DEPARTMENT OF
MECHANICAL ENGINEERING

Scheme of Instruction
and Syllabi of

B.E. IV YEAR
MECHANICAL ENGINEERING

With effect from 2014-2015

UNIVERSITY COLLEGE OF ENGINEERING
(AUTONOMOUS)
Osmania University,
Hyderabad–500 007. (Telangana)
UNIVERSITY COLLEGE OF ENGINEERING, OSMANIA UNIVERSITY

VISION OF THE INSTITUTE

The Vision of the Institute is to generate and disseminate knowledge through a harmonious blending of Science, Engineering and Technology. To serve the society by developing a modern technology in students' heightened intellectual, cultural, ethical and humane sensitivities, fostering a scientific temper and promoting professional and technological expertise.

MISSION OF THE INSTITUTE

- To achieve excellence in Teaching and Research.
- To generate, disseminate and preserve knowledge.
- To enable empowerment through knowledge and information.
- Advancement of knowledge in Engineering, Science and Technology.
- Promote learning in free thinking and innovative environment.
- Cultivate skills, attitudes to promote knowledge creation.
- Rendering socially relevant technical services for the community.
- To impart new skills of technology development.
- To inculcate entrepreneurial talents and technology appreciation programmes.
- Technology transfer and incubation.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION OF THE DEPARTMENT

To generate and disseminate knowledge in Mechanical Engineering and nurture professional, technical and scientific temper for serving the needs of the industry, research organizations and society.

MISSION OF THE DEPARTMENT

- Create technically competent mechanical engineers to suit the changing needs of global industry and society.
- To cultivate skills, attitudes to promote knowledge creation and technology development.
- Interact with prominent educational institutions and R&D organizations for enhancing teaching, research and consultancy services.
## PROGRAM EDUCATIONAL OBJECTIVES

<table>
<thead>
<tr>
<th>PEO</th>
<th>Statement</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
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<tbody>
<tr>
<td>PEO 1</td>
<td>To provide the requisite fundamentals of varied subjects related to Mechanical Engineering to conceive, plan, model, design, construct, maintain and improve systems to enhance human comfort.</td>
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<td>PEO 2</td>
<td>To provide knowledge of experimental, computational, analytical, simulation tools and techniques require to address the challenges in Mechanical Engineering and other allied fields.</td>
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<td>PEO 3</td>
<td>To provide knowledge to apply Mechanical Engineering Fundamentals to design and implement cost effective systems in manufacturing.</td>
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<td>PEO 4</td>
<td>To provide effective communication skills, creative methods, ethics and continuous learning techniques to fulfill their professional requirements and societal needs.</td>
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PROGRAM OUTCOMES (POs):

At the end of the program, the student will be able to:

<table>
<thead>
<tr>
<th>POs</th>
<th>Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an mechanical engineering to the solution of complex engineering problems.</th>
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<tbody>
<tr>
<td>PO2</td>
<td>Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems related to mechanical engineering and allied fields reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.</td>
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<td>PO3</td>
<td>Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.</td>
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<td>PO4</td>
<td>Conduct investigations of complex problems: Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.</td>
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<td>PO5</td>
<td>Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.</td>
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<td>PO6</td>
<td>The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Mechanical engineering practice.</td>
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<td>PO7</td>
<td>Environment and sustainability: Understand the impact of the Mechanical engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.</td>
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<td>PO8</td>
<td>Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the mechanical engineering practice.</td>
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<td>PO9</td>
<td>Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.</td>
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<td>PO10</td>
<td>Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.</td>
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<td>PO11</td>
<td>Project management and finance: Demonstrate knowledge and understanding of the mechanical engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.</td>
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<td>PO12</td>
<td>Lifelong learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.</td>
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</table>

Program Specific Outcomes

| PS01 | Apply the principles of collaborative and multi disciplinary approach for solving problems |
| PS02 | Able to interact with industry and R&D institutions leading to start-ups/ budding entrepreneurs. |
### Scheme of Instruction & Examination

**B.E. IV-Year (Mechanical Engineering)**

#### Semester-I

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Syllabus Ref. No.</th>
<th>Subject</th>
<th>Scheme of Instruction</th>
<th>Scheme of Examination</th>
<th>Credits</th>
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<td>Periods / week</td>
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<td>Max. Marks</td>
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<tr>
<td>1.</td>
<td>ME 401 UE</td>
<td>Production and Operations Management</td>
<td>4</td>
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<tr>
<td>2.</td>
<td>ME 402 UE</td>
<td>Thermal Turbomachines</td>
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<td>3.</td>
<td>ME 403 UE</td>
<td>CAD/CAM</td>
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<td>Control Systems Theory</td>
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<td>CM 221 UE</td>
<td>Managerial Economics &amp; Accountancy</td>
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<td>Elective-II</td>
<td>4</td>
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<td>ME 431 UE</td>
<td>Thermal Engineering Lab.</td>
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<td>Project Seminar</td>
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<td>SI 400 UE</td>
<td>Summer Internship</td>
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*Note: Summer Internship (6-Weeks) is after III/IV II-Semester. Grade will be awarded in IV/IV I-Semester.*

#### Elective-II

1. ME 406 UE Design of Solar Energy Systems
2. ME 407 UE Non-conventional Methods of Machining & Forming
3. ME 408 UE Additive Manufacturing Technologies
4. ME 409 UE Entrepreneurship
5. ME 410 UE Aerodynamic Design of Thermal Turbines
6. ME 411 UE Materials Handling
7. ME 412 UE Finite Element Analysis
8. ME 413 UE Numerical Methods in Engineering
9. CS 408 UE Database Systems
# SCHEME OF INSTRUCTION & EXAMINATION

## B.E. IV-YEAR

### SERVICE COURSES OFFERED TO OTHER DEPARTMENTS

#### SEMESTER-I

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<tr>
<th>Sl. No.</th>
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<td>Entrepreneurship</td>
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<td>ME 412 UE (CSE/BME)</td>
<td>Finite Element Analysis</td>
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## Scheme of Instruction & Examination
### B.E. IV-Year (Mechanical Engineering)

#### Semester-II

<table>
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<td>Management and Information Systems</td>
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| **PRACTICALS** |         |         |       |       |                |            |                  |
| 1.      | ME 481 UE | Seminar. | - | 3 | - | - | 25 | - |
| 2.      | ME 482 UE | Project | - | 6 | Viva-Voce | *Grade | 50 | 12 |

**TOTAL:** 12 9 9 225 150 24

* S/A/B/C/D/F

#### Elective-III
1. ME 454 UE Waste Heat Recovery & Co-Generation
2. ME 455 UE Composite Materials
3. ME 456 UE Machine Tool Engineering & Design
4. ME 466 UE Advanced Propulsion & Space Science
5. EC 465 UE Embedded System Design
6. EC 466 UE Microprocessor Applications
7. CS 459 UE Information Security (New elective)
8. EE 451 UE Reliability Engineering

#### Elective-IV
1. ME 460 UE Robotics
2. ME 461 UE Energy Conservation & Management
3. ME 462 UE Tool Design
4. ME 465 UE Non-Destructive Testing
5. CS 458 UE Data Mining
6. LA 454 UE Intellectual Property Rights
7. BM 454 UE Bio-Electricity
8. CE 461 UE Disaster Management (New elective)
WITH EFFECT FROM ACADEMIC YEAR 2014-2015

SCHEME OF INSTRUCTION & EXAMINATION
B.E. IV-YEAR

SERVICE COURSES OFFERED TO OTHER DEPARTMENTS

SEMESTER-II

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Syllabus Ref. No.</th>
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<td>Robotics</td>
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<td>ME 471 UE EEE/ECE</td>
<td>Industrial and Financial management</td>
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THEORY
ME 401 UE

PRODUCTION AND OPERATION MANAGEMENT

Instruction (Periods per week) 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks.
Credits 4

Objectives:
* To understand the concept of scientific management, classify various types of manufacturing processes and importance of plant layout and the role of scheduling function in optimizing the utilization of resources
* To understand the importance of quality, inventory control and concepts like MRP I and MRP II
* To know the emerging management concepts like TQC, Kanban, Lean and Agile Manufacturing.

UNIT-I

UNIT-II
Locating production and services facilities, effects of location and costs and revenues, factor rating simple median model (linear programming). Layout planning: process layout; product layout- Assembly lines; line balancing manufacturing cellular layout. Scheduling system and aggregate planning for production and services; loading assignment algorithm; priority sequencing and other criteria. Work study, Work measurement techniques; predetermined time study; Work sampling

UNIT-III
Quality planning and control; basic concepts, definitions and history of quality control. Quality function, Quality policy and objectives. Economics of quality and measures of the cost of quality. Quality consideration in design, Use of statistical process control charts for variables and attributes. Acceptance sampling; single double and multiple sampling, operating characteristic Curve- calculation of producers risk and consumer’s risk.

UNIT-IV
Inventory Control: Definition of Inventory and Inventory Control, Types of Inventory, Objectives & Benefits of Inventory Control, Terminology, Cost Trade-off, Inventory Models: Deterministic and Stochastic inventory models: variable demand: lead time, specific service level, perishable products and service. Selective Control of Inventory: ABC, VED and SDE Analysis. Inventory control procedures; Fixed Order Quantity System (Q-System) versus Fixed Period Quantity systems (P-System); Material requirement planning(MRP); MRP as a scheduling and ordering system; MRP system components; MRP computational procedure, MRP –limitations and Advantages. Detailed Capacity Planning: Capacity planning decision, measuring capacity: estimating future capacity needs, Manufacturing Resource Planning (MRP-II).

UNIT V
Emerging Management Concepts: Japanese management overview, value added manufacturing, Japanese manufacturing techniques; total quality control - Deming contribution to TQC, quality circles; fishbone diagram, Taguchi method of quality control, push or pull system, Kanban system, Juran’s Triology, Quality Loss Function and Calculations. Introduction to Lean and Agile Manufacturing Concepts.

Suggested Readings:
THERMAL TURBOMACHINES

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

Course Objectives:
* To learn about formulation of governing equations for compressible fluid flows
* To understand the design concepts of mechanical devices handling compressible fluids
* To learn about the functioning of turbomachines and related performance parameters.

Unit-I
Introduction to compressible flows: bulk modulus and coefficient of compressibility, acoustic velocity, mach number, pressure field created by a point disturbance, mach cone and mach angle.

Isentropic flow through variable area devices: Energy equation for flow through nozzles and diffusers, Relations connecting stagnation and static properties-enthalpy, temperature, pressure and density. Various regimes of flow-adiabatic steady flow ellipse. Effect of back pressure on nozzle performance.

Unit-II
Flow through constant area ducts with friction (Fanno flow): Governing equation, Fanno line, Fanno relations for perfect gas, maximum length of a duct.

Flow through constant area ducts with heat transfer (Rayleigh flow): Governing equation, Rayleigh line, Rayleigh relations for perfect gas, choking due to heat transfer.

Types of shocks-normal, oblique and expansion.
Normal shock waves : Governing equations, Prandtl-Meyer equation, Rankine-Hugoniot relations.
Oblique shock waves: Relation between deflection angle and wave angle.

Unit-III
Definition and classification of turbo machines, Euler's equation for energy transfer.

Rotodynamic compressors : General classification, comparison with positive displacement compressors.
Concept of shape number-selection of impeller.

Axial flow compressors: Stage velocity triangles, enthalpy-entropy diagram, Euler's work input, flow coefficient, blade loading coefficient, relations for static pressure rise in rotor, stator and stage. Stage and polytropic efficiency. Factors affecting stage pressure ratio. Degree of reaction. Surging, stalling and choking.

Centrifugal compressors: Elements of a centrifugal stage, stage velocity triangles, performance of different types of impellers- forward, radial and backward swept blades. Enthalpy-entropy diagram, degree of reaction. Slip factor, actual work and stage and polytropic efficiency.

Unit-IV
Steam Turbines: Classification, flow over blades, impulse and reaction turbines, Pressure and velocity compounding of steam turbines.


Parson's reaction turbine: Reaction stage analysis, degree of reaction, maximum blade efficiency, representation on enthalpy-entropy diagram. Height of turbine blades.
Unit-V

Jet Propulsion: Aircraft propulsion turbo engines: Turbo jet, turboprop, turbofan, ramjet and pulse jet engines. Propulsion performance parameters: Thrust force, thrust power and thrust specific fuel consumption. Thrust, propulsion, transmission and overall efficiencies


Suggested Reading
ME 403 UE

CAD/CAM

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

Course Objectives:
• To help the students in understanding the functioning of computer numerical control machine tools and also in writing programs for operating this machines.
• To help the student in understanding advanced manufacturing concepts like Group technology, flexible manufacturing systems, Computer aided Process Planning, Computer aided quality control, Artificial Intelligence etc.

Outcomes:
• Understand the fundamental applications of computer in design, manufacturing and geometric transformation techniques in CAD
• Develop mathematical Model for curves, surfaces, solid models and understand the fundamental concepts of Finite Element Analysis
• Write CNC Part program for manufacturing components
• Understand the concepts of Machining Centres, adaptive control and as well as fundamentals knowledge of robotics
• Understand the working of various components of an modern manufacturing systems

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<th>Unit</th>
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Unit-I
CAD Fundamentals: Classification and basic elements of CAD work station hardware, Hardware integration and networking. CAD Software: Definitions of system software and application software. Graphic Standards and Exchange Formats. CAD database and structure.

Automatic 2-D facilities such as Fillets, Chamfers, Hatching, Dimensioning, Editing, Windowing & Zooming. 2-D & 3-D Geometric Transformations.

Unit-II
Geometric modeling: 3-D wire frame modeling: wire frame entities and their definitions, Interpolation and approximation of curves, synthetic curves and curve fitting. Definitions of cubic, Bezier, and B-spline curves.

Surface modeling: Definitions of basic surfaces, surface of revolution, blends, intersection, and Cubic, Bezier, B-spline surfaces.


Finite element modeling: Introduction, modeling, Meshing, Characteristics of different elements, different solvers and post processing.
Unit-III

Unit-IV
Computer Control in NC and Robots: Machining centers, CMC, DNC and adaptive control systems. Their types, typical configurations and relative features.

Industrial Robots: Classification based on manipulator configurations, relative characteristics, Online and offline programming methods, controls and drives, applications.

Unit-V

Computer Aided Quality Control: Computer in quality control, Contact and non contact inspection, optical and non optical computer aided testing.

Others: Basic concepts of FMS, Experts systems. Artificial intelligence, Typical Applications of computer in manufacturing viz. management, in-process measurement, CAD/CAM integration.

Suggested Reading
ME 404 UE

CONTROLS SYSTEMS THEORY

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

Course Objectives:
- To introduce students to the fundamental of feedback control system theory and use of analytical design methods in designing, analyzing various physical systems and to apply the gained knowledge in developing solutions for real world systems.
- To develop the ability of formulating mathematical models and designing feedback control systems.
- To provide students with necessary tools to analyze linear feedback control systems.
- To introduce the students to the concepts of digital control and modern control.

Outcomes:
- Differentiate open and closed loop systems and develop mathematical models of various systems like mechanical, electrical, electro- mechanical systems.
- Evaluate the effects of transient and steady state responses and apply these models to real time systems.
- Application of time response and frequency response methods to determine the stability of the system.
- Apply the concepts of discrete time control systems.
- Analyse and design multi input, multi output systems by state space analysis.

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Unit-I

Derivation of system equations: The simultaneous equation method. Block diagram method and Laplace transform approach.

Error sensing devices: Potentiometer, synchros, and AC-DC servomotors, Encoders, Decoders.

Unit-II

Root Locus Techniques: Typical systems analyzed by Root Locus Techniques. Effect of location of roots on the system response.

Unit-III
Frequency response analysis: The frequency response of a second order system, effect of numerator factors, zero factors in a transfer function. Bode plots, Gain-Phase plot, Nyquist criterion for stability, Gain Margin and Phase Margin, compensation techniques.

Unit-IV
Unit-V
State space representation: Concept of state. State variable, state models of linear time invariant systems, derivation of state model from transfer functions and differential equations. State transition matrix, solution of state equations by time domain method.

Suggested Reading
MANAGERIAL ECONOMICS AND ACCOUNTANCY

Instruction (periods per week) 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits 4

Outcomes:

• Understand the responsibilities of a manager of a business undertaking
• Able to Forecast & compute the future sales level
• Outline the features, steps, merits, uses & limitations of Pay Back, ARR, NPV, PI & IRR methods of Capital Budgeting
• Assess various factors influencing demand elasticity and determine Break Even Point (BEP) of an enterprise

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UNIT -I
Introduction to economics and its evolution: Managerial Economics its Scope, Importance and relation to other sciences, its usefulness to engineers-Basic concepts of Managerial Economics.

UNIT-II
Demands: Analysis-concept of demand, determinants, law of demand, its assumptions, elasticity of demand, price, income and cross elasticity, demand forecasting-markets competitive structure, price-output determination under perfect competition and Monopoly. (Theory questions and small numerical problems can be asked).

UNIT-III

UNIT -IV
Capital management: Significance, determinates and estimation of fixed and working capital requirements, sources of capital. Introduction to capital budgeting, methods of payback and discounted cash flow methods with problems.
(Theory questions and numerical problems on estimating working capital requirements and evaluation of capital budgeting opportunities can be asked)

UNIT-V
Book-keeping: Principles and significance of double entry book keeping, journal, subsidiary books, ledger accounts, trial balance concepts and preparation of final accounts with simple adjustments-analysis and interpretation of financial statements through ratios.
(Theory questions and numerical problems on preparation of final accounts, cash book, petty cash book, bank reconciliation statement, calculation of some ratios)
SUGGESTED READING:
1. Varshney RL and KI Maheswari, Managerial Economics, Sultan Chand.
2. JC Pappas and EF Grigham, Managerial Economics.
THERMAL ENGINEERING LAB

Instruction (periods per week) : 3
Duration of University Examination : 3 Hours
University Examination : 50 Marks
Sessional : 25 Marks
Credits : 2

Course Objectives:
• To understand working principles of heat transfer equipment
• To understand the flow phenomena on cascade blades.

Outcomes:
• Understand the fundamental applications of measuring instruments in equipment
• Able to find the performance of compressors, blowers
• Understand the working and determine the performance various turbines
• Able to estimate the heat transfer in various types of heat exchangers
• Able to find out conductivity of solids and liquids and convection in liquids

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A representative list of experiments to be conducted is as follows:

1. Determination of static pressure distribution on a turbine blade surface at midspan on low speed wind tunnel.

2. Study on downstream wake profile of a turbine cascade at midspan on low speed wind tunnel.

3. Study on downstream wake profile of a compressor cascade at midspan on low speed wind tunnel.


5. Study of Finned Tube Heat Exchanger: Determination of Overall heat transfer coefficient in Parallel and counter flow modes of operation.


8. Study on Thermal conductivity of metal rod.


10. Study on Thermal conductivity of insulating powder

11. Study on performance of Centrifugal blower with forward swept blades.


15. Critical Heat flux apparatus (Boiling Heat Transfer)
17. Study on heat pipe demonstrator
18. Study on Stefan Boltzmann apparatus
19. Pressure distribution in convergent air nozzle
ME 432 U E  

CAD/CAM LAB  

Instruction (Periods per week) : 3  
Duration of University Examination : 3 Hours  
University Examination : 50 Marks  
Sessional : 25 Marks.  
Credits : 2  

Course Objectives:  
- To understand the various features of geometric modeling packages like Creo(Pro-E) /CATIA/Solid Works like 2d-Sketching, Part Modeling and Assembly  
- To understand the application of Finite Element Analysis packages like ANSYS/ NASTRAN/ADINA in solving structural and thermal problems  
- To develop NC part program, simulate and manufacture components on CNC machine  

Outcomes:  
- Understand the Various Features of Geometric Modeling Package Creo(Pro-E) like 2d-Sketching, Extrude, revolve, sweep, surface of revolution, blend etc.  
- Apply the knowledge of Finite Element analysis in solving structural and thermal problems using Ansys software.  
- Write NC Part program, simulate and manufacture components on CNC machine  

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Computer Aided Design  

1. Introduction to various features of geometric modeling packages like: Creo (Pro-E) /CATIA/Solid Works.  
2. Practicing problems on 2D-Sketching.  
3. Practicing problems on Part Modeling  
4. Practicing problems on Assembly Modeling.  
5. Static Structural Analysis using 2D truss/beam/etc. for different types of loads using ANSYS/NASTRAN/ADINA etc.  
6. Steady state heat transfer and transient heat transfer analysis.  

Computer Aided Manufacturing  

7. Development of CNC part program for turning, facing, step turning, taper turning etc with and without canned or fixed cycle.  
8. Tool path simulation using any CAM software  
9. Demonstration of manufacturing of simple parts on CNC machine  
10. Programming for simulation of integrating various machines, robots and material handling equipment using plant layout simulation software like FlexSim/Arena/Promodel etc.
ME 433 UE

PROJECT SEMINA

Instruction : 3 Periods per week  
Sessional  : 25 Marks

Objective of the project seminar is to actively involve the students in preparation of the final year project with regard to following components:

- Problem definition and specification
- Literature survey, familiarity with research journals
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of graphs, bar (activity) charts and analyzing the results.
- Presentation - oral and written.

Outcomes:

- Able to define Problem with specifications
- Relevant Literature survey, familiarity with research journals
- Critically evaluate various available techniques to solve a particular problem
- Able to Plan the work, prepare required graphs, bar (activity) charts and analyse the results and arrive at a solution
- Prepare and present results in a scientific manner (Presentation - oral and written)

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The department can initiate the project allotment procedure at the end of III year 2nd semester and finalise it in the first two weeks of IV year 1st semester.

First 4 weeks of IV year 1st semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R & D institutions. The objective of these preliminary talks will be to expose the students to real life practical problems and methodology to solve the technical problems.

Seminar schedule will be prepared by the co-ordinator for all the students from 5th week to the last week of the semester which should be strictly adhered to.

Each student will be required to:
1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 20 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.
ELECTIVE-II
ME 406 UE

DESIGN OF SOLAR ENERGY SYSTEMS

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

Course Objectives:
- To learn concepts of solar energy conversion
- To understand the design principles of solar energy systems, their utilization and performance evaluation
- To understand the applications of solar photovoltaic systems

Outcomes:
- Understand the basic principle and Estimation solar radiation
- Analyze the conversion of solar radiation into heat also methods of reducing heat loss
- Design and analyze the solar energy systems
- Study the methods of performance and testing of solar collector
- Study the design and applications of Solar Photovoltaic Systems

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Unit-I

Unit-II
Principles of Solar Energy Utilization:

Unit-III
Design of Solar Energy Systems:

Unit-IV
Performance Testing of Solar Collectors:

Unit-V
Design and Application of Solar Photovoltaic Systems:
Solar photovoltaics - Photovoltaic conversion, Photon energy, p-n junction, Solar cells, efficiency of solar cells, Silicone crystal cells, Photovoltaic applications for refrigeration, street lights, water pumps and power generation.
Suggested Reading
**ME 407 UE**

**NON-CONVENTIONAL METHODS OF MACHINING AND FORMING**

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**Course Objectives:**

* To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications
* To understand the basics of various forming operations and machining techniques.

**Unit-I**

Ultrasonic Machining (USM): Process description, abrasive slurry, Abrasive materials and their characteristics. Functions of liquid medium in slurry. Types of Transducers, effect of process parameters, applications and limitations.

Abrasive Jet Machining (AJM): Principle of operation, process details, process variables and their effect on MRR and accuracy. Equation for MRR. Advantages, disadvantages and applications.

Water Jet Machining (WJM): Schematic diagram, equipment used, advantages and applications.

**Unit-II**

Electro Discharge Machining (EDM): Process description with schematic diagram, process parameters, functions and characteristics of dielectric medium, dielectric fluids, over cut and side taper Flushing. Mechanism of metal removal, crater volume, types of power supply circuits, mathematical analysis of metal removal rate (MRR), characteristics of spark eroded surfaces, advantages, disadvantages and applications, wire electro-discharge machining principles and description.

Electro-Chemical Machining (ECM): Schematic of the process, process parameters, function and characteristics of electrolyte, chemistry of the process. Equation for specific MRR and electrode feed rate, advantages, limitations and applications.

Rotary Machining, Hot machining, high speed machining, description of each process, process parameters, advantages and applications.

**Unit-III**

LASER Beam Machining (LBM): Principle of LASER Beam production, materials used, thermal analysis of the process, process parameters, equations for power density and machining rate, advantages, limitations and applications.

Plasma Arc Machining (RAM): Equipment used, process description and parameters, types of plasma arc: Transferred arc and non-transferred arc and process applications.

Electron Beam Machining (EBM): Schematic of the process, process parameters, principle of production of Electron beam, equipment used, Advantages, disadvantages and applications. ION Etching: Process description and applications.

Hybrid Machining Processes: Principle and applications of Electro chemical discharge machining, electro chemical abrasive finishing, electro discharge abrasive grinding.

**Unit-IV**

Rubber Pad Forming: Principle of the process, process details, process variants - Guerin, wheelon, Marforming and Hydro forming processes and applications.

High Energy Rate Forming (HERF): Advantages of high energy rate forming, Explosive forming: Explosive materials, standoff operation and contact operation, advantages and applications.

Unit-V
Stretch Forming: Introduction, types of stretch forming: stretch draw forming, rotary stretch forming or stretch wrapping, compression forming, radial draw forming. Stretch forming equipment and accessories, accuracy and surface finish, process variables and limitations.

Tube spinning: Introduction, methods of tube spinning, Backward spinning, Forward spinning, machines and tools used. Machine variables, speeds and feeds, effect of tube spinning on work metal properties and applications.
Hydrostatic Forming: Process principle description and applications.

Water Hammer Forming (WHF): Schematic diagram of the process, principle of operation, process variable, work materials, process limitations and applications.

Suggested Reading
3. Davies and Austin, "Developments in High Speed Metal Forming". The Machinery Publishing Co. Ltd., 1985
ME 408 UE

ADDITIVE MANUFACTURING TECHNOLOGIES

Instruction 4 Periods per week
Duration of University Examination 3 Hours
University Examination 75 Marks
Sessional 25 Marks
Credits 4

Course Objectives:
• To understand the fundamental concepts of Additive Manufacturing (i.e. Rapid Prototyping) and 3-D printing, its advantages and limitations.
• To classify various types of Additive Manufacturing Processes and know their working principle, advantages, limitations etc.
• To have a holistic view of various applications of these technologies in relevant fields such as mechanical, Bio-medical, Aerospace, electronics etc.

Outcomes:
• Comprehend the importance, historical background and fundamentals of additive manufacturing (AM)
• Build the prototypes using AM technologies like Stereo Lithography Apparatus (SLA), Solid Ground Curing (SGC), Laminated Object Manufacturing (LOM), and Fused Deposition Modelling (FDM)
• Construct prototypes using powder based AM technologies like Selective Laser Sintering (SLS), Three Dimensional Printing (3DP), and classify, evaluate Rapid Tooling Processes
• Preparation of CAD data, evaluation of STL file problems and features of various AM software
• Apply AM processes for Mechanical, Bio-medical, Aerospace, Automotive, Medical etc. industries

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UNIT-I


UNIT-II


UNIT-III


UNIT-IV


UNIT-V


Suggested Reading:
ME 409 UE

ENTERPRENEURSHIP

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

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

Unit-I
Indian Industrial Environment – Competence; Opportunities and Challenges, Entrepreneurship and Economic growth, Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

Unit –II
Identification and characteristics of entrepreneurs, Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas, their sources and decision making. Choice of Technology – Collaborative interaction for Technology development.

Unit-III
Project formulation, analysis of marked demand, demand supply gap, financial and profitability analysis, technical analysis and risk analysis. Project financing in India.

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

Unit-V
Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Reading
ME 410 UE

AERODYNAMIC DESIGN OF THERMAL TURBINES

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

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

Outcomes:
- The Students are expected to be explain the Euler’s Turbine equations application and Concepts of 1D 2D and 3D Flows in Turbines
- The Students are expected to be able to understand Aerodynamics of flow over turbine cascades and relevant performance parameters,
- The Students are expected to be use 1D and 2D Blade Design Methods and solve problems on Axial turbine stages cascades.
- The Students are expected to understand 3D Blading design methods and use Radial equilibrium and Actuated Disc theories of Axial flow turbine cascades.
- The Students are expected to understand the performance maps of Axial turbines and estimate losses in turbine cascades. They are also expected to understand wind tunnel experimental test procedures and related instrumentation.

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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
1 D and 2D Blade Design Methods:
2 D 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 Reading
ME 411 UE

MATERIAL HANDLING

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

Course Objectives:
• To know about the working principle of various material handling equipments
• To understand the Material handling relates to the loading, unloading and movement of all types of materials
• To understand the estimation of storage space and maintenance of material handling equipments

Outcomes:
• Importance of individual components of a material handling system
• Classify various conveying systems that are available in industry
• Compare and contrast various bulk solid handling systems and their design features
• Evaluate various modern material handling systems and their integration
• Calculate number of MH systems required, storage space, cost and maintenance

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UNIT-I
Mechanical Handling Systems: Belt Conveyors and Desing, Bucket Elevators, Package conveyors, Chain and Flight Conveyors, Screw Conveyors, Vibratory Conveyors, Cranes and Hoists.

UNIT-II

UNIT-III

UNIT-IV
Modern Material Handling Systems: Constructional features of (i) AGV (ii) Automated storage and retrieval systems. Sensors used in AGVs and ASRS. Bar code systems and RFID systems: Fundamentals and their integration with computer-based information systems.

UNIT-V
Total MH Throughput: Calculation for no. of MH systems; storage space estimation based on no of aisles. Maintenance of MH equipment, spare parts management, cost of materials handling, cost per unit load computations.
Suggested Reading
ME 412 UE

FINITE ELEMENT ANALYSIS

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

Course Objectives
* To understand the theory and application of the finite element method for analyzing structural systems.
* To learn Approximation theory for structural problems as the basis for finite element methods
* To learn formulations for a variety of elements in one, two, and three dimensions. Implementations of element formulations will be examined using Matlab.
* To understand modeling and analysis of structures using planar, solid, and plate elements

Unit-I
Introduction to Finite Element Method, solution method using FEM, discretisation, Boundary conditions, load application, types of elements comparison, Stress and Equilibrium, Boundary conditions. Strain-Displacement relations. Stress-strain relations.
One Dimensional problems: Finite element modeling, coordinates and shape functions.

Unit-II
Analysis of trusses and frames: Element stiffness matrix for a truss member. Analysis of plane truss with number of unknowns not exceeding two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node.
Analysis of Beams: Element stiffness matrix for two nodded, two degrees of freedom per node beam element.

Unit-III
Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions.
Finite element modeling of Axisymmetric solids subjected to Axisymmetric loading with triangular elements.

Unit-IV
Two dimensional four nodded isoparametric elements and numerical integration.
Steady state heat transfer analysis: Onedimensional analysis of a solid and two dimensional analysis of thin plate. Analysis of uniform shaft subjected to torsion.

Unit-V
Dynamic Analysis: Formulation of finite element mode, element matrices, evaluation of Eigen values and Eigen vectors for a stepped bar and a beam.
Time dependent field problems: Application to one dimensional heat flow in a rod. Finite element formation to three dimensional problems in stress analysis. Types of elements used.
Convergence requirements and geometric isotropy. Local, natural and global coordinates. Introduction to Finite Element Analysis Software.

Suggested Reading
ME 413 UE

NUMERICAL METHODS IN ENGINEERING

Instruction : 4 Periods/ week
Duration of University Examination : 3 Hrs
University Examination : 75 Marks
Sessional : 25 marks
Credits : 4

Course Objectives:
* To understand application of numerical methods in solving sets of equations
* To understand interpolation & polynomial approximation using numerical methods
* To understand numerical differentiation & integration methods

UNIT I:
Solving linear sets of equations

UNIT II:
Solving nonlinear sets of equations
Minimization of function, Newton’s Method, Steepest Descent Method, Eigen Values & Vectors, Norms, Power Method

UNIT III:
Interpolation & Polynomial Approximation
Least Squares Method, Langrage Interpolation, Hermite Interpolation, Cubic Spline interpolation, Chebeshev Polynomials & Series

UNIT IV:
Numerical Differentiation & Integration
Numerical Differentiation, Richardson’s Extrapolation, Definite & Indefinites Integrals, Simpson’s Rule, Trapezoid Rule, Gaussian Quadrature

UNIT V:
Ordinary Differential Equations
First and Higher Order Taylor Series, First order Runge-kutta Method, Fourth order Runge-kutta method, Errors, Convergence Criteria

Suggested Reading:
CS 408 UE  

**DATABASE SYSTEMS**  
(Service Course)

Instruction: 4 Periods per week  
Duration of University Examination: 3 Hours  
University Examination: 75 Marks  
Sessional: 25 marks  
Credits: 4

**Course Objectives:**
- Understand the mathematical foundations on which RDBMS are built  
- Model a set of requirements using the Extended Entity Relationship Model (EER), transform an EER model into a relational model, and refine the relational model using theory of Normalization  
- Develop Database application using SQL and Embedded SQL  
- Use the knowledge of file organization and indexing to improve database application performance  
- Evaluate working of concurrency control and recovery mechanisms in RDBMS

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**UNIT-I**
Data and Data Management: Role of Data and Databases  
Database and Database Management System: Key Database concepts-Basic Database Models-Database Components  
DataModeling: Database Design-Relational Database Models-Relationships-Comparing Data Models

**UNIT-II**
SQL language: SQL features-command basics-SELECT Fundamentals-Operators and Functions-DDL Commands-DML Commands.  
Data Access and Manipulation: SELECT statement Advanced Syntax-Joins and Sub Queries.  
SQL Procedures: SQL Procedures and Functions-Triggers.

**UNIT-III**
Designing a Database: Designing Relational Tables-Comparing Relational Designs-Normalizing Data.  
Implementing a Database: Physical Design and Implementation-Adjusting Design to the Real World-Implementing Database Objects.

**UNIT-IV**
Database Administration: Need for Administration-Administration Responsibilities-Management Task.

**UNIT-V**

**Suggested Reading:**
ME 451 UE

MANAGEMENT AND INFORMATION SYSTEMS

Instruction (Periods per week) 4
Duration of University Examination 3 Hours
University Examination 75 Marks
Sessional 25 Marks.
Credits 4

Course Objectives:
- To understand the concept of motion study, ergonomics, forecasting and their role of management
- Understand the concept of forecasting and its types using different techniques along with cost analysis
- To understand the marketing concepts and strategies with financial and time management
- To understand maintenance management and cost associated evaluation of life testing of products using reliability testings
- To understand the role of information systems and in implementing modern management concepts

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UNIT-I

Method Study: Introduction and Definition, Objectives of Method Study, Steps involved in method study, Selection of the job for method study, Recording Techniques, Micro-Motion Study, Memo Motion Study, Cycle Graph and Chronocycle Graph, Principles of Motion Economy.


UNIT-II

Forecasting: Introduction, Need for forecasting, Long-term and Short-term forecasts, Classification of Forecasting Methods, Judgment Techniques, Time-Series Analysis: Least Square Method of Forecasting (Regression Analysis), Moving Average Forecasting, Exponential Smoothing Method, Casual Forecasting Method, Forecast Error, Costs and Accuracy of Forecasts.

UNIT-III


UNIT-IV


UNIT- V

**Information System:** Definition of Information System (IS), Organizational Need for Information System, Impact of IT on Organization Structure, Operating Elements of an IS, Main Functions of IS, Information Flows in organization, Information users and their information needs, Characteristics of the information systems, Information System at operational, tactical and strategic levels, Model of an information system, strategic uses of information technology. Categories of computers, input/ output devices, primary and secondary storage, introduction to operating system.

**Suggested Readings**

ME 481 UE

SEMINAR

Instruction of University
Sessional

3 Periods per week
25 Marks

Oral presentation is an important aspect of engineering education. The objective of the Seminar Course is to motivate a student to do a systematic and independent study of state-of-art topics in a broad area of his/her interest.

Seminar topics may be chosen by the student with the suggestions from the faculty members. Students are to be exposed to following aspects of seminar presentation.

- Literature survey
- Organization of material to be presented
- Preparation of OHP/ Slides/PC Presentation
- Technical writing.

Each student is required to

1. Submit one page synopsis of the seminar talk for display on notice board of the department.
2. Give a 20 minutes presentation with the aids of an OHP/PC/Slide Projector, followed by a 10 minutes discussion.
3. Submit the report on the seminar topic presented along with list of reference and slides/ transparencies used.

Seminars are scheduled from the 3\textsuperscript{rd} week to the last week of the semester and any change in schedule is discouraged.

Sessional marks will be awarded jointly or independently by at least two faculty members. The awards be on the basis of the oral presentation made, written materials submitted, active participation of the student in the proceedings as well as involvements in the discussions.
ME 482 UE

**PROJECT**

| Instruction         | : | 6 Periods per week |
|---------------------|--|--|-------------------|
| Duration of University Examination | : | Viva voce |
| University Examination | : | Grade* |
| Sessional          | : | 50 Marks |
| Credits            | : | 12 |

**OUTCOMES**

- Able to define Problem with specifications
- Relevant Literature survey, familiarity with research journals
- Critically evaluate various available techniques to solve a particular problem
- Able to Plan the work, prepare required graphs, bar (activity) charts and analyse the results and arrive at a solution
- Prepare and present results in a scientific manner (Presentation - oral and written)

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Solving a real life problem' should be the focus of U.G. projects. Faculty members should propose the project briefs (scope and references) well in advance which should be made available to the students at the departmental library. The project could be classified as experimentation, theoretical calculation, computational analysis, Mathematical modeling. It should involve one or many elements of techniques such as analysis, design, simulation and synthesis.

The Department will appoint a project coordinator who will coordinate the following.

- Grouping of students (max. 3 in a group).
- Allotment of Projects and project guides Project monitoring at regular intervals

All projects allotment is completed by the 2nd week of 4th year 1st semester, so that students get sufficient time for completion of the project.

All projects will be monitored at least twice in a semester through students presentation. Sessional marks are to be based on the Grades/Marks, awarded by a monitoring committee comprising of faculty members in the presence of the supervisor.

Efforts should be made that some of the projects are carried out in Industries with the help of industry coordinators.

Common norms will be established for final documentation of the project report by the respective departments.

*S/A/B/C/D/F
ELECTIVE - III
ME 454 UE

WASTE HEAT RECOVERY AND CO-GENERATION

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

Course Objectives:
- Understand the concept of waste heat recovery
- Distinguish heat exchangers and recuperators
- Acquire knowledge about various cogeneration methods
- Understand the cogeneration concept and thermodynamic advantages
- Understand the source of waste heat and methods of utilization

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Unit-I

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Unit-III
First and Second law of thermodynamics, and it's 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-Overview, Industrial application of cogeneration.

Unit-V

Suggested Reading
ME 455 UE

COMPOSITE MATERIALS

Instruction (periods per week) : 4
Duration of University Examination: 3 Hours
University Examination: 75 Marks
Sessional: 25 Marks
Credits: 4

Course Objectives:
- Understand the concept of composites its advantages and applications
- Compare and contrast different manufacturing methods of composites
- Analysis and evaluation of laminate composites using micromechanics
- Analysis and evaluation of laminate composites using macromechanics
- Estimate the properties of composites using micormechanics and macromechanics.

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Unit-I
Introduction: Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon fibre composites.

Unit-II
Micromechanics of Composites:
Mechanical properties: Production of Elastic constant, micromechanical approach, Halpin-Tsal 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.

Unit-IV
Inter-laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams.
Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: Single and multiple fracture, de-bonding, fibre pullout and de-lamination failure, fatigue of laminate composite. Effect of variability of fibre strength.

Unit-V

Suggested Reading
ME 456 UE

MACHINE TOOL ENGINEERING AND DESIGN

Instruction (periods per week) : 4
Duration of University : 3 Hours
Examination University : 75 Marks
Examination Sessional : 25 Marks
Credits : 4

Course Objectives:

- Understand the basic working principles of different machine tools with kinematic mechanisms.
- Distinguish the functional and operational requirements of different machine tools
- Design speed and feed gear boxes for a particular configuration.
- Design machine tool structures for strength and rigidity
- Understand various controls used in machine tools

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Unit-I

Unit-II

Unit-III

Unit-IV

Unit-V

Suggested Reading
ME 466 UE

ADVANCED PROPULSION AND SPACE SCIENCE

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

Course Objectives:
* To learn about gas dynamic concepts of rocket propulsion system
* To understand rocket engine system.
* To understand celestial sphere and its parameters
* To learn about Satellites & Remote Sensing

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 Reading
EC 402 UE  
EMBEDDED SYSTEM DESIGN

Instruction : 4 Periods per week  
Duration of university examination : 3 hours  
University examination : 75marks  
Sessional : 25marks  
Credits : 4

Course Objectives:  
• acquire an overview of what an embedded system implies  
• understand the architecture of a microprocessor and microcontroller to enable to design embedded applications using them  
• apply theoretical learning to practical real time problems for automation.  
• understand how to build and debug an embedded system application.  
• analyze and design real world applications and interface peripheral devices to the microprocessor.

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Unit I  

Unit II  

Unit III  
RTOS Availability: Language/Microprocessor Support, Tool Compatibility, Device Drivers, Services: Tool Chain Availability: Compilers, Hardware And Software Debugging Tools: Other Issues In Selection Process.

Unit IV  

Unit V  

Suggested Books:  
EC 466 UE

MICROPROCESSORS APPLICATIONS
(Elective for ME)

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 75 Marks
Sessional: 25 Marks
Credits: 4

Course Objectives:
* To Understand The Basic Building Blocks Of The Digital Circuits.
* To Gain Knowledge About Stored Program Computer Concept.
* To Understand Different Peripherals.

Unit I
Introduction to digital systems, number systems and architecture, Boolean algebra and logic gates – AND, OR, NOT, NAND, NOR, EXCLUSIVE-OR, Combinational logic circuits, binary adder, binary subtracter, BCD adder and BCD subtracter.

Unit II
Functional Aspect Of Decoder, Multiplexer, Demultiplexer, Encoder, Flip-Flops, Binary Counter, Bcd Counter, Shift Register, Octal Tristate Latch, Octal Bidirectional Buffer, Read Only Memory, Random Access Memory (Read/Write), Digital To Analog (D/A)Converter, Analog To Digital (A/D)Converter.

Unit III

Unit IV
Memory Interfacing: ROM And Static ROM Chips, I/O Interfacing, Simple I/O Ports(Intel 8282), Programmable Peripheral Interface & Chip (8255), Programmable Communication Interface Chip (8251), RS232C Interface.

Unit V
Peripherals Interfacing Using Toggle Switches, Keyboard, LEDs, Seven-Segment LEDs, ADC, DAC, Centronic Parallel Printer, CRT Data Terminals, Interrupts, DMA Data Transfer.

Suggested Reading:
CS 459 UE

INFORMATION SECURITY

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 75 Marks
Sessionals: 25 Marks
Credits: 4

Course Objectives:

- Describe the steps in Security Systems development life cycle (SecSDLC)
- Understand the common threats and attack to information systems
- Understand the legal and ethical issues of information technology
- Identify security needs using risk management and choose the appropriate risk control strategy based on business needs
- Use the basic knowledge of security frameworks in preparing security blue print for the organization

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UNIT-I

UNIT-II

UNIT-III

UNIT-IV
Cryptography: The basic elements of cryptography: symmetric (Symmetric Key-DES, IDEA, and AES), and public key cryptography (Public Key Encryptions-RSA).

UNIT-V
Message digest (MD-5, SHA), digital signatures. SSL and SET: SSL and SET protocols, Internet transactions using both SSL and SET.

Suggested Reading:
EE 451 UE  

**RELIABILITY ENGINEERING**

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks

**OUTCOMES**
- Understand the importance of various probability density functions
- Classify the various failures and their causes
- Develop reliability block diagrams and evaluate failure rate
- Analyse various markov models for single and multi components
- Determine the frequency of failure and cumulative failure using markov and other models

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**UNIT- I**

**UNIT -II**

**UNIT- III**

**UNIT- IV**
Availability, MTTR and MTBF Markov models and State transition matrices. Reliability models for single component, two component. Load sharing and standby systems. Reliability and availability models of two unit parallel system with repair and standby system with repair.

**UNIT- V**

**Suggested Reading**
ELECTIVE – IV
ME 460 UE

ROBOTICS

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

Course Objectives:
- To provide student the fundamental knowledge of the various sub-disciplines in serial robots such as kinematics, dynamics, control & manipulation, and computer based acquisition etc.
- To provide adequate background in both analysis and design of serial robots.

OUTCOMES:
- Capable to relate mechanical structures of industrial robots and their operational workspace characteristics and have an understanding of the functionality and limitations of robot actuators and sensors
- Apply spatial transformation to obtain forward/Inverse kinematics
- equation of robot manipulators using analytical/numerical/simulation tools
- Apply robot vision techniques to get the required information from input images
- Design and develop a industrial robot for a given purpose economically
- Appreciate the current state and potential for robotics in new application areas

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UNIT-I

UNIT-II

UNIT-III
Jacobian for direct and inverse kinematics. Trajectory planning for Robots. Trajectory control based on incremental inverse kinematics of kinematic equations, Static force analysis, stiffness.

UNIT-IV
Newton - Euler formulation of dynamic equation. Lagrangian formulation. Inertia tensor. Control schemes, individual joint control and disadvantages. Control through computed torques.

UNIT-V
ME 460 UE

Suggested Reading
ME 461 UE

ENERGY CONSERVATION AND MANAGEMENT

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

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

OUTCOMES:
- Student will able to understand different forms of energy
- Student will be able to calculate the amount of heat energy available
- Students able to understand the industry energy conservation modeling
- Students able to understand methodology for forecasting industrial energy supply and demand.
- Understand the energy storage techniques

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UNTT-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

UNTT-IV
ME 461 UE

UNTT-V

Suggested Reading
ME 462 UE

TOOL DESIGN

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

Course Objectives:
* To understand the basic knowledge of select appropriate materials for tooling applications
* To grasp the Design, develop, and evaluate cutting tools and work holders for a manufactured product
* To comprehend the basic knowledge of press tools for sheet metal working.

Outcomes:
- Understand ASA and ORS systems of tool geometry
- Design a single point or multi point cutting tool to machine a required job
- Design a die and punch for blanking, piercing, drawing and bending operations
- Discriminate the knowledge of jigs and fixtures design
- Apply the concepts and design a GO and NO GO gauge

UNIT-I
Cutting tool materials and single point cutting tools:
Cutting tool materials, desired properties. Types, major Constituent, relative characteristics, latest development: ISO; classification and coding of carbides.
Geometry of single point cutting tool. Influence of each geometrical parameters on the cutting tool performance. Factors involved in their selection. Tool signature and geometry in MRS, ORS, NRS. Cutting forces and design features of HSS and carbide tipped tools.
Feature of high production cutting tools. Chipbreakers and their types.

UNIT-II
Form tools and multi point cutting tools:
Form tools: Radial and tangential: flat and circular. Form correction and tool holding methods.
Drills Geometry: Variation of rake and clearance angles along tips, effect of geometrical parameters on thrust and torque effect of feed rate on rake and clearance, web thinning. Types of drill points, Grinding of drills.
Milling Cutters: Major types, geometry of peripheral, end and face milling cutters. Profile sharpened and form relieved expression for minimum number of teeth. Design features, forces and power estimation, Grinding of milling cutters.
Reamers: Types, geometry, Reaming allowance, design features tolerance disposition.

UNIT-III
Press tools for sheet metal working:
Bending dies: Spring back and bending allowance estimation of punch load.
Drawing Dies: Punch load, blank size, number of draws, methods of retaining metal in draw dies. Metal flow during drawing.
Metal spinning: Configuration and design features of metal spinning, shear forming and flow forming.

UNIT-IV
ME 462 UE
UNT-T-V


**Plastic Tools:** Application of plastic as a tooling material viz., for Gauges, Surface plates, jigs and fixtures. Forming dies.

**Suggested Reading**
ME 465 UE

NON-DESTRUCTIVE TESTING

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

Course Objectives:

* To understand the basic principles, techniques, equipment, applications and limitations of basic NOT methods.
* To learn the selection of appropriate NOT methods.
* To grasp the standards and specifications related to NOT technology.
* To know the developments and future trends in NOT.

Outcomes:

- Able to understand the basic principles, techniques and equipment of NDT methods
- Able to analyse and interpret the results from NDT TESTS
- Able to apply the codes, standards and specifications used in NDT
- Able to select proper NDT method for inspection of industrial products
- Able to know the developments and future trends in NDT

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UNIT-I

Liquid Penetrant 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 Inspection: Principle, Magnetisation methods, continuous and residual methods, sensitivities, Demagnetisation, Magnetic particles, Applications, Advantages and limitations.

UNIT-II

Eddy Current Testing: Principle, Lift-off factor, and edge effects, Skin effect, Inspection frequency, coil arrangements, inspection probes, types of circuit, reference pieces, phase analysis, display methods and applications.

UNIT-III


UNTT-IV

Radiography: Principle and uses of Radiography, limitations, Principle, Radiation sources, Production of X-rays, x-ray spectra, Attenuation of radiation, Radiographic equivalence, Shadow formation, enlargement and distortion, Radiographic 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.

Suggested Reading
**CS 458 UE**

**DATA MINING**

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**Course Objectives**

* To understand the different steps in data mining
* To learn the different classification techniques
* To gain knowledge of association rule mining
* To understand the techniques of clustering

**UNIT-I**

Introduction: Challenges – Origins of Data Mining and Data Mining Tasks
Data: Types of Data – Data Quality – Data Preprocessing – Measures of Similarity and Dissimilarity – OLAP and Multidimensional Data Analysis

**UNIT-II**


**UNIT-III**

Classification: Nearest-Neighbor classifiers – Bayesian classifiers – Artificial Neural Networks – Support vector machine – Ensemble methods – Class imbalance problem – Multiclass problem

**UNIT-IV**


**UNIT-V**


**Suggested Reading:**

5. Galit S, Nitin RP, Peter C Bruce. *Data Mining for Business Intelligence*. Wiley India Edition. 2007
LA 454 UE

INTELLECTUAL PROPERTY RIGHTS

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

COURSE OUTCOMES:

- Is aware of Engineering Ethics providing basic knowledge about ethics, moral issues & moral dilemmas and professional ideals
- Identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP.
- Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development
- Identify activities and constitute IP infringements and the remedies available to the IP owner
- Describe the precautionary steps to be taken to prevent infringement of proprietary rights and duties in products and technology development.

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UNIT - I

UNIT - II
History of the patent system. Patents in all fields of technology.

i. Patents on genetic resources patents on chemicals, designs, patents based on software, business methods, internet patents, etc.

ii. Exceptions to exclusive rights conferred to a patent holder, iii. Grounds for revocation of a patent, iv. Remedies for infringement of a patent.

UNIT - III

UNIT - IV
Nature and scope of protection of design rights, protection of layout designs (topographies) of Integrated circuits, protection of undisclosed information, protection of trademarks, domain names and geographical indications.
UNIT - V
Practical aspects - Drafting of a patent. Some exercises on the preliminary rules on preparing an application seeking a patent.

Suggested Reading:
BM 454 UE

BIOELECTRICITY
(Elective for CSE/ECE/EEE/ME)

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 75 Marks
Sessional: 25 Marks
Credits: 4

OBJECTIVES:
* Electrical properties of the cell membrane
* Action potentials
* Extra cellular waveforms
* Cardiac electrophysiology
* Function stimulation (FES)

UNIT I

UNIT II

UNIT III

UNIT IV
Electro-physiology of Heart: Properties of Cardiac muscle, Heart vector, electrical activity of the heart. Standard leads, lead vectors. Recording of the ECG from the surface. Dipole theory of the heart. Relationship between the different ECG leads.

UNIT V
Application of Bio-Electric Phenomena:
Functional Neuro-muscular stimulation, impedance plethysmography, measurement of resistance of isotropic & anisotropic tissue and Electro encephalography.

Suggested Reading:
CE 461 UE

DISASTER MANAGEMENT
(Elective –IV for BME/CSE/CE/ECE/EE/ME)

Instruction 4 Periods per week
Duration of University Examination 3 Hours
University Examination 75 Marks
Sessionals 25 Marks
Credits 4

Course Objectives:
- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR).
- To enhance awareness of institutional processes in the country.
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

COURSE OUTCOMES:
- Is exposed to disasters, their significance and types.
- Understand the relationship between vulnerability, disasters, disaster prevention and risk reduction and understand impact on Natural and manmade disasters.
- Preliminary understanding of approaches of Disaster Risk Reduction (DRR).
- Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.
- Evaluate available Disaster management systems and evolve at better systems.

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UNIT-I
Introduction to Disasters: Concepts and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks.

Natural and Manmade disasters, impact of drought, review of past disasters and drought in India, its classification and characteristics. Classification of drought, causes, Impacts (including social, economic, political, environmental, health, psychosocial, etc.).

UNIT-II
Disaster: Classifications, Causes, Impacts including social, economic, political, environmental, health, psychosocial etc.

Differential Impacts - in terms of caste, class, gender, age, location, disability Global trends in disasters, urban disasters, pandemics, complex emergencies, climate change.

Cyclones and Floods: Tropical cyclones & Local storms, Destruction by tropical cyclones and local storms, Cumulative atmospheric hazards/ disasters, Cold waves, Heat waves, Causes of floods, Rood hazards in India.
UNIT-III
Approaches to Disaster Risk Reduction: Disaster cycle - its analysis, Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural sources, roles and responsibilities of community, Panchayati Raj Institutions/Urban Local Bodies (PRis/ULBs), states, Centre, and other stake-holders.

UNIT-IV
Inter-relationship between Disasters and Development: Factors affecting Vulnerabilities, differential impacts, impact of development projects such as dams, embankments, changes in Land-use etc. Climate Change Adaptation, Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT-V
Disaster Risk Management in India: Hazard and Vulnerability profile of India Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, OM Act and Policy, other related policies, plans, programmes and legislation)

Field Work, Case Studies: The field work is meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the geographic location and hazard profile of the region where the college is located.

Suggested Reading:
SERVICE COURSES
ME 471 UE

INDUSTRIAL AND FINANCIAL MANAGEMENT

Instruction (periods per week) : 4
Duration of University Examination : 3 Hours
University Examination : 75 Marks
Sessional : 25 Marks
Credits : 4

Course Objectives:
* To understand various types of organizational structures, manufacturing processes and importance of plant layout and the role of scheduling function in optimizing the utilization of resources
* To understand the importance of quality, inventory control and concepts like MRP I and MRP II
* To understand the nature of financial management and concepts like breakeven analysis, depreciation and replacement analysis

Course Outcomes:
- Understand the different phases of product life cycle, types of manufacturing systems, plant layout optimization problems
- Role of scheduling function in better utilization of resources
- Fundamental concepts of quality control, process control, material control and appreciate the importance of MRP-I and MRP –II.
- Know the different terminology used in financial management and apply different techniques of capital budgeting
- Analyse and various types of costs involved in running an industrial organisation

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Unit-I

Unit-II
Locating production and services facilities, effects of location and costs and revenues, factor rating, simple median model (linear programming) Layout planning; process layout; product layout — Assembly lines; line balancing manufacturing cellular layout. Scheduling systems and aggregate planning for production and services; loading assignment algorithm; priority sequencing and other criteria.

Unit-III

Unit-IV
**Inventory control:** deterministic and stochastic inventory models; variable demand; lead time, specific service level, perishable products and service.

Inventory control in application; concepts for the practitioners; saving money in inventory systems; ABC classifications.

Inventory control procedures; Quantity - reorders versus periodic inventory systems; material requirement planning (MRP); MRP as a scheduling and ordering system; MRP system components; MRP computational procedure; Detailed capacity planning; MRP - limitation and advantages; Manufacturing Resources Planning (MRP-II).

**Unit-V**

Elements of cost, overheads, breakeven analysis, depreciation, replacement analysis. Nature of financial management-time value of money, techniques of capital budgeting and method, cost of capital, financial leverage.

**Suggested Reading**