage for Power Systems", Peter* Peregrinus Ltd.London
5. B.Kilkis and S.Kakac (1989),"*Energy Storage Systems",*(Ed),KAP,London,1989

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M.Tech- II Sem (TSES) **L C**

3 2

(13D11206) MANUFACTURING SIMULATION LAB

1. Simulation of Plane Poiseuille flow through long Parallel and Stationary Plates and Plotting Velocity Contours and Velocity Variation along the horizontal central line . Take the distance between the plates as 4 cm. Properties of fluid are v=0.000217 m2/s p=800 kg/m2
2. Simulation of Couette flow when the upper plates is moving with a velocity of 40 m/s. Take the distance between the plates as 4 cm properties of fluid are v=0.000217 m2/s, p=800 kg/m3 . Make simulations for a pressure gradient of 0-30000 N/m2/m and 20000 N m2/m and report the variation of velocity contours for each case.
3. Simulation of a channel flow (Tube flow) for a tube of diameter. 5 cm and take the fluid as water at 300C at the entry of the tube of length 0.7m. A heat flux of 3000 W/m2 is imposed along a wall. Obtain the contours of velocity and temperature along the length of the tube and also obtain the centre line temperature and velocity of fluid.
4. Simulation of a channel flow (Tube flow) for a tube of diameter 5 cm and take the fluid as water at 300C at the entry of the tube length 0.7m . A Constant wall temperature of 3000C is imposed along the wall. Obtain the contours of Velocity and temperature along the length of the tube and also obtain the centre line temperature and velocity of fluid.
5. Unsteady simulation of compressible flow of air through 2D a convergent – Divergent nozzle, with inlet and outlet of 0.2m size and both are joined by a throat section where the flow area is reduced by 10% and is of sinusoidal shape. Air enters the nozzle at a pressure of 0.9 bar and leaves at 0.73 bar. Obtain the contours of velocity, pressure and Mach number.
6. Simulation of flow over a circular cylinder of size 5 cm for different Reynold's number values of air and plotting the contours of velocity and vorticity
7. Simulation of temperature counters for a square plate of size 0.2m subjected to different types of boundary conditions.
8. Simulation of temperature counters for a pin fin in natural and forced convective conditions.