### SCHEME OF INSTRUCTION & EXAMINATION

#### B.E. VIII - SEMESTER

(MECHANICAL ENGINEERING)

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<th>S. No.</th>
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<td>Theory Courses</td>
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<td>Design of Solar Energy System</td>
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<td>PE 822 ME</td>
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<td>PW 961 ME</td>
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#### Professional Elective – II

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#### Professional Elective – III

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<tbody>
<tr>
<td>1</td>
<td>PE 826 ME</td>
<td>Power Plant Engineering</td>
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<tr>
<td>2</td>
<td>PE 827 ME</td>
<td>Robotic Engineering</td>
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<td>3</td>
<td>PE 828 ME</td>
<td>Tool Design</td>
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<td>PE 829 ME</td>
<td>Product Design And Process Planning</td>
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#### Professional Elective – IV

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<tr>
<td>1</td>
<td>PE 831 ME</td>
<td>Intellectual Property Rights</td>
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<td>2</td>
<td>PE 832 ME</td>
<td>Additive Manufacturing Technology</td>
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<td>PE 833 ME</td>
<td>Machine Tool Engineering and Design</td>
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<td>PE 834 ME</td>
<td>Entrepreneurship Development</td>
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#### Professional Elective – V

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<td>1</td>
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<td>Energy Conservation and Management</td>
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<td>2</td>
<td>PE 842 ME</td>
<td>Advanced Propulsion and Space Science</td>
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<td>3</td>
<td>PE 843 ME</td>
<td>Waste Heat Recovery and Co-Generation</td>
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<td>4</td>
<td>PE 844 ME</td>
<td>Aerodynamic Design of Thermal Turbines</td>
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**Note:**

1) Each contact hour is a Clock Hour

2) The duration of the practical class is two clock hours, however it can be extended wherever necessary, to enable the student to complete the experiment.
Faculty of Engineering, O.U  

CBCS Curriculum with effect from Academic Year 2019 - 2020

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<td>PE 821 ME</td>
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Prerequisite

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Course Objectives

Student will understand:
- Understand the design concepts of solar systems.
- Design and development of solar thermal systems.
- Design of photovoltaic system and its components.
- Analyse the performance of solar energy systems.

Course Outcomes

After completing this course, students will be able to:
1. Analyse the design concepts of solar systems.
2. Apply the design concepts of solar systems.
3. Understand various solar components
4. Design and select various solar components
5. Evaluate the performance solar system

UNIT-I

System conceptual design, design of major components, overall system, design of physical principles to the solar system based on application. The process includes idea generation, concepts selection and estimation, design of major components, and overall system design, solar radiation data.

UNIT-II

Design of solar thermal systems for water, space heating, cooling and power generation. f-Chart calculation method for sizing solar water and space heating systems. Design of non-focusing and focusing collectors.

UNIT-III

Design aspects of solar thermal energy storage systems. Selection criteria of storage materials for heating and cooling applications, selection of heat transfer fluid for heating and cooling applications. Design of LHTES for solar process heating and power generation applications.

UNIT-IV

Design of photovoltaic off-grid and grid-connected power systems. Design of system components - PV modules, batteries, charge controllers, inverters, auxiliaries. Performance analysis of a photovoltaic system. Using software codes for design of solar thermal and photovoltaic systems.

UNIT-V

Performance analysis of various solar thermal systems, PV system and evaluation of solar thermal energy storage system, selection of components and materials, estimation of economics. Using software tools for design of solar thermal and photovoltaic systems, case studies.

Suggested Readings:
Course Code | Course Title | Core/Elective
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PE 822 ME | Mechanical Vibrations | Elective

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### Course Objectives

Students have to understand the:
- Explain the concept of vibrations, with single and multi-degree freedom
- Discuss the numerical methods involved in vibrations
- Demonstrate the concept of Transient vibrations and Random vibrations
- Identify various methods of vibration control.
- Describe the concept of Non-Linear vibrations
- Identify various methods of vibration control.

### Course Outcomes

At the end of the course, the students will be able to:
1. analyse the multi degree of freedom systems vibrations
2. formulate vibration problem using various numerical methods
3. interpret the concept of the Random and Transient vibrations
4. apply various methods for vibration control
5. interpret the non-linear phenomenon of vibrations and their formulation

### UNIT-I


### UNIT-II

**Continuous System:** Vibrations of String, Bars, Shafts and beams, free and forced vibration of continuous systems.

### UNIT-III


### UNIT-IV

**Vibration Control:** Balancing of rotating machine, In-situ balancing of rotors, control of natural frequency introduction of damping, vibration isolation & vibration absorbers.


### UNIT-V

**Random Vibrations:** Expected values auto and cross correlation function, Spectral density, response of linear systems, analysis of narrow band systems.
Nonlinear Vibrations: Systems with non-linear elastic properties, free vibrations of system with non-linear elasticity and damping, phase-plane technique, Duffing’s equation, jump phenomenon, Limit cycle, perturbation method.

Suggested Readings:
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<td>PE 823 ME</td>
<td>Composite Materials</td>
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**Prerequisite**

**Contact Hours Per Week** | CIE | SEE | Credits
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**Course Objectives**

The objectives of this course are to:
- Discuss the basic structure of composites
- Define Elastic constants and Hygro-thermal stresses
- Identify stress-strain relations in composites
- Describe the behaviour and Design with composites
- Demonstrate the basic equations of plate bending

**Course Outcomes**

On completion of the course the student will be able to:
1. Demonstrate knowledge of composites and their structure
2. Predict the Elastic constants and Hygrothermal stresses
3. Analyse the stress-strain relationship in composites
4. Summarise and apply the Design procedure and the failure criteria.
5. Formulate Plate bending equations for various Boundary conditions of composite plates.

**UNIT-I**

**Introduction:** Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composite, carbon fibre composites.

**UNIT-II**

**Micromechanics of Composites:** Mechanical Properties: Prediction of Elastic constant, micromechanical approach, Halpin-Tsai equations, Transverse stresses. Thermal properties: Hygrothermal stresses, mechanics of load transfer from matrix to fibre.

**UNIT-III**

**Macromechanics of Composites:** Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams.

**UNIT-IV**

**Strength, fracture, fatigue and design:** Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: Single and multiple fracture, de-bonding, fibre pullout and delamination failure, fatigue of laminate composites, Effect of variability of fibre strength.

**Strength of an orthotropic lamina:** Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials.

**UNIT-V**

**Analysis of plates and stress:** Plate equilibrium equations, Bending of composite plates, Levy and Navier solution for plates of composite material. Analysis of composite cylindrical shells under axially symmetric loads.

**Suggested Readings:**
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**Prerequisite**

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**Course Objectives**

Student has to understand the

- Need, basic concepts and technologies of Non-Destructive Testing (NDT)
- Security precautions from Radiography, protection from radiation and measurement of radiation received by personnel.
- Technology of acoustic emission (AE), the associated instrumentation and applications
- Technologies like neutron radiography; laser induced ultrasonics, surface analysis and thermography
- Merits and demerits of the different NDT Technologies
- Latest research and developments in NDT

**Course Outcomes**

At the end of the course, the students will be able to demonstrate

1. the knowledge of different NDT techniques.
2. clear understanding of liquid penetrant inspection and magnetic particle inspection.
3. view and interpret radiographs, utilize the various principles of radiography for different components of different shapes.
4. the knowledge of acoustic emission for NDT and the instrumentation used for NDT.
5. the ability to analyse and prepare a technical report.
6. the knowledge of latest research, developments and trends in NDT.

**UNIT-I**

**Liquid penetrate inspection:** Principles of penetrant inspection, characteristics of a penetrant, water washable system, post emulsification system, solvent removable system, surface preparation and cleaning, penetrant application, development, advantages limitations, and applications. Magnetic particle instruction: Principle, magnetization methods, continuous and residual methods, sensitivities, demagnetization, magnetic particles, applications advantages and limitations.

**UNIT-II**

**Eddy current testing:** Principle, lift-off factor, and edge effect, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuit, reference pieces, phase analysis, display methods and applications.

**UNIT-III**

**Ultrasonic testing:** Generation of ultrasound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, display systems, probe construction, type of display, inspection techniques, identification of defects, Immersion testing, sensitivity and calibration. Reference standards. Surface condition, Applications.

**UNIT-IV**

**Radiography:** Principle and uses of radiography, limitation principle, radiation sources, production of X-Rays, x-ray spectra, attenuation of radiation, radiographic equivalence, shadow formation enlargement and distortion, radio graphic film and paper, Xeroradiography, fluoroscopy, exposure factors, radiographic screens, identification markers and image quality indicators, inspection of simple shapes, inspection of complex shapes, viewing and interpretation of radiographs, radiation hazard, protection against radiation, measurement of radiation received by personnel.
UNIT-V

**Acoustic Emission:** Physical Principles, Sources of emission, instrumentation and applications, Other NDT Techniques: Neuron radiography, Laser induced ultrasonics, surface analysis, and thermography.

**Suggested Readings:**

3. Dove and Adams, *Experimental Stress analysis and Motion Measurement*, Prentice Hall of India, Delhi
Course Code: PE 826 ME
Course Title: Power Plant Engineering
Core/Elective: Elective

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Course Objectives
Student has to understand the
- Operation of steam turbine and gas turbine power plants
- About hydraulic power plant, hydrology, dams and spillways
- Various types of nuclear power plants including Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor
- The power plant economics
- The environmental and safety aspects of power plant operation.

Course Outcomes
At the end of the course, the students will be able to demonstrate
1. Select coal and ash handling methods for a coal fired power plant.
2. Comprehend basic working principle of steam and gas turbine power plant
3. Classify Dams and Spillways.
4. Demonstrate the basic principles of thermal-fission and fast-breeder nuclear power plants, such as pressurized-water, boiling-water, and heavy-water reactors.
5. Analyse load factor, capacity factor, average load and peak load on a power plant.
6. Illustrate the control methods of major pollutants emitted from fossil-fuel power plants.

UNIT-I
Introduction to Sources of Energy-Resources and Development of Power in India. Steam Power Plant: Plant layout, working of different Circuits, Fuel and handling equipment, types of coal, coal handling, choice of handling equipment, coal storage, ash handling systems.

UNIT-II
Combustion Process: Properties of coal- overfeed and underfeed 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, corrosion and feed water treatment.
Gas Turbine Power Plant: Introduction -Classification-Layout with Auxiliaries-Principles of working of closed and open cycle gas turbines

UNIT-III

UNIT-IV

UNIT-V
Power Plant Economics and Environmental Considerations: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, average load and load factor,
delivery factor-related exercises Effluents from power plants and impact on environment - Pollutants and Pollution Standards - Methods of pollution control

**Suggested Readings:**

Course Code | Course Title | Core/Elective
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PE 827 ME | Robotic Engineering | Elective

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### Course Objectives

Students will understand:

- The configuration, work envelop and motion controls and applications
- Familiarities with the kinematics of robots.
- Robot end effectors and their design.
- Familiarities with the dynamics of robots.
- Robot Programming methods & Languages of robot.
- Various Sensors and drives and their applications in robots

### Course Outcomes

At the end of the course, the students will be:

1. Equipped with robot anatomy, work volume and robot applications
2. Familiarized with the kinematic motions of robot
3. Having good knowledge about robot end effectors and their design concepts
4. Familiarized with the robot dynamics
5. Equipped with the Programming methods & drives used in robots
6. Equipped with the principles of various Sensors and their applications in robots.

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### UNIT-I

**Robots:** History and evolution of robots, Laws of Robotics, basic configuration, degree of freedom, work envelope, motion control methods, Application in industry, material handling, loading & unloading, processing, welding & painting applications, assembly and inspection, Robot specification requirements

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### UNIT-II

**Rotation matrix:** Homogenous transformation matrix, Denavit-Hartenberg convention, Euler angles, RPY representation, Direct and inverse kinematics for industrial robots for position and orientation, Redundancy

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### UNIT-III

**Manipulator Jacobian:** Joint, End effector velocity, direct and inverse velocity analysis, Trajectory Planning, interpolation, cubic polynomial, linear segments with parabolic blending, static force and moment transformation, solvability, stiffness, singularities

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### UNIT-IV

**Robot dynamics:** Lagrangian formulation, link inertia tensor and manipulator inertia tensor, Newton-Euler formulation for RR & RP manipulators, Control: Individual joint, computed torque

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### UNIT-V

**End effectors:** position and velocity measurement, Sensors: Proximity and range, tactile, force and torque, Drives for Robots: Electrical, Hydraulic and Pneumatic, Robot vision: Introduction to technique, image acquisition and processing, introduction to robot programming languages.

### Suggested Readings:

Faculty of Engineering, O.U  

CBCS Curriculum with effect from Academic Year 2019 - 2020

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<tr>
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<td>PE 828 ME</td>
<td>Tool Design</td>
<td>Elective</td>
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**Course Objectives**

Students will understand:

- Various forces involved in the machining operations
- Heat generation in machining & coolant operation
- Tools, jigs and fixtures, suitable for a particular machining operation

**Course Outcomes**

At the end of the course, the students will be able to:

1. Calculate the values of various forces involved in the machining operations
2. Design various single and multipoint cutting tools
3. Analyse heat generation in machining & coolant operation
4. Illustrate the properties of various cutting tool materials and hence select an appropriate tool material for particular machining application
5. Identify appropriate combination of tools, jigs and fixture, suitable for a particular machining operation
6. Design assembly of jigs and fixtures on simple work-piece

**UNIT-I**

Metal Cutting: Classification of metal cutting operations, mechanics of metal cutting, tool signature, built up edge formation, mechanism of chip formation, types of chips, oblique and orthogonal cutting - Merchant’s force diagram, two component tool dynamometer, Merchant’s theory of metal cutting, Lee and Schaffler’s theory of metal cutting.

**UNIT-II**

Tool Wear and Tool Life: Sources of heat in metal cutting, heat dissipation and distribution to chip, tool and work piece, methods of evaluating temperature at tool-chip interface. Machinability, factors affecting machinability, Taylor’s tool life equation, crater wear and flank wear, mechanics of tool wear and various types of tool failure. Effects of tool geometry, feed, depth of cut, cutting speed on tool wear.

**UNIT- III**

Cutting Tool Materials: Essential requirements of a tool material, tool materials - HCS, HSS, Cast alloys, Carbides, Ceramic tools, Diamond tool bits. Essential requirements of a good cutting fluid, types of cutting fluids and their relative applications. Economics of machining - introduction, economic tool life, optimal cutting speed to maximum production and maximum profit.

**Unit – IV**


**Unit – V**

Jigs and Fixtures: Design of jigs and fixtures. Locating devices, clamping devices, principles of design of jigs and fixtures, some examples

Design of Cutting Tools: Broach design, elements of twist drill, HSS twist drill design, design of rotary milling cutter. Design of single point cutting tool.
Suggested Readings:

Course Code | Course Title | Core/Elective  
---|---|---  
PE 829 ME | **Product Design and Process Planning** | Elective  
  
| Prerequisite | Contact Hours Per Week | CIE | SEE | Credits  
---|---|---|---|---  
- | 3 | - | - | 30 | 70 | 3  
  
**Course Objectives**  
A student shall understand  
- The Product Design and Process Functions  
- The essence of innovation in product development  
- The Human Machine Interactions (ergonomics)  
- The various Intellectual Property Rights  
- The interaction between Design, Manufacturing, Quality and Marketing  
- The awareness about overall view of Process Planning  
  
**Course Outcomes**  
At the end of the course, the students will be able to  
1. Identify the functions of design of a product in a system in a given situation and select a suitable product; identify the procedure for technological innovation of a product; explain the importance of brainstorming and Delphi techniques in innovation  
2. Explain the importance of design, human machine interaction in project selection and evaluation methods including ergonomic considerations  
3. Explain the importance of research in new product development; describe the process of patenting including search of patents, patent laws and international code and discriminate the scope of IPR for a product patent.  
4. Discuss the features of design of a new product with respect to manufacture, quality testing and marketing; and steps to evaluate a new product for introduction;  
5. Develop process planning including creating process sheets; explain value engineering, group technology and concurrent engineering in the selection of manufacturing process.  
  
**UNIT-I**  
  
**UNIT-II**  
  
**UNIT-III**  
**New Product Development:** Research and new product development. Patents, definitions, patent search, patent laws, international code for patents -Intellectual Property Rights (IPR).  
  
**UNIT-IV**  
**New Product Planning:** Interaction between the functions of design, manufacture, quality, testing and marketing. Steps for introducing new products after evaluation.  
  
**UNIT-V**

**Suggested Readings:**

2. Harry Nystrom, *Creativity and Innovation*, John Wiley & Sons,
Course Code | Course Title | Core/Elective
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PE 831 ME | Intellectual Property Rights | Elective

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**Course Objectives**
Students will understand
- Fundamental aspects of IP
- Aspects of IPR acts.
- Awareness of multi-disciplinary audience
- Awareness for innovation and its importance
- The changes in IPR culture
- About techno-business aspects of IPR

**Course Outcomes**
At the end of the course, the students will be able to
1. Will respect intellectual property of others
2. Learn the art of understanding IPR
3. Develop the capability of searching the stage of innovations.
5. Completely understand the techno-legal business angle of IP.
6. Capable of converting creativity into IP and effectively protect it.

**UNIT-I**
**Overview of Intellectual Property:** Introduction and the need for intellectual property right (IPR), IPR in India – Genesis and Development, IPR abroad, Some important examples of IPR. Importance of WTO, TRIPS agreement, International Conventions and PCT

**Patents:** Macro economic impact of the patent system, Patent and kind of inventions protected by a patent, Patent document, how to protect your inventions. Granting of patent, Rights of patent, how extensive is patent protection. Why protect inventions by patents. Searching a patent, Drafting of a patent, Filing of a patent, the different layers of the international patent system, (national, regional and international options), compulsory licensing and licensors of right & revocation, Utility models, Differences between a utility model and a patent. Trade secrets and know-how agreements

**UNIT-II**
**Industrial Designs:** What is an industrial design. How can industrial designs be protected? What kind of protection is provided by industrial designs? How long does the protection last? Why protect industrial designs?

**UNIT-III**
**Trademarks:** What is a trademark, Rights of trademark? What kind of signs can be used as trademarks? Types of trademark, function does a trademark perform, how is a trademark protected? How is a trademark registered? How long is a registered trademark protected for? How extensive is trademark protection? What are well-known marks and how are they protected? Domain name and how does it relate to trademarks? Trademark infringement and passing off.

**UNIT-IV**
**Copyright:** What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights. Distinction between related rights and copyright. Rights covered by copyright? Copy rights in computer programming.
UNIT-V


**Unfair Competition:** What is unfair competition. Relationship between unfair competition and intellectual property laws.

**Suggested Readings:**

2. B. L. Wadehra; *Law Relating to Patents, Trade Marks, Copyright, Designs &Geographical Indications*; Universal law Publishing Pvt. Ltd., India 2000
3. P. Narayanan; *Law of Copyright and Industrial Designs*; Eastern law House, Delhi 2010
Course Code | Course Title | Core/Elective
---|---|---
PE 832 ME | Additive Manufacturing Technology | Elective

Prerequisite | Contact Hours Per Week | CIE | SEE | Credits
---|---|---|---|---
- | L T D P | 3 0 0 | 7 0 | 3

**Course Objectives**

Students will understand
- the importance of RPT
- Apply various liquid and solid based RPT Systems
- Apply various powder based RPT systems and rapid tooling
- Recognize various STL formats and slicing methods and tessellation
- Application of RPT in Engineering, Jewellery and Bio medical etc.

**Course Outcomes**

At the end of the course, the students will be able to
1. understand the developments of RPT and its terminology, Advantages and limitations of RPT
2. understand mechanism involved in stereo lithography apparatus system, and terminated object manufacturing, fused deposition modelling and their applications.
3. understand mechanism in selective laser interims and its application. Understand the importance of Rapid tooling
4. recognize various types of file format and slicing methods in RP and various software available to convert 3D models.
5. apply RPT in various fields of Engineering

**UNIT-I**

**Introduction:** Prototyping fundamentals, Historical development, fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, commonly used terms, classification of RP process, Rapid prototyping process chain: Fundamental Automated processes, process chain.

**UNIT-II**

**Liquid based rapid prototyping systems:** Stereo lithography apparatus (SLA): Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid ground curing (SGC): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

**Solid based rapid prototyping systems:** Laminated object manufacturing (LOM): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

**UNIT-III**


**Rapid Tooling:** Introduction to Rapid Tooling (RT), Conventional Tooling Vs Rt, need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, investment casting, spin casting, diecasting, sand casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

53
UNIT-IV
**Rapid Prototyping Data Formats:** STL Format, STL File Problems, Consequence of Building Valid and invalid tesselated models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats.

**Rapid Prototyping Software’s:** Features of various RP software’s like Magics, Mimics, Solid View, view expert, 3 D view, velocity 2, Rhino, STL view 3 data expert and 3 D doctor

UNIT-V

**RP Applications:** Application – Material Relationship, application in design, application in engineering, Analysis and planning, aerospace industry, automatic industry, Jewellery industry, coin industry, GIS application, Arts and Architecture.

**RP Medical and Bioengineering Application:** Planning and simulation of complex surgery, customized implant and prosthesis, design and production of medical devices, forensic science and anthropology, visualization of biomolecules.

**Suggested Readings:**
Course Code | Course Title | Core/Elective
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PE 833 ME | Machine Tool Engineering and Design | Elective

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**Course Objectives**

Students will understand
- Types of tools for heavy machining processes
- Design elements in sheet metal operation
- Use of jigs and fixtures for automation in industries

**Course Outcomes**

At the end of the course, the students will be able to
1. Understand basic motions involved in a machine tool.
2. Design machine tool structures
3. Design and analyse systems for specified speeds and feeds
4. Understand control strategies for machine tool operations
5. Apply appropriate quality tests for quality assurance

**UNIT-I**


**UNIT-II**


**UNIT-III**


**UNIT-IV**


**UNIT-V**

Hydro copying system. Evaluation of machine tools with regard to accuracies, sound and vibration. Machine tool testing.

**Suggested Readings:**

Course Code | Course Title | Core/Elective
---|---|---
PE 834 ME | Entrepreneurship Development | Elective

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**Course Objectives**
- To motivate students to take up entrepreneurship in future
- To learn nuances of starting an enterprise & project management
- To understand the design principles of solar energy systems, their utilization and performance evaluation
- To understand the behavioral aspects of entrepreneurs and time management

**Course Outcomes**
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques
5. Understand the Behavioural aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addiction and time management matrix.

**UNIT-I**

**UNIT-II**
Identification and characteristics of entrepreneurs. Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology - Collaborative interaction for Technology development.

**UNIT-III**
Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.

**UNIT-IV**
Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

**UNIT-V**
Suggested Readings:

Course Code | Course Title | Core/Elective
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PE 841 ME | Energy Conservation and Management | Elective

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Course Objectives

- To learn about energy conservation
- To understand sources of loss of power in energy conversion
- To understand Procedure for Comprehensive Energy Conservation Planning
- To understand Industrial energy conservation methods

Course Outcomes

On successful completion of this course, the student will be able to

1. Understand different forms of energy
2. Calculate the amount of heat energy available
3. Understand the industry energy conservation modelling
4. Understand methodology for forecasting industrial energy supply and demand.

UNIT-I


UNIT-II

Heat energy and storage - Media of transport of heat energy - steam, oil and flue gases. Calculation of steam quality. Calculation of amount of heat energy available. Recuperators. Constructional details, Selection of materials to store heat energy. Concept of power. Modes of mechanical energy transport - Gears, pulleys, belts, shafts etc., Calculation of power. Sources of loss of power in energy conversion into electricity, potential energy (i.e., pumps).

UNIT-III


UNIT-IV


UNIT-V

Suggested Readings:

Course Code | Course Title | Core/Elective
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PE 842 ME | Advanced Propulsion and Space Science | Elective

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**Course Objectives**

- To learn about gas dynamic concepts of rocket propulsion system
- To learn rocket engine system.
- To learn celestial sphere and its parameters
- To learn about Satellites & Remote Sensing

**Course Outcomes**

Student will be able to

1. Classify different rocket propulsion systems and understand the concept of gas dynamics
2. understand the working principle of rocket engine system
3. understand celestial sphere and its parameters

**UNIT-I**
Advanced Gas Dynamics: Normal shock waves, pitot tubes, moving shock waves, oblique shock waves, reflected shock waves, conical shock waves, hypersonic flow, Newtonian theory, high temperature flows, low density flows.

**UNIT-II**
Advanced Propulsion: Rocket engines - Operation and performance of rocket engines, design and operating parameters - total impulse, thrust, energy and efficiencies, Typical performance values, overview of monopropellant, bipropellant liquid, solid and hybrid rocket propulsion systems, combined cycle propulsion, Electric / Ion propulsion.

**UNIT-III**

**UNIT-IV**
Two Body Problem: Formulation, relative motion and solution, Kepler's equation, motions of rockets and artificial satellites, transfer orbits, minimum energy interplanetary transfer orbits, use of parking orbits, Perturbations of artificial satellites due to atmospheric drag and flattening of earth.

**UNIT-V**
Nuclear Processes in the Sun, Solar wind, interaction of solar Wind and Earth's magnetic field, Van Allen radiation belts.

**Suggested Readings:**
Course Code | Course Title | Core/Elective
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PE 843 ME | Waste Heat Recovery and Co-Generation | Elective

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Course Objectives
- To learn concepts of waste heat recovery
- To learn the applications of heat exchangers & recuperators in heat recovery
- To understand cogeneration methods

Course Outcomes
Student will be
1. Understand the concept of waste heat recovery
2. Distinguish heat exchangers and recuperators
3. Acquire knowledge about various cogeneration methods

UNIT-I

UNIT-II

UNIT-III
First and Second law of thermodynamics, and its effect on design of recuperators. Recuperators-Ceramic, metallic and reradiant recuperators, high temperature recuperators. Concept of porosity, Peclet number superficial velocity, pressure drop, and selection of material for heat storage and recovery.

UNIT-IV
Cogeneration - Definition, Two basic cogeneration concepts, thermodynamic advantage, Cogeneration efficiency, potential benefits and costs of cogeneration. Cogeneration-Over view, Industrial application of cogeneration.

UNIT-V

Suggested Readings:
Course Code | Course Title | Core/Elective
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PE 844 ME | Aerodynamic Design of Thermal Turbines | Elective

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Course Objectives
- To learn design concepts of thermal turbines
- To understand the analysis of flow past a turbine cascade
- To understand turbine blade design methods

Course Outcomes
The student will be able to
1. explain the concepts of thermal turbines
2. analyze the flow past a turbine cascade
3. design the turbine blade

UNIT-I
Introduction: Definition of a turbine stage. Enthalpy - Entropy diagram for a Turbine stage. Definition of Euler work, specific work and isentropic work. Euler's turbine equation and Energy transfer equation. Definitions of shape No, stage efficiency, stage reaction, work done factor, utilization factor and coupling power.

UNIT-II

UNIT-III
1D and 2D Blade Design Methods:
2D methods: Concepts of singularities, simple relations. Schlichting Method - equations for induced velocity, Camber line and thickness distribution for an arbitrary aerofoil shape - Direct and indirect design problems. Channel flow approach - Stanitz I and I approximation methods.

UNIT-IV
3D Blading Design Methods:
Radial Equilibrium theory: Fundamental equation and approaches for the vortex design of axial turbine cascades; Simple problems on Radial equilibrium theory.
Actuator Disc theory: Concept and application to simple design problems on axial flow turbine cascades.
UNIT-V

Performance Evaluation:

Suggested Readings:
Course Code | Course Title | Core / Elective
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PW 961 ME | Project Work - II | Core

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**Course Objectives**

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic literature survey and documentation.
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas.

**Course Outcomes**

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility.
3. Effectively plan a project and confidently perform all aspects of project management.
4. Demonstrate effective written and oral communication skills.

The aim of Project work – II is to implement and evaluate the proposal made as part of Project Work - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The department will appoint a project coordinator who will coordinate the following:

1. Re-grouping of students - deletion of internship candidates from groups made as part of project Work-I
2. Re-Allotment of internship students to project guides
3. Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1st week of VIII semester so that students get sufficient time for completion of the project.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for 25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

**Note:** Three periods of contact load will be assigned to each project guide.