Course Structure and Syllabi for Pre Ph.D
MECHANICAL ENGINEERING (2017-18)

PART – I

Choose any one subject of the following

<table>
<thead>
<tr>
<th>S.NO</th>
<th>PAPER</th>
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<tbody>
<tr>
<td>1</td>
<td>Thermal Engineering</td>
<td>17PH03101</td>
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<tr>
<td>2</td>
<td>Mechanical Engineering Design</td>
<td>17PH03102</td>
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<td>3</td>
<td>Industrial Engineering</td>
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<td>4</td>
<td>Advanced Production Technology</td>
<td>17PH03104</td>
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<td>5</td>
<td>Material Technology</td>
<td>17PH03105</td>
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<tbody>
<tr>
<td>1</td>
<td>Refrigeration Equipment and Cryogenic Engineering</td>
<td>17PH03201</td>
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<td>2</td>
<td>Heat and Mass Transfer</td>
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<td>3</td>
<td>I.C. Engines and Alternative Fuels</td>
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<td>4</td>
<td>CAD Theory and Practice</td>
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<td>5</td>
<td>Mechanical Vibrations and Condition Monitoring</td>
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<td>Design for Manufacture</td>
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<td>7</td>
<td>Special Manufacturing Processes</td>
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<td>8</td>
<td>Industrial Robotics</td>
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<td>9</td>
<td>Simulation Modeling and Analysis of Manufacturing Systems</td>
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<tr>
<td>10</td>
<td>Advanced Optimization Techniques</td>
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<td>11</td>
<td>Logistics and Supply Chain Management</td>
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<td>12</td>
<td>Advanced Operations Management</td>
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<td>13</td>
<td>Mechanics of Composite materials</td>
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<td>14</td>
<td>Energy Conservation</td>
<td>17PH03214</td>
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<td>15</td>
<td>Computational Methods</td>
<td>17PH03215</td>
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Unit 1:

Thermodynamic property relations: Availability (Exergy) – Unavailability (Anergy) – Irreversibility – Partial derivatives – Maxwell’s relations – Clausius Clayperon equation – General relations for du, dh, ds, $C_v$, $C_p$ for ideal gases (pure substances) and real gases.

Gas Mixtures: Composition of a Gas mixture – mass and mole fractions – PVT behavior of gas mixtures (Ideal and Real gases) – Properties of gas mixtures (Ideal and Real gases)


Unit 2:


Vapor power cycles: Carnot vapor cycle – Ideal Rankine cycle – Deviation of Actual Vapor power cycle from Ideal cycle – Actual Rankine cycle – Methods to increase efficiency of Rankine cycle (Lowering of condenser pressure, Super heating steam to High temperature, Increasing Boiler pressure) – Ideal Reheat Rankine cycle

Unit 3:

Gas Turbines - Gas Turbine cycle – Combined cycle analysis – Design for high temperature combined cycles with heat recovery boiler – STAG combined cycle power plant – Combined cycle with multi pressure steam, Influence of component efficiencies on cycle performance – Combined cycle with Nuclear power plant – ICGCC plant.

Unit 4:


Heat Transfer to Fluids with Phase Change – Heating and cooling of fluids in forced convection outside tubes – Heat transfer from condensing vapors – Heat transfer to boiling liquids.
Unit 5:

IC Engines: Classification- Engine components, valve timings and mechanism, Spark ignition, four stroke Engine, carburetor, air fuel mixtures, mixture requirements, simple plain tube carbuector, fuel pump- ignition system, fuel pump and injector, two stroke engine, scavenging of two stroke engine.

Refrigeration: Simple vapour compression cycle, units of refrigeration, reversed carnot cycle for vapour, actual refrigeration cycle, the effect of sub cooling, superheating, common refrigerants.

References:

1. Engineering Thermodynamics by P.K.Nag /TMH
2. Thermo dynamics by Sontag & Van Wylen/Mc Grow Hill Education.

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Unit 1:

**Introduction**: Introduction to design, the engineering model, computer aided design and Engineering, materials, load analysis, stresses, strains, deflection and stability, stress element representation for different types of loads. Locating critical sections, force flow concept, methodology for solving machine component problems. Static failure theories-failure of ductile materials, failure of brittle materials, fracture mechanics, fatigue-failure theories, surface failures.

Unit 2:

**Design synthesis**: Design process and methodologies of systematic design. Conceptual design variants and evaluations. Load transmission, load equalization, light weight and rigid constructions. Machining considerations. Design of assembly and dismantling, modular constructions. Erection, operation, inspection and maintenance considerations.

Unit 3:


Unit 4:

**Design of power transmission elements**: Design of flat belts, v-belts, toothed belts, roller chains, hydrodynamic drives. Design of Gears: Spur, Helical, Bevel and Worm gears, Gear materials, forces, stresses, lubrication, design procedure considering Lewis beam strength, Buckingham dynamic load and wear load. Algorithms for the design procedure of different types of gears.

Unit 5:

**Bearings and Lubrication**: Lubricants, hydrodynamic lubrication theory, design of hydrodynamic bearings, rolling element bearings, selection of rolling element bearings, bearing mountings and special bearings. Algorithms for the design procedure of bearings.

*(PSG Design data book is permitted in examination)*

References:


6. **Product Design** by Chitale, P.H.I.

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Unit I:
**Industrial Engineering**: Introduction, Definition, objectives, Techniques, Functions of an Industrial Engineer, Role of IE in manufacturing and service organizations.

**Productivity**: Definition. Benefits, Factors influencing productivity, Partial and total productivity measures.

**Plant Layout**: Economics of plant location, Rural Vs Suburban sites, Types of layouts, Travel chart technique, Assembly line balancing, simple problems.

**Plant Maintenance**: Objectives and types.

Unit II:
**Production Planning and Control**: Types of productions, Production cycle, Product design and development, Process planning, Loading, Scheduling, Dispatching, Routing, Progress, Control, Simple problems.

**Materials Handling**: Principles, Concept of unit load, Containerization, Palletization, Selection of material handling equipment, Applications of belt conveyors, Cranes, Forklift trucks in industry.

**Forecasting**: Factors affecting forecasting, Sources of data, Forecasting models, Forecast errors, Mean absolute deviation, Mean squared error, Tracking signal.

Unit III:
**Work Study**: Concept of productivity, Method Study - Basic steps in method study, Process charts, Diagrams, Models and Templates, Principles of motion economy, Micro motion study, Therbligs, SIMO chart. Work Measurement - Stop watch procedure of time study, Performance rating, allowances, Work sampling, Simple problems.

Unit IV:

**Job evaluation and incentive scheme**: Job description and job analysis - Job evaluation-different methods - Individual and group incentive concepts and implications - Different types of incentive schemes - Suggestion schemes

Unit V:
**Materials Management**: Introduction, Purchasing, Objectives of purchasing department, Buying techniques, Purchase procedure, Stores and material control, Receipt and issue of materials, Store records. Inventory Control, EOQ model(Simple problems).

**Statistical Quality Control** – Definition, Control charts for variables and attributes. OC curve, Sampling plans, Six sigma, TQM.

**References**:
1. **Principles of Management** by Koontz & Donnel.
2. **Production and Operations Management** by Everette Adam & Ronald Ebert.
5. **Production and Operations Management** by R. Panneerselvam, PHI
6. **Industrial Engineering Management**, by Dr. O. P. Khanna

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Unit 5: Processing of plastics and Composites: Processing methods for plastics, composites, tool making and die making for plastics, composites.

References:
1. Manufacturing engineering and technology by Serope Kalpajian, SR Schmid.
2. Modern materials and manufacturing processes by RG Bruce, WK Dalton.
Unit 1:
Elasticity in metals and polymers, mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening.

Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non crystalline material.

Unit 2:
Griffith’s Theory, stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson Miller Parameter, Deformation and Fracture mechanism maps.

Unit 3:
Fatigue, Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and Paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis.

Unit 4:
Motivation for selection, cost basis and service requirements, Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep.

Selection for Surface durability, Corrosion and Wear resistance, Relationship between Materials Selection and Processing, Case studies in Materials Selection with relevance to Aero, Auto, Marine, Machinery and Nuclear Applications.

Unit 5:
MODERN METALLIC MATERIALS : Dual Phase Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity ( TRIP) Steel, Maraging Steel, Intermetallics, Ni and Ti Aluminides, Smart Materials, Shape Memory alloys, Metallic Glass, Quasi Crystal and Nano Crystalline Materials.


References:
Unit 1:

Unit 2:
Condensers - types - Water cooled Condensers-Air cooled, Evaporative types - Economic water rate - Economic water velocity - over all heat transfer co-efficient - design - temperature distribution and heat flow in a condenser - pressure drop - fouling factor - LMTD correction factor (no problems).

Unit 3:

Evaporators - types - Flooded and dry Evaporators, natural and forced convection type - shell and tube - shell and coil, plate type - secondary Evaporators - temperature distribution and heat flow in evaporator - pressure drop - fouling correction factor (no problems).

Unit 4:
Expansion devices - Capillary tube, thermostatic expansion valve - float valves, externally equalized valves - automatic expansion valves - solenoid control valve - location of piping and pump design consideration.(no problems)

Performance of complete Vapour compression system-Performance of condensing unit-compressor -Evaporator-balancing of load in two stage compression.(no problems)

Unit 5:

Cooling by adiabatic de-magnetization - Gas separation and cryogenic systems-separation of gases- Rectifying columns-Air separating- single and double columns Air separation plant. Storage and handling of cryogenic liquids - Dewars and other types of containers.
References:


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(17PH03202) HEAT AND MASS TRANSFER

Unit 1:
Unsteady state heat transfer process by conduction, governing equations and boundary conditions - Two dimensional steady state conduction, semi-infinite and finite flat plate; temperature field in infinite and finite cylinders- Numerical methods, relaxation method and finite difference methods in heat conduction - simple problems.

Unit 2:
Heating and cooling of bodies with negligible internal resistance, sudden changes in the surface temperature of infinite plates, cylinders and semi-infinite bodies-simple problems- Forced convection in laminar flow - exact and approximate solutions of boundary layer, energy equation for plane isothermal plate in longitudinal flow - problems.

Unit 3:
Boiling and condensation: analysis of film condensation on a vertical surface - pool boiling and forced convection boiling inside tubes – problems

Unit 4:
Radiation network for an absorbing and transmitting medium, radiation exchange with specular surfaces, radiation exchange with transmissivity and reflecting absorbing medium. Formulation for numerical solution. Solar radiation: Radiation properties of environment, effect of radiation on temperature measurement, the radiation heat transfer coefficient, problems.

Unit 5:
Steady state diffusion in dilute solutions in stationary media, transient diffusion in dilute solutions in stationary media, one dimensional non dilute diffusion in gases with one component stationary - Connective mass transfer - governing equations-forced diffusion from flat plate- Dimension less correlation's for mass transfer. Simultaneous heat and mass transfer - analogy between heat, mass and momentum transfer.

References:

Heat transfer by J.P. Holman, International student edition


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Unit 5: Modern Trends in IC Engines: Computer Simulation and Optimized Design - Lean Burning and Adiabatic concepts - Rotary Engines. Modification in IC Engines to suite Bio-Fuels

References:

1. I.C. Engines Fundamentals/Heywood/Mc Graw Hill
2. I.C. Engines / Ferguson/John Wiley(WE & Exclusive)
3. I.C. Engines / Maleev
4. IC Engines / V Ganesan
7. Combustion Engine Processes / Lichty
8. Scavenging of two stroke Cycle Engines / Switzer

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Unit 1:

CAD TOOLS: Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software.

Unit 2:

GEOMETRIC MODELLING: Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves her mite cubic splines Bezier curves B-splines rational curves

Unit 3: SURFACE MODELING: Mathematical representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.

Unit 4:

PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES: Hermite Bi-cubic surface, Bezier surface, B- Spline surface, COONs surface, Blending surface , Sculptured surface, Surface manipulation–Displaying, Segmentation, Trimming, Intersection, Transformations(both 2D & 3D).

GEOMETRIC MODELLING-3D: Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).

Unit 5: CAD/CAM data Exchange:

Evaluation of data – exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.

Mechanical tolerances, Mass property calculations, Finite Element Modeling and Analysis and Mechanical Assembly.


TEXT BOOKS:

References:

Mastering CAD/CAM / Ibrhim Zeid / Mc Graw Hill international.

1. CAD/CAM / P.N.Rao / TMH.
2. CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH03205) MECHANICAL VIBRATIONS AND CONDITION MONITORING

Unit 1: Single degree freedom systems - Introduction - Single degree freedom systems - free and forced vibrations - Damping classification and damped systems. Two degree freedom systems - Free, forced damped and undamped motions - Use of influence coefficients, Matrix methods and Lagrange's equations - Phenomenon of beat - Dynamic absorbers – Applications.

Unit 2: Transient (Shock) vibrations as applied to single and two degree freedom systems - Use of mathematics and graphical techniques in the analysis (superposition integral, Laplace transformations, phase plane techniques).

Unit 3: Multi degree freedom systems - Free and forced motions in longitudinal, torsional and lateral modes - damped and undamped, critical speeds of rotors. Continuous systems - free and forced vibrations of string, bars and beams - Principle of Orthogonality Classical and energy methods by Rayleigh, Ritz and Gelerkin.


Unit 5: Vibration Measurements and analysis - Transducers and mounting methods, Data acquisition using instrumentation recorders/data loggers, Time domain signal analysis, Orbit analysis, Filters, Frequency domain analysis (Narrow band FFT analysis), Nyquist criteria, sampling, aliasing, windowing and averaging. Fault Diagnosis, Interpreting vibration measurements for common machine faults, Imbalance, Misalignment, Bearing and Gearing faults, Faults in Induction motors, Resonances, Some case studies.

References:
1. Mechanical Vibrations by A.H. Church.

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Unit 2: Machining Process: 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 4: Forging – Design factors for Forging – Closed die forging design – parting lines of dies – drop forging die design – general design recommendations –


References:


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Unit 1:

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.

Unit 2:


Unit 3:

EDM - principles, equipment, generators, analysis of R-C circuits, MRR, Surface finish, WEDM. LBM - working, equipment, PAM - working, system, performance. EBM - working, equipment, process parameters. ECM - principle, equipment, mechanical properties, MRR, parameter analysis.

Unit 4:

Processing of ceramics: Applications, characteristics, classification. Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics.

Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

Unit 5:

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 micro electronics, surface mount technology, Integrated circuit economics, properties of nano-materials, introduction to micromachining, High Speed Machining and rapid prototyping process.

References:

1. Manufacturing Engineering and Technology / Kalpakijian / Adisson Wesley.
4. MEMS & Micro Systems Design and manufacture / Tai - Run Hsu / TMGH
5. Advanced Machining Processes / V.K.Jain / Allied Publications.

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Unit 1:

Introduction: Robot anatomy, robot configuration, work volume, characteristics, dynamic performance, precision of movement.

End effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors, consideration in gripper selection and design.

Unit 2:

Motion analysis: Manipulator kinematics, Position representation, Homogeneous transformation, DH notation, Forward kinematics, Simple problems applied to different configurations up to 6 dof. Inverse kinematics, simple problems applied to different configurations up to 6 dof.

Unit 3:

Differential kinematics: Differential transformations of 2 dof and 3dof manipulators, Jacobians, Problems


SENSORS: Desirable features, Internal and external sensors, Feedback components, tactile, proximity and range sensors, uses sensors in robotics.

Unit 4:

MACHINE VISION: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, Image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

ROBOT PROGRAMMING: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SIGNAL AND DELAY commands, Branching capabilities and Limitations.

ROBOT LANGUAGES: Textual robot languages, Generation, Robot language structures, Elements in function. Programming of various functions in PTP and CP system of robots with suitable examples.

Unit 5: Trajectory planning: theory and problems relating to trajectory path planning
ROBOT CELL DESIGN AND CONTROL: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detection, Work cell controller.

ROBOT APPLICATIONS: Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application.

References:

1. Industrial robotics / Mikell P.Groover / McGraw Hill.
3. Robotics for engineers, Yoram Koren, McGraw Hill

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Models: Model Automated Manufacturing systems, Role of performance modeling, Nature of Models, Basic approach to modeling, types of models, analytical Vs simulation models-Need for the both.

Unit 2: Simulation Modeling: The nature of simulation, systems models and simulation discrete event simulation, principles of valid simulation modeling, verification of simulation computer programs, general perspectives on validation, A three-step approach for developing valid and credible simulation models, Random number generators.

Unit 3: Markov Chain Models: Review of basic probability and statistics, Estimation of means and variances, memoryless random variables, geometric and exponential random variables stochastic process in Manufacturing, Discrete time Markov chain models, continuous time Markov chain models, Semi Markov process in manufacturing.

Unit 4: Queuing Models: Queues, the M/M/1 Queue, the M/M/m Queue, batch arrival queuing systems, Queues with general distributions, Queues with breakdowns, Queuing networks, Open and closed queuing networks, Queuing networks with blocking, Performability analysis.

Pertrinet Models: Classical petrinets, Stochastic petrinets, Generalized stochastic petrinets (GSPN), GSPN Modeling of typical manufacturing systems.


References:


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Unit 2: Numerical methods for optimization: Direct search methods – Random search methods, Nelder Mead’s Simplex search method, Hooke and Jeeves’ method, Powell’s method.

Indirect search methods: Gradient of a function, Steepest descent method, Newton’s method, Davidon-Fletcher-Powell method, types of penalty methods for handling constraints.

Unit 3:


Dynamic programming(D.P): Multistage decision processes. Concepts of sub optimization and Principal of optimality, computational procedure in dynamic programming calculus method and tabular methods. Linear programming as a case of D.P. and continuous D.P.

Unit 4:


Unit 5:

Non-traditional optimization techniques: Multi-objective optimization - Lexicographic method, Goal programming method, Genetic algorithms, Simulated annealing, Neural Networks based Optimization.

References:

2. **Optimization for Engineering Design** – Kalyanmoy Deb, PHI Publishers
5. **Multi objective Genetic algorithms** - Kalyanmoy Deb, PHI Publishers
6. **Operations Research- Principles and Practice** by Ravindran, Phillips and Solberg, John Wiely

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Unit I:


**Customer Service Dimension:** The marketing and logistics interface – Customer service and customer retention - Service – driven logistics systems – Basic service capability – Increasing customer expectations – Value added services – Customer satisfaction and success – Time based logistics – Case studies.

Unit II:


**Logistics and Supply chain relationships:** Benchmarking the logistics process and SCM operation – Mapping the supply chain processes – Supplier and distributor benchmarking – setting benchmarking priorities – identifying logistics performance indicators – Channel structure – Economics of distribution – channel relationship – logistic service alliances.

Unit III:

**Sourcing, transporting and pricing products:** Sourcing decisions in supply chain – transportation in the supply chain – transportation infrastructure – supplier of transport services – basic transportation economics and pricing – transportation documentation – pricing and revenue management in the supply chain – Coordination in the supply chain – pricing and revenue management in supply chains.

Unit IV:

**Coordination and Technology in Supply chain:** Lack of coordination and Bullwhip Effect – Impact of lack of coordination – obstacles to coordination – managerial levers to achieve

Unit V:


References:


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Aggregate Planning – definition – Different Strategies – Various models of Aggregate Planning-Transportation and graphical models


Project Appraisal: Criteria for financial appraisal, Payback period, Net present value, Internal rate of return, Profitability index, Capital rationing and selection of projects

Unit 4: Total Quality Management: Philosophy of TQM, Quality Gurus, QC tools, Quality circles, Bench marking, Strategic quality planning, Quality function deployment,


Reference:
1. Total Quality Management by Rose, J.E., Kogan Page Ltd., 1993
5. “Production and Operations Management” by Chary, TaTa Mc Grow-Hill
7. “Production & Operation Management” by Panner Selvam PHI
8. “Production & Operation Analysis” by Nahima
Unit 1:
Introduction to composite materials Definition, classification and characteristics of composite materials, Materials-fibrous composites, laminated composites, particulate composites, Basic concepts and characteristics: Geometric and Physical definitions, natural and man-made composites, applications, types and classification of composites, lamina and laminate characteristics and configurations, constituent materials and properties.

Unit 2:

Unit 3:
Strength of unidirectional lamina: Micro mechanics of failure, Failure mechanisms, Strength of an orthotropic lamina, Strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micromechanical predictions of elastic constants.

Unit 4:
Characteristics of fiber reinforced lamina Fundamentals, elastic properties unidirectional, continuous fiber zero degree and angle ply lamina. Analysis of laminated composite plates

Unit 5:
Applications of composites-- Advantages, disadvantages, limitations and applications of composite. Properties of typical composite materials. Introductions to shape memory alloys

References:
5. Introduction to composite materials by Hull and Clyne Cambridge uNIVERSITY
6. Fiber reinforced composites P K MALLICK by Marcel Dekker , Inc
(17PH03214) ENERGY CONSERVATION

Unit 1:


Unit 2:

THERMODYNAMICS: Availability, energy, and Anergy-Exergy, energy, entropy relationship - Degradation of energy - exergy analysis - exergy conservation - combustion, adiabatic flame temperature, Thermal efficiency, thermal losses; thermal balance sheets.


Unit 3:

ENERGY CONSERVATION: Rules for efficient energy conservation - technologies for energy conservation - outline of waste heat and material reclamation, load management, alternative energy sources, Energy storage.


Unit 4:


Unit 5:


HEAT RECOVERY SYSTEMS: Liquid to liquid heat exchangers - Gas to gas recovery systems; regenerators, recuperators, rotating regenerators - Miscellaneous heat recovery methods - selection of materials for heat exchangers - combined radiation and convective heat exchanger, U-tube heat exchanger, tubular heat exchanger, fluidized bed heat exchanger - economizer.
References:

Unit 1: Finite differences – Forward, Backward and Central difference approximations to derivatives - Jacobi’s Method – Gauss Siedel iterative method


Unit 2:
Introduction to FEM: Basic concepts – Historical background – General Applications of FEM - General description of the FEM – Comparison of FEM with other methods - Basic element shapes discretization process - Node numbering scheme – interpolation models – convergence requirements - Stress and equilibrium – boundary conditions – stress – strain relations

Unit 3:

Unit 4:
Two dimensional problems – modeling – Constant strain triangle – boundary condition – Load vector – Quadrilateral element

Basic equation of heat transfer – steady state heat transfer – 1-D heat conduction – Fin element – 2-D heat transfer.

Unit 5:

References:

2. **Numerical Methods** /B.S.Grawel, Khanna Publication.
3. **Computational Fluid flow and Heat transfer** / Edt.K.Muralidhar and T.Sundarajan / Narosa
4. **Finite Elements in Engineering** / S.S.Rao
5. **Introduction to Finite Element Engineering**/T.R.Chandrupatla and A.D. Belagundu
6. **Numerical fluid flow and Heat transfer** /S.V.Patankar