Faculty of Engineering and Technology

B.E. MECHANICAL ENGINEERING
(Full Time)

DEPARTMENT OF MECHANICAL ENGINEERING

Board of Studies

2019
VISION
The Mechanical Engineering Department endeavors to be recognized globally for outstanding education and research leading to well qualified engineers, who are innovative, entrepreneurial and successful in advanced fields of mechanical engineering to cater the ever changing industrial demands and social needs.

MISSION
The Mechanical Engineering program makes available a high quality, relevant engineering education. The Program dedicates itself to providing students with a set of skills, knowledge and attitudes that will permit its graduates to succeed and thrive as engineers and leaders. The Program strives to:

- Prepare the graduates to pursue life-long learning, serve the profession and meet intellectual, ethical and career challenges.
- Extend a vital, state-of-the-art infrastructure to the students and faculty with opportunities to create, interpret, apply and disseminate knowledge.
- Develop the student community with wider knowledge in the emerging fields of Mechanical Engineering.
- Provide set of skills, knowledge and attitude that will permit the graduates to succeed and thrive as engineers and leaders.
- Create a conducive and supportive environment for all round growth of the students, faculty & staff

PROGRAM EDUCATIONAL OBJECTIVES

1. Prepare the graduates with a solid foundation in Engineering, Science and Technology for a successful career in Mechanical Engineering.

2. Train the students to solve problems in Mechanical Engineering and related areas by engineering analysis, computation and experimentation, including understanding basic mathematical and scientific principles.

3. Inculcate students with professional and ethical attitude, effective communication skills, team work skills and multidisciplinary approach

4. Provide opportunity to the students to expand their horizon beyond mechanical engineering

5. Develop the students to adapt to the rapidly changing environment in the areas of mechanical engineering and scale new heights in their profession through lifelong learning
B.E. MECHANICAL ENGINEERING

PROGRAMME OUTCOMES

PO1: Engineering Knowledge: Graduates will be able to apply knowledge of mathematics, science and engineering for the solution of mechanical engineering problems.

PO2: Problem analysis: Graduates will be able to formulate and analyze complex mechanical engineering problems.

PO3: Design/development of solutions. Graduates will be able to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, and public health.

PO4: Conduct investigations of complex problems: Graduates will be able to design and conduct experiments, and to analyze and interpret data.

PO5: Modern tool usage: Graduates will be able to use the techniques, skills, and modern engineering tools necessary for mechanical engineering practice.

PO6: The engineer and society: Graduates will be able to include social, cultural, ethical issues with engineering solutions.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

PO9: Individual and team work: Graduates will be able to function effectively on multidisciplinary teams.

PO10: Communication: Graduates will be able to communicate effectively.

PO11: Project management and finance: Demonstrate knowledge and understanding of the 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

PO12: Life-long learning: Graduates will be able to adopt technological changes and promote life-long learning.

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Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming III Semester.
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*For the Lateral entry students total credit for III Semester is 23.5 as they are exempted from internship during summer vacation of II semester.

### FOURTH SEMESTER

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**Total Credits** 21.5

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester.
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**Total Credits** 26.5

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**Total Credits** 21.0

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.
## SEVENTH SEMESTER

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| Total Credits | 19.5 |

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| Total Credits | 12 |

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PROFESSIONAL ELECTIVES
1. MEPE SCN Internal Combustion Engines
2. MEPE SCN Mechatronic Systems
3. MEPE SCN Microprocessors in Automation
4. MEPE SCN Composite Materials
5. MEPE SCN Computer Aided Design and Manufacturing
6. MEPE SCN Refrigeration and Air Conditioning
7. MEPE SCN Finite Element Analysis
8. MEPE SCN Power Plant Engineering
9. MEPE SCN Gas Dynamics and Jet Propulsion
10. MEPE SCN Process Planning and Cost Estimation
11. MEPE SCN Principles of Management
12. MEPE SCN Automobile Engineering
13. MEPE SCN Design of Transmission Systems
14. MEPE SCN Total Quality Management
15. MEPE SCN Energy Conservation and Management

OPEN ELECTIVES
1. MEOE SCN Automotive Engineering
2. MEOE SCN Automotive Safety
3. MEOE SCN Electric and hybrid vehicles
4. MEOE SCN Computational fluid dynamics
5. MEOE SCN Finite element methods
6. MEOE SCN Energy Engineering Technology and Management
7. MEOE SCN Renewable energy technology
8. MEOE SCN Industrial pollution prevention and control
9. MEOE SCN Power plant instrumentation
10. MEOE SCN Introduction to hydraulics and pneumatics
11. MEOE SCN Basic thermodynamics and heat transfer
12. MEOE SCN Energy auditing
13. MEOE SCN Energy conservation
14. MEOE SCN Solar energy utilization
15. MEOE SCN Waste heat recovery and co generation
16. MEOE SCN Maintenance & Safety Engineering
17. MEOE SCN Engine Pollution & Control

HONOURS ELECTIVES
1. MEHE SCN Computational Heat transfer
2. MEHE SCN Steam Engineering
3. MEHE SCN Advanced Engines and Emission Systems
4. MEHE SCN Energy Auditing
5. MEHE SCN Mechanical Vibration
6. MEHE SCN Robotics

MINOR ELECTIVES
1. MEMI SCN Basic Thermal Engineering
2. MEMI SCN Instrumentation and Control
3. MEMI SCN Elements of Heat transfer
4. MEMI SCN Elements of Machine Design
5. MEMI SCN Power Plant Technology
6. MEMI SCN Automobile Technology
THIRD SEMESTER

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COURSE OBJECTIVES

- To learn, partial differential equations, Fourier series, Boundary value problems.
- To learn the transforms such as Sine, Cosine, Fourier transform and Z-transforms.
- To gain knowledge of the method to find the Solution of difference equations.

UNIT I
Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions
- Solution of standard type of first order partial differential equations - Lagrange’s linear equation
- Linear partial differential equations of second order with constant coefficients.

UNIT II
Dirichle's conditions - General Fourier series - Odd and Even functions - Half range sine series
- Half range cosine series - Complex form of Fourier series – Parseval’s identity.

UNIT III
Solutions of one dimensional wave equation – One dimensional heat equation (without derivation)
- Fourier series solutions in Cartesian co-ordinates.

UNIT IV

UNIT V

TEXT BOOKS


REFERENCES

COURSE OUTCOMES
At the end of the course the students will be able to acquire knowledge on
1. Partial differential equations.
2. Fourier series.
3. Fourier transform.
4. Z-transforms and the methods of solving them.
5. Solving boundary value problems.

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ETES302 ENVIRONMENTAL STUDIES

COURSE OBJECTIVES
- To study the nature and the facts about environment.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To Study the dynamic processes and understand the features of the earth interior and surface.

Unit–I Introduction - Multidisciplinary nature of environmental studies - Definition, scope and importance - Need for public awareness. Natural resources - Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.- Role of an individual in conservation of natural resources.- Equitable use of resources for sustainable lifestyles.

Unit–II Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological - pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit–IV Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster management: floods, earthquake, cyclone and landslides.

Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.


Field Work
Visit to a local area to document environmental assets-river / forest / grassland / hill / mountain - Visit to a local polluted site-Urban/Rural/ Industrial/ Agricultural - Study of common plants, insects, birds - Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

TEXT BOOKS
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)

REFERENCES
2. Clark R.S., Marine Pollution, Claderson Press Oxford (TB)
5. Down to Earth, Centre for Science and Environment (R)
   (M) Magazine (R) Reference (TB) Textbook

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Gain public awareness of environment at infant stage.
2. Gain basic knowledge on the significance of environmental studies
3. Develop their standard of living
4. Understand the effects of environmental disasters.
5. Understand Human rights
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**ETES303 | ENGINEERING MECHANICS | L | T | P | C**

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**COURSE OBJECTIVES**

- To introduce the fundamentals of forces and their effects with their governing laws.
- To understand the definitions of particle, body forces and their equilibrium conditions.
- To understand and predict the forces and its related motions

**UNIT-I** Introduction to Engineering Mechanics-Force Systems-Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminancy

**UNIT-II** Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

**UNIT-III** Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.


**UNIT-IV** Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton’s 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique).

**UNIT-V** Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D’Alembert’s principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation
Mechanical Vibrations covering, Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;

**Tutorials** from the above modules covering, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack

**TEXT BOOKS**

**REFERENCES**

**COURSE OUTCOMES**
At the end of this course, students will demonstrate the ability to
1. Understand the concepts of co-ordinate systems.
2. Analyze the three-dimensional motion.
3. Understand the concepts of rigid bodies.
4. Analyze the free-body diagrams of different arrangements.
5. Analyze torsional motion and bending moment.

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COURSE OBJECTIVES

- To provide an overview of electronic device components to Mechanical engineering students.
- To learn the fundamentals of Digital Electronics.

Unit-I: Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

Unit-II: Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

Unit-III: Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

Unit-IV: Digital Electronics Fundamentals :Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using Kmap, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Unit-V: Electronic Communication Systems: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
At the end of this course students will demonstrate the ability to
1. Understand the principles of semiconductor devices and their applications.
2. Design an application using Operational amplifier.
3. Understand the working of timing circuits and oscillators.
4. Understand logic gates, flip flop as a building block of digital systems.
5. Learn the basics of Electronic communication system.
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**COURSE OBJECTIVES**

- To learn about work and heat interactions, and balance of energy between system and its surroundings
- To learn about application of I law to various energy conversion devices
- To evaluate the changes in properties of substances in various processes
- To understand the difference between high grade and low grade energies and II law limitations on energy conversion

**Unit-I:** Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

**Unit-II:** First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.

**Unit-III:** Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in Ts coordinates;

**Unit-IV:** Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier’s chart

**Unit-V:** Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle. Definition of Isentropic efficiency for compressors, turbines and nozzles-Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.
TEXT BOOKS
2. Thermodynamics –An Engineering Approach –Yunus A Cengel & Michael A Boles

REFERENCES

COURSE OUTCOMES
After successful completion of the course, students will be able to
1. Apply energy balance to systems and control volumes, in situations involving heat and work interactions
2. Evaluate changes in thermodynamic properties of substances
3. Evaluate the performance of energy conversion devices
4. Differentiate between high grade and low grade energies.
5. Learn various thermodynamic cycles

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MEPC306 SOLID MECHANICS

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COURSE OBJECTIVES
- The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.
- To learn the basics of stress and strain.

Unit-I: Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions

Unit-II: Constitutive equations: Generalized Hooke's law, Linear elasticity, Material symmetry;

Unit-III: Boundary Value Problems: concepts of uniqueness and superposition.
Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.

Unit-IV: Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-d contact problems.
Unit-V: Solutions using potentials. Energy methods. Introduction to plasticity.

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
Upon completion of this course, students will be able to
1. Learn the basics of stress and strain
2. Learn the significance of Hooks law.
3. Understand the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.
4. Understand the stress behavior on cylindrical surfaces
5. Learn the basics of plasticity.

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COURSE OBJECTIVES

- To understand the operation of basic electronic devices.
- To understand the basic functions of operational amplifier.
- To illustrate the application of operational amplifier.
- To understand the basic code conversion and Karnaugh Map reduction

List of Experiments

2. Half wave and full wave rectifiers with and without capacitor filter.
3. Mathematical operations using OP-AMP
4. Zero crossing detector using OP-AMP
5. Schmitt trigger using OP-AMP
6. R.C Phase Shift Oscillator using OP-AMP
7. Design of a stable and Bistable multivibrator.
8. Verification of basic gates and logic circuit using universal building blocks.
9. Karnaugh Map reduction
10. Multiplexer and Demultiplexer
11. Design of Modulo UP and DOWN Counters
12. Design of Half adder and full adder circuits

COURSE OUTCOMES

1. Learn the application and characteristics of basic electronic devices.
2. Gain knowledge to troubleshoot various electronic circuits.
3. Understand the functional characteristics of linear IC as a rectifiers, converters and amplifiers.
4. Acquire the operating theory of combinational and sequential circuits.
5. Explore the use of digital logic in integrated circuit applications.

Mapping of COs with POs

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COURSE OBJECTIVES

- To inculcate the knowledge about the working of I.C engines and different types of dynamometers.
- To study the valve timing and port timing of an IC engine
- To study and determine the properties of fuel like kinematic viscosity, calorific value etc.

List of Experiments
1. Study and valve timing on four stroke diesel engine.
2. Study and port-timing on two stroke petrol engine.
3. Dismantling and assembling of four stroke single cylinder diesel engine
4. Study of various parts of multi-cylinder diesel/petrol engine.
5. Study of Carburetor
6. Study of fuel injection pump
7. Study of cooling system
8. Study of lubrication system
9. Study of air compressor
10. Determination of calorific value of liquid fuel
11. Determination of flash and fire point of liquid fuel
12. Determination of cloud and pour point fuel
13. Determination of kinematic viscosity of fuel

COURSE OUTCOMES

Upon completion of course, the students will be able to:
1. Understand the various types of engines
2. Learn the working principles of dynamometers.
3. Know the dismantling and assembling procedure of a four stroke CI engines.
4. Determine kinematic viscosity and the influence of temperature on viscosity.
5. Determine the properties of fuels

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COURSE OBJECTIVES

- Students have an ability to apply knowledge of modeling, science & engineering.
- Student can modeled this drawing even in CAD/CAM software by applying the basic knowledge of machine drawing.
Students will able to demonstrate an ability to design and conduct experiments, analyze and interpret data, assembly and disassembly drawings knowledge will be provided.

**Free Hand Sketches**
Fasteners: Different form of rivet heads – Single, double riveted lap and butt joints - Foundation bolts - Locking arrangements for nuts - lock nut, split pin, locking plate and spring washer - Stud Set screws – Different forms of machine screws - pan, countersunk, slotted and philip headed screws - Keys - sunk taper key, gib headed taper key, feather key, woodruff key, saddle key.

**Orthographic and Assembly Drawings**
To draw orthographic views from the given isometric views of simple objects. Detailed assembly drawing and additional views from the given drawing.
(a) Shaft coupling - Protected type and Pin type flexible coupling
(b) Bearings and Supports - Bushed bearing, Foot step bearing and Plummer Block
(c) Eccentric
(d) Steam engine stuffing box
(e) Screw jack.

**TEXT BOOKS**

**REFERENCES**

**COURSE OUTCOMES**
Upon completing this course, students should be able to:
1. Improve their imagination skills
2. Improve their drawing skills
3. Understand and apply the knowledge of machine drawing as a system of communication in which ideas are expressed clearly and all information fully conveyed.
4. Understand the design of a system, component or process to meet desired needs within realistic constraints such as manufacturability, economic, environmental, safety & sustainability etc., to represent a part drawing and assembly drawings.
5. Recognize the need and an ability to engage in self education and life-long learning.
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COURSE OBJECTIVES

- Be exposed to probability, random processes, and statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.
- To develop the skills of the students in numerical mathematics - using method of finite difference interpolation, finding numerical solution of algebraic and transcendental equations, and finding numerical solution of ordinary and partial differential equations.

Unit–I : Probability and Random Variables
Definition – Types of random variables - probability distribution function - probability density function – expectation and moments – moment generating functions –joint probability distribution - marginal probability distribution function – joint probability density function – marginal probability density function – conditional probability density function.

Unit–II : Random Processes

Unit–III : Test of Significance
Hypothesis, testing – Large sampling tests – small sampling test based on t, F and chi-square distributions – interval estimates of mean, standard deviation and proportion.

Unit–IV : Interpolation, Numerical Differentiation and Integration

Unit–V : Solution of Algebraic, Transcendental and ordinary Differential Equations


TEXT BOOKS
REFERENCES

COURSE OUTCOMES
Upon completing this course, students should be able to:
1. Acquire skills in handling situations involving random variables
2. Able to solve problems on random processes
3. Solve problems using numerical methods.
4. Solve problems on integration
5. Solve problems on differential equations

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COURSE OBJECTIVES
- Today’s world is all about relationship, communication and presenting oneself, one’s ideas and the company in the most positive and impactful way.
- This course intends to enable students to achieve excellence in both personal and professional life.

Unit-I Know Thyself/ Understanding Self Introduction to Soft skills-Self discovery-Developing positive attitude-Improving perceptions-Forming values

Unit-II Interpersonal Skills/ Understanding Others Developing interpersonal relationship-Team building-group dynamics-Net working-Improved work relationship

Unit-III Communication Skills / Communication with others Art of listening-Art of reading-Art of speaking-Art of writing-Art of writing e-mails-e mail etiquette

Unit-IV Corporate Skills / Working with Others Developing body language-Practising etiquette and mannerism-Time management-Stress management

Unit-V Selling Self / Job Hunting Writing resume/cv-interview skills-Group discussion- Mock interview-Mock GD – Goal setting - Career planning
**TEXT BOOKS**

**REFERENCES**
1. Developing the leader within you John c Maxwel
2. Good to Great by Jim Collins
3. The seven habits of highly effective people Stephen Covey
4. Emotional Intelligence Daniel Goleman
5. Principle centred leadership Stephen Covey

**COURSE OUTCOMES**
After completing this course, the students should be able to
1. Understand the human values
2. Develop Interpersonal relationship
3. Improve their communication skills
4. Handle time and stress effectively
5. Plan their carrier

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**COURSE OBJECTIVES:**
- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
- To calculate the elastic deformation occurring in various simple geometries for different types of loading

**Unit-I:** Deformation in solids- Hooke’s law, stress and strain- tension, compression and shear stresses elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr’s circle.

**Unit-II:** Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.
**Unit-III:** Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell’s reciprocal theorems.

**Unit-IV:** Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

**Unit-V:** Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.

**TEXT BOOKS**

**REFERENCES**

**COURSE OUTCOMES**
After completing this course, the students should be able to
1. Recognize various types loads applied on machine components of simple geometry
2. Understand the nature of internal stresses developed within the components
3. Evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading
4. Learn the basics of torsional stresses
5. Understand the effects of axial stresses

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COURSE OBJECTIVES

- To learn about the application of mass and momentum conservation laws for fluid flows
- To understand the importance of dimensional analysis
- To obtain the velocity and pressure variations in various types of simple flows
- To analyze the flow in water pumps and turbines.

Unit-I: Definition of fluid, Newton’s law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli’s equation and its applications.

Unit-II: Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody’s diagram.


Unit-IV: Euler’s equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump–working principle.

Unit-V: Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, Unit-quantities, performance curves for turbines – governing of turbines.

TEXT BOOKS
1. Fluid Mechanics, Sadhu Singh, Khanna Publishing House, NewDelhi

REFERENCES

COURSE OUTCOMES
Upon completion of this course, students will be able to
1. Learn the basics of fluid mechanics
2. Analyze simple flow situations mathematically
3. Understand the significance of dimensionless parameters
4. Gain knowledge about the functions of fluid machines
5. Able to evaluate the performance of pumps and turbines.
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### MEPC405 | MANUFACTURING PROCESSES | L | T | P | C
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### COURSE OBJECTIVES

- To learn the various manufacturing process.
- To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

#### Unit-I: Conventional Manufacturing processes:
Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy, plastic injection moulding.

#### Unit-II: Metal cutting:
Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

#### Unit-III: Additive manufacturing:
Rapid prototyping and rapid tooling. Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

#### Unit-IV: Unconventional Machining Processes:
Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM.

#### Unit-V: Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.
TEXT BOOKS

REFERENCES
1. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

COURSE OUTCOMES
Upon completion of this course, students will be able to
1. Understand the different conventional manufacturing processes
2. Learn the basics of metal cutting
3. Learn the basics of additive manufacturing
4. Introduce unconventional manufacturing methods
5. Understand advanced machining processes for a lifelong learning.

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Mapping of COs with POs

MEPC406 | DESIGN OF MACHINE ELEMENTS | L | T | P | C
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COURSE OBJECTIVES
- To familiarize the various steps involved in the Design Process.
- To understand the principles involved in evaluating the shape and dimensions of Component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data To learn to use catalogues and standard machine components.


Unit–II Shafts - Material and design stresses - Calculation of equivalent bending moment and twisting moment - Design of shafts subjected to combined bending moment and twisting moment.


Unit–IV Power screws - Thread forms Design consideration and materials - wear and shear - design procedure. Coupling - Types - Design and selection of coupling - Flange coupling, Bushed pin type, flexible coupling design and selection.

TEXT BOOKS

REFERENCES
3. Design Data Book, Mahadevan, CBS Publishers & Distributors

COURSE OUTCOMES
Upon completing this course, students should be able to:
1. Appreciate the functions of various machine elements and assemblies
2. Design various machine components according to the requirement as per the prescribed standards
3. Apply the knowledge of materials and their properties
4. Use a standard design data book.
5. Understand the significance of designing joints

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COURSE OBJECTIVES

- To impart practical training on simple machines like screw jack, worm wheel, etc.
- To understand the theoretical and practical aspects of elasticity and plasticity of the materials through a variety of experiments.
- To determine the mechanical advantage and efficiency of some of the simple machines like screw jack, worm wheel, differential wheel and axle.
- To study the behavior of the materials by conducting tension, compression and shear, hardness impact, deflection and ductility tests.

List of Experiments

1. Simple machine-compound wheel and axle.
2. Screw Jack
3. Worm wheel
4. Handle Winch
5. Deflection Test on Steel Pipe
6. Tension Test Steel Rod
7. Izod Impact Test
8. Shear Test on steel rod
9. Brinell Hardness Test
10. Rockwell Hardness Test
11. Test on Helical Springs

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses
2. Learn the fundamental concepts of stress, strain and elastic behavior of materials.
3. Utilize appropriate materials in design considering engineering properties, sustainability, cost and weight.
4. Perform engineering work in accordance with ethical and economic constraints related to the design of structures and machine parts.
5. Work as a team to gain practical knowledge, helpful for a lifelong learning.

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COURSE OBJECTIVES

- To understand the properties of fluids and fluid statics, methods for determination of co-efficient of discharged are to be explained and computed practically.
- To study the characteristic features of pumps and turbines using experiments in envisaged.
- To understand the significance and role of such utilities in their further course of study.

List of Experiments

1. Determination of Co-efficient of discharge of Mouth Piece.
2. Determination of Co-efficient of discharge of Venturimeter.
3. Determination of Co-efficient of Head loss due to Sudden Change in Section.
4. Determination of Co-efficient of Head loss due to Friction in Pipe.
5. Determination of Co-efficient of discharge of Rectangular Notch.
7. Study of Performance characteristics of Sump Pump (Centrifugal Pump).
8. Study of Performance characteristics of Submersible Pump (Centrifugal Pump).
10. Study of Performance characteristics of Pelton Turbine (Constant Speed method).
11. Study of Performance characteristics of Francis Turbine (Constant Head method).
12. Determination of Metacentric Height of a floating vessel (Demo Only).

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Determine the properties of fluids, pressure and their measurements.
2. Measure flow in pipes and determine frictional losses.
3. Compute forces on immersed plane and curved plates applying continuity equation and energy equation in solving problems on flow through conduits.
4. Determine the characteristics of pumps
5. Determine the characteristics of turbines.

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COURSE OBJECTIVES

- To impart practical training to the students on various welding processes
- To develop procedural and manual skills in machining and also to provide training in making greensand moulds

List of Experiments

Foundry shop
1. Face Plate (Solid Pattern)
2. Hexagonal Nut (Self Core Pattern)
3. Ball Handle (Split Pattern)
4. Pipe Flange (Split Pattern)
5. Lathe Saddle (Loose Piece Pattern)

Welding shop
1. Butt Joint
2. Lap Joint
3. Corner Joint
4. Arc Welding Power Sources with Effect of Heat input on bed geometry
5. Temperature Measurement of Arc Welding Process
6. Non-destructive testing of Welding

Machine shop
1. Plain Turning
2. Step Turning
3. Taper Turning
4. Thread Cutting

COURSE OUTCOMES

Upon the completion of this course, the students will be able to
1. Handle metal working machine (Lathe) for making simple operations
2. Prepare green sand moulds of given patterns
3. Prepare different types of weld joints.
4. Understand non destructive testing
5. Work as a team for a lifelong learning

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FIFTH SEMESTER

MEPC501  MATERIALS ENGINEERING  L T P C

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COURSE OBJECTIVES

- Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
- To provide a detailed interpretation of equilibrium phase diagrams
- Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Unit-I Crystal Structure: Unit-cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. Mechanical Property measurement: Tensile, compression and torsion tests; Young’s modulus, relations between true and engineering stress-strain curves, generalized Hooke’s law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Unit-II Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT).

Unit-III Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Unit-IV Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

Unit-V Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupronickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys. Introduction to Corrosion and coatings

TEXT BOOKS
REFERENCES
3. Engineering Materials Properties and Selection, Budinski and Budinski, PHI
4. Material Science & Engineering, R. Balasubhramanium, Wiley India

COURSE OUTCOMES
Upon the completion of this course, the students will be able to
1. Identify crystal structures for various materials
2. Understand the defects in materials
3. Understand how to tailor material properties of ferrous and non-ferrous alloys
4. Learn the effects of heat treatment in steels
5. How to quantify mechanical integrity and failure in materials

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COURSE OBJECTIVES
- To provide a basic knowledge about measurement systems and their components
- To learn about various sensors used for measurement of mechanical quantities
- To learn about system stability and control
- To integrate the measurement systems with the process for process monitoring and control


Unit–III Measurements of Pressure and flow - Measurements of high pressure and low pressure - Measurements of flow by obstruction meters - Velocity probes - Hot wire anemometer - Calibration of pressure gauges and flow meters - Time constant of pressure gauges.

Unit–IV Elementary ideas of automatic control - Open and closed systems, on-off, proportional, and floating modes, reset and rate actions. Basic combined modes for pneumatic, hydraulic and electrical systems.
**Unit-V** Transfer function - Stability - Routh's criterion - Analysis of second order systems – System response to step – step, pulse - ramp inputs. Introduction to computerized measurement and control systems (Description only)

**TEXT BOOKS**
2. Benjamin Kuo, Automotive Control Engineering, EEE Publications.

**REFERENCES**
6. Instrumentation and control systems by W. Bolton, 2\textsuperscript{nd} edition, Newnes, 2000

**COURSE OUTCOMES**
Upon completion of this course, the students will be able to
1. Learn basic measurement systems
2. Design and maintain measuring equipments for the measurement of temperature and flow
3. Work in quality control and quality assurances divisions in industries
4. Design a sensors and transducers used for stress analysis.
5. Understand the significance of transfer functions.

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COURSE OBJECTIVES

- To provide knowledge on machines and related tools for manufacturing various components.
- To understand the relationship between process and system in manufacturing domain.
- To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

Unit-I Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design.

Unit-II Metrology: Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as microscale machining. Inspection and workpiece quality GD&T Introduction.

Unit-III Assembly practices: Manufacturing and assembly, process planning, selective assembly, Material handling and devices.

Unit-IV Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment, Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling;

Unit-V Production planning & control: Forecasting models, aggregate production planning, materials requirement planning. Inventory Models: Economic Order Quantity, quantity discount models, stochastic inventory models, practical inventory control models, JIT. Simple queuing theory models.

TEXT BOOKS:

REFERENCES
2. Manufacturing Technology, Vol. 1, 2, 3, PN Rao, TMH
4. Production and Operations Management, S.N.Chary, TMH
COURSE OUTCOMES
Upon completion of this course, students will be able to
1. Understand the tooling needed for manufacturing.
2. Learn the various precise measurements
3. Understand the various material handling devices.
4. Apply optimization methods in manufacturing.
5. Learn the significance of forecasting in manufacturing.

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Mapping of COs with POs

MEPC504 | KINEMATICS AND THEORY OF MACHINES | L | T | P | C
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COURSE OBJECTIVES
- To understand the kinematics and rigid-body dynamics of kinematically driven machine components
- To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
- To be able to design some linkage mechanisms and cam systems to generate specified output motion

Unit-I Classification of mechanisms-Basic kinematic concepts and definitions-Degree of freedom, mobility- Grashof’s law, Kinematic inversions of four bar chain and slider crank chains-Limit positions-Mechanical advantage-Transmission angle-Description of some common mechanisms-Quick return mechanism, straight line generators-Universal Joint-Rocker mechanisms

Unit-II Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations kinematic analysis of simple mechanisms- slider crank mechanism dynamics-Coincident points-Coriolis component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation

Unit-III Classification of cams and followers-Terminology and definitions-Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication- friction clutches- belt and rope drives- friction in brakes

Unit-IV Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics. Governors – Watt, Porter, Hartnell and Proell
Unit-V Elementary insights of vibrations – Free, forced and damped (Theory Only) Balancing of rotating masses – single rotating mass by single mass in same and different planes (Simple problems only) Balancing of reciprocating masses – Primary and secondary forces – swaying couples and hammer blow (Theory Only)

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
Upon completion of the course, students can ale to
1. Design various types of linkage mechanisms
2. Determine specific motion and analyze them for optimal functioning
3. Learn the significance of cam and followers
4. Learn the basics of governers
5. Understand the need for balancing

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COURSE OBJECTIVES
• To provide hands on experience in handling precise metrology instruments and their calibration.
• To provide hands on experience in special machines

List of Experiments
Machine Shop
1. Keyway machining using a shaper
2. Angular machining using a shaper
3. Convex profile machining on a slotter

Special Machine Shop
1. Plain milling
2. Spur gear milling
Metrology Lab
1. Inspection of screw-thread
   (A) Checking the straightness of straight edge
   (B) Measurement of radius (internal and external)
2. Calibration of micrometer

Metallurgy Lab
1. Effect of section size on hardness
2. End quenching (or) Jominy hardenability test

COURSE OUTCOMES
Upon the completion of this course, the students would be able to
1. Understand the usage of precision instruments and the handling methods.
2. Learn the basic operation of various traditional and non-traditional manufacturing processes.
3. Justify the most appropriate manufacturing process and material for a given product.
5. Work as a team to gain knowledge for a lifelong learning.

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MECP508 MACHINE THEORY LAB

COURSE OBJECTIVES
- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To make the students understand the working principle of various types of governors, balancing systems, Cam analyzer, Torsional vibration of single rotor system, whirling speed concept, action of forces in gyroscope.

List of Experiments
1. Experimental verification of natural frequency in undamped vibration of single rotor system.
2. Determine the characteristic curves of watt/Hartnell governors.
3. Determination of mass moment of inertia of connecting rod and fly wheel.
4. Studies on cam analyser.
5. Study of gyroscopic couple.
7. Study and experiments on static and dynamic balancing of rotating masses.
COURSE OUTCOMES
Upon the completion of the course, the students will be able to:
1. Determine the mass moment of inertia of connecting rod and flywheel either experimentally or theoretically or both.
2. Understand the working principle of governors.
3. Calculate the stiffness of springs.
4. Analyze the different types of motion in cams.
5. Ability to analyze particle dynamics

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MECP509 | INSTRUMENTATION & CONTROLS LAB | L | T | P | C
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COURSE OBJECTIVES
- To learn the temperature measuring techniques
- To make the students understand the working principle of various measuring devices.
- To understand the concept of proportional control action, integral control action and derivative control

List of Experiments
1. Determination of coefficient of discharge of Orificemeter
2. Determination of coefficient of discharge of Venturimeter
3. Determination of Reynolds number by Reynolds apparatus
4. Experiment on DC motor position control system
5. Experiments on DC Servo motor controller
6. Experiments on pressure process station by On/Off method
7. Experiments on temperature trainer by On/Off and PID method
8. Measurement of displacement using LVDT
10. Measurement of temperature using resistance temperature detector
11. Temperature measurement by bimetallic thermometer

COURSE OUTCOMES
Upon completion of course, the students will be able to:
1. Classify various temperature measuring devices
2. Determine the coefficient of discharge of various flow measuring devices.
3. Understand the concept of proportional control action, integral control action and derivative control action in a control system.
4. Measure the procedure for measuring strain using strain gauge.
5. Work as a team to gain knowledge for a lifelong learning
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COURSE OBJECTIVES

- To understand the importance of automation in the field of machine tool based manufacturing
- To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC
- To understand the basics of product design and the role of manufacturing automation

Unit-I Introduction: Why automation, Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools.

Unit-II Flexible automation: Computer control of Machine Tools and Machining Centers, NC and NC part programming, CNC-Adaptive Control, Automated Material handling. Assembly, Flexible fixturing.


Unit-IV Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC-Adaptive Control Low cost automation: Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies

Unit-V Introduction to Modeling and Simulation: Product design, process route modeling, Optimization techniques, Case studies & industrial applications.

TEXT BOOKS

REFERENCES
1. Yoram Koren, Computer control of manufacturing system, 1st edition

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Understand the basics of CAD/CAM
2. Able to classify NC and CNC
3. Learn the basics of CAD
4. Learn the advanced topics in manufacturing
5. Understand the importance of modeling and simulation
Mapping of COs with POs

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COURSE OBJECTIVES

- To learn about I law for reacting systems and heating value of fuels
- To learn about gas and vapor cycles and their first law and second law efficiencies
- To understand about the properties of dry and wet air and the principles of psychrometry
- To learn about gas dynamics of air flow and steam through nozzles

Unit-I Introduction to solid, liquid and gaseous fuels--Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

Unit-II Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Supercritical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling.

Unit-III Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point. Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.


Unit-V Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Analysis of steam turbines, velocity and pressure compounding of steam turbines.

TEXT BOOKS


REFERENCES

COURSE OUTCOMES
After completing this course, the students will to
1. Learn various types of fuels
2. Understand various practical power cycles and heat pump cycles.
3. Learn the basics of compressible flow
4. Analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
5. Understand the phenomena occurring in high speed compressible flows.

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MECP607 | APPLIED THERMAL LAB | L | T | P | C
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COURSE OBJECTIVES
- To evaluate the performance and emission characteristics of an single cylinder diesel engine
- To conduct performance test on double stage reciprocating air compressor
- To conduct the heat balance test on single and double cylinder diesel engine.
- To understand the usage of different refrigeration tools.

List of Experiments
1. Load Test on Four Stroke Diesel Engine / petrol engine
2. Study and performance test on Air Compressor
3. Heat Balance Test on Four Stroke Diesel Engine
4. Speed test on multi cylinder Four Stroke Diesel Engine
5. Performance test on Refrigeration trainer
6. Trial on Ice Plant
7. Performance test on window air conditioner
8. Performance test on central A/C plant
9. Performance test on heat pump trainer

COURSE OUTCOMES
Upon completion of this practical class, the students will be able to:
1. Learn about the different heat losses in the engine viz., cooling water, exhaust gas and un-accountable losses.
2. To learn about the performance parameter of Diesel and Petrol engine.
3. To learn about the air compressor performance parameters.
4. Understand the basic analysis of any refrigeration system
5. Work as a team to gain knowledge for a lifelong learning.
Mapping of COs with POs

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MECP608 | AUTOMATION LAB | L | T | P | C
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COURSE OBJECTIVES
- To understand the strength of OOPS using c++
- To impart programming skills in C++ programming.
- To provide hands-on experience in developing basic mechanical models and assembly drawing using AUTO CAD.
- To introduce the basics of MAT LAB.

List of Experiment
Search, generate, manipulate data using MS office/ Open Office
Presentation and Visualization – graphs, charts, 2D, 3D
Preliminary Auto CAD 2 D drawing exercise
Auto CAD machine drawing
  Knuckle Joint
  Bushed bearing
  C++, Programming,
  Otto cycle efficiency
  Compressor dimensions
  Simple MATLAB Exercises

COURSE OUTCOMES
Upon completing this course, students should be able to:
1. Attempt the basics in MS office
2. Write and compile programmes in C++
3. Develop assembly drawings with different views using auto cad
4. Exchange file formats between AutoCAD & other analysis packages
5. Solve simple mathematical models using MATLAB.

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SEVENTH SEMESTER

ETHS701 ENGINEERING ETHICS

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COURSE OBJECTIVES

- To understand the moral and ethical dimensions in engineering.
- To take balanced decisions.


**Unit-II** Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.


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

TEXT BOOKS


REFERENCES


COURSE OUTCOMES

Upon the completion of the course, the students will be able to:

1. Understand the relationship between the engineer and the society.
2. Learn the importance of codes in engineering practice.
3. Acquire knowledge on the legal, moral and ethical aspects in engineering.
4. Understand the various rights of engineers
5. Understand the importance of honesty
COURSE OBJECTIVES

- The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
- Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
- The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Unit-I: Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, Composite Medium, critical insulation thickness. Extended surfaces

Unit-II: Lumped system approximation and Biot number, Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

Unit-III: Heat convection, basic equations, boundary layers- Forced convection, external and internal flows-Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Unit-IV: Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann’s law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method. Radiation Shields

Unit-V: Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε-NTU methods. Boiling and Condensation heat transfer, Pool boiling curve. Introduction mass transfer, Similarity between heat and mass transfer.

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
After completing the course, the students will be able to
1. Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer
2. Obtain exact solutions for the temperature variation using analytical methods
3. Design devices such as heat exchangers and also estimate the insulation needed
4. Learn the basics of radiation shields
5. Learn the basics of mass transfer.

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Mapping of COs with POs

MECP706 | HEAT TRANSFER LAB | L | T | P | C
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COURSE OBJECTIVES
- To make the students understand the modes of heat transfer and to conduct the trails on various experiments to analyze the heat transfer parameters.
- To understand the behavior of a system at different operating conditions
- The students will learn the basics of solar energy, how to determine solar intensity, and how to estimate daily and annual solar energy potential at each location
- To evaluate the performance of steam boiler, turbine and condenser.

List of Experiments
1. Experiment on (parallel flow and counter flow) heat exchanger
2. Determination of Stefan-Boltzmann constant
3. Determination of critical heat flux
4. Experiment on composite wall apparatus.
5. Natural convection from vertical cylinder
6. Performance test on Solar air heater
7. Performance test on water heater
8. Performance test on Solar Still
9. Study and performance test on steam boilers
10. Study and performance test on Steam turbines
11. Study and performance test on Reader vertical steam engine.
12. Study and performance test on steam condenser.
COURSE OUTCOMES
Upon completing this course, students should be able to:
1. Calculate the temperature distribution and heat conduction in the metal rod.
2. Evaluate the radiation heat transfer between surfaces.
3. Analyze the performance of heat exchanger.
5. Experimentally determine the performance of a steam boiler, turbine and condenser.

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COURSE OBJECTIVES

- To expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions.
- To have hands-on experience in the students’ related field so that they can relate and reinforce what has been taught at the university.
- To promote cooperation and to develop synergetic collaboration between industry and the university in promoting a knowledgeable society.
- To set the stage for future recruitment by potential employers.

The student has to present a seminar on the chosen topic. However, the student can select a topic duly approved by the Seminar Coordinator and the Head of the Department concerned. The student who has presented the seminar has to submit a report and appear for viva-voce examination at the end of the semester conducted by faculty members nominated by head of the department.

For Industrial training, the student has to undergo training in a reputed industry for 15 days and has to submit a report on completion of the training. The report will be evaluated by a team of faculty members nominated by the head of the department.

COURSE OUTCOME
Upon completion of the Training, students will have the:
1. Ability to work in a team
2. Ability to take initiatives.
3. Ability to effectively communicate solution to problems (oral, visual, written).
4. Ability to manage a project within a given time frame.
5. Ability to apply prior acquired knowledge in problem solving.
EIGHTH SEMESTER

**MEPV803** PROJECT WORK & VIVA VOCE

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**COURSE OBJECTIVES**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

**COURSE OUTCOMES**

Upon completing this course, students should be able to:

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Students will acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
3. Students will acquire collaborative skills through working in a team to achieve common goals.
4. Students will be able to learn on their own, reflect on their learning and take appropriate actions to improve it.
5. Students will acquire the skills to communicate effectively and to present ideas clearly and coherently to specific audience in both the written and oral forms.

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PROFESSIONAL ELECTIVE COURSES

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COURSE OBJECTIVES
- To familiarize with the terminology associated with IC engines.
- To understand the basics of IC engines.
- To understand combustion, and various parameters and variables affecting it in various types of IC engines.
- To learn about various systems used in IC engines and the type of IC engine required for various applications.

UNIT-I - Advanced Engines

UNIT-II – Ideal, Fuel – Air and Actual Cycles

UNIT-III - SI and CI Engine Combustion

UNIT-IV - Fuel Supply Systems

UNIT-V – Auxiliries And Testing Of Ic Engine

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
Upon completing this course, students should be able to:
1. Learn the working of latest engines
2. Understand the various working cycles
3. Understand the combustion phenomenon
4. Study the fuel supply system in a engine
5. Analyze the performance of a engine

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COURSE OBJECTIVES
- To construct various system models and to determine their stability.
- To understand the functions and applications of sensors and transducers.
- To learn the structure of microprocessor and their applications in mechanical devices.


TEXT BOOKS

REFERENCES BOOKS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
1. Design a Mechatronics Systems
2. Handle Microprocessor, PLC and other Electrical and Electronics Circuits.
3. Gain knowledge related to Electronic circuits
4. Learn the functions of actuators
5. Learn the applications of mechatronic systems

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COURSE OBJECTIVES
- To introduce the basic concepts of Digital circuits, Microprocessor system and digital controller
- To learn the programming of Micro Processor.

Unit-I Number Systems, codes, digital electronics: Logic Gates, combinational circuits design, Flip-flops, Sequential logic circuits design: Counters, Shift registers.
Unit-II Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals.

Unit-III Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing.

Unit-IV Assembly Language Programming: Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt controller; Interfacing peripherals: Programmable peripheral interface (8255).

Unit-V Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253); 8086/8088 Microprocessor and its advanced features, Introduction to Digital Control: Sampling theorem, Signal conversion and Processing, Z-Transform, Digital Filters, Implementation of Digital Algorithm.

TEXT BOOKS
1. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited

REFERENCES
3. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
1. Able to perform numerical conversions
2. Learn the basic elements of microprocessor
3. Understand the working of basic 8085 microprocessor
4. Write assembly language programs
5. Provide good idea of the use of microprocessors in automation.

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Mapping of COs with POs
COURSE OBJECTIVES

- To understand the mechanical behaviour of composite materials
- To get an overview of the methods of manufacturing composite materials

Unit-I Definition and applications of composite materials, Fibers-glass, carbon, ceramic and aramid fibers; Matrices-polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices.

Unit-II Lamina-assumptions, macroscopic viewpoint, generalized Hookes law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.

Unit-III Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill’s criterion for anisotropic materials, Tsai-Hill’s criterion for composites, prediction of laminate failure, thermal analysis of composite laminates Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies

Unit-IV Metal Matrix Composites: Characteristics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC. Limitations of MMC, Metal Matrix, Reinforcements particles- fibres. Effect of reinforcement - Volume fraction - Rule of mixtures, Processing of MMC - Powder metallurgy process - diffusion bonding - stir casting, squeeze casting


TEXT BOOKS

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Know the basics of composites
2. Learn the rules for attaining a good composite
3. Understand the various methods of composites manufacture
4. Learn the powder metallurgy technique
5. Learn the properties of ceramic composites
Mapping of COs with POs

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MEPESCN | COMPUTER AIDED DESIGN AND MANUFACTURING | L | T | P | C
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COURSE OBJECTIVES:
- To provide an overview of how computers can be utilized in mechanical component design
- To learn the principles of CAD/CAM.

Unit-I Fundamentals of Computer Graphics- Product cycle, sequential and concurrent engineering, Computer Aided Design, CAD system architecture, computer graphics, Coordinate systems, 2D and 3D transformations, viewing transformation

Unit-II Geometric Modeling- representation of curves, Hermite curves, Bezier curves, B-spline curves, rational curves, Techniques of surface modelling, surface patch, Coons and bicubic patches, Bezier and B-spline surfaces, Solid modelling techniques, CSG and B-rep. Visual realism- hidden line-surface-solid removal algorithms, shading, colouring, computer animation

Unit-III Assembly of parts- assembly modelling, interferences of positions and orientation, tolerance analysis, mass property calculations, mechanism simulation and interference checking CAD standards- Graphical Kernel System (GKS), standards for exchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc., Communication standards


Unit- V Computer Integrated Manufacturing- Flexible Manufacturing system, Group Technology - Part families, part classification and coding - Production flow analysis - machine cells, design automation - Computer aided process planning - IMS components - application-Automated production.

TEXT BOOKS
REFERENCES

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Learn the fundamentals of CAD
2. Use computer and CAD software for modeling mechanical components
3. Check CAD standards
4. Understand the basics of computer aided manufacturing
5. Understand the basics of computer integrated manufacturing

Mapping of COs with POs

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MEPESCN | REFRIGERATION AND AIR CONDITIONING | L | T | P | C
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COURSE OBJECTIVES
- To familiarize with the terminology associated with refrigeration systems and air conditioning
- To understand basic refrigeration processes
- To understand the basics of psychrometry and practice of applied psychrometrics
- To acquire the skills required to model, analyse and design different refrigeration as well as air conditioning processes and components


Unit–II Introduction to Steam Jet Refrigeration, vapour absorption refrigeration and solar refrigeration – (Description only) – performance Analysis of vapour compression cycle – Ideal and actual conditions – Problems – Representation of cycle on p-h and T-s diagram – Properties of refrigerants and their choice for different applications – Eco friendly refrigerant.


Unit-V  Air-conditioning system – classification – Unitary, packaged and central type summer and winter air conditioning systems – (Description only) – merits and demerits – Comfort indices – Air purification – Air-conditioning – Heat gain and load calculations – RSHF, GSHF and ERSXF – energy efficiency in building – Need for reheating.

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
Upon completion of this course the student will able to
1. Understand the components of refrigeration and air conditioning systems
2. Understand the psychrometry of mixture of water vapor and air.
3. Understand the working principles of refrigeration and air-conditioning systems.
4. Understand the need for pure air
5. Know the current trends in HVAC systems

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COURSE OBJECTIVES

- To illustrate the principle of mathematical modeling of engineering problems
- To introduce the basics and application of Finite Element Method

Unit-I Historical Background, Basics of FEA, FEM applications. General field problems in engineering, Modeling — discrete and continuous models, difficulties involved in solution-relevance and place of FEM. Boundary and initial value problems

Unit-II Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method. Simultaneous Linear equation – Gauss elimination, Choleskeys factorization and Gauss seidel iterative methos.

Unit-III One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

Unit-IV Two dimensional equations, variational formulation, finite element formulation, triangular elements shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

Unit-V Natural coordinate systems, isoparametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software.

TEXT BOOKS


REFERENCES


COURSE OUTCOMES

Upon completion of the course, students will be able to

1. Understand the FEM formulation
2. Solve simple structural and thermal problems
3. Formulate problems on natural vibrations
4. Generate problems on torsional objects
5. Introduce software available for analysis
### COURSE OBJECTIVES

- To provide an overview of power plants and the associated energy conversion issues
- To learn the basic components of power plants

**Unit-I** Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

**Unit-II** Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

**Unit-III** Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

**Unit-IV** Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

**Unit-V** Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

### TEXT BOOKS


### REFERENCES


### COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Understand the principles of operation of coal based power plant
2. Learn the working of gas power plants
3. Basics of nuclear reactors
4. Understand various non-conventional power plants
5. Gain knowledge on power plant economics.

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**COURSE OBJECTIVES**

- To understand the features of compressible isentropic flows and irreversibilities like shocks.
- To provide a basic knowledge of jet and rocket propulsion technologies.

**Unit-I** Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow

**Unit-II** Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows.

**Unit-III** Normal shock relations, oblique shock relations, isentropic and shock tables

**Unit-IV** Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

**Unit-V** Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights.

**TEXT BOOKS**


**REFERENCES**


**COURSE OUTCOMES**

Upon completion of this course, the students will be able to

1. Understand the basics of gas dynamics
2. Learn the basics of non-isentropic flow
3. Understand the need for shocks
4. Learn the operating principle of jet operation
5. Apply gas dynamics principles to jet and space propulsion systems

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**COURSE OBJECTIVES**
- To introduce process planning concepts to make cost estimation for various products
- To learn the basics of cost estimation.

**Unit-I** Introduction of Process Planning- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection

**Unit-II** Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies

**Unit-III** Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost

**Unit-IV** Machining time estimation- importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planing and Grinding

**Unit-V** Production costs- different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost

**TEXT BOOKS**

**REFERENCES**

**COURSE OUTCOMES**
Upon completion of this course, the students will be able to
1. Understand the basics of process planning
2. Detain economics of process planning
3. Learn the economics of cost estimation
4. Calculate machining time
5. Calculate production cost

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**Mapping of COs with POs**

**COURSE OBJECTIVES:**
- To understand the principles of management and their application to the functioning of an organization
- To learn the purpose of planning and Organizing

**Unit-I** Definition of management, science or art, manager vs entrepreneur; Types of managers-managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

**Unit-II** Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.

**Unit-III** Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.

**Unit-IV** Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

**Unit-V** Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

**TEXT BOOKS**
REFERENCES

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Gain knowledge on the current trends in management
2. Learn the purpose of planning
3. Understand the need for organizing
4. Learn various leadership theories
5. Apply computers in management for an effective organization

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COURSE OBJECTIVES
- To understand the construction and working principle of various parts of an automobile
- To learn the present scenario of Indian Automotive industry.

Unit-I Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines-components, function and materials, variable valve timing (VVT). Present Scenario of Indian Automotive industry.

Unit-II Engine auxiliary systems, electronic injection for SI and CI engines, Unit-injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

Unit-III Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, Over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

Unit-IV Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

Unit-V Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, Electric and Hybrid vehicles, application of Fuel Cells in automobiles.
TEXT BOOKS

REFERENCES

COURSE OUTCOMES
Upon completion of this course, students will be able to
1. Gain the basics of automobile
2. Learn the fuel injection systems used in CI and SI engines
3. Learn the transmission systems
4. Learn various braking systems used in automobiles
5. Gain knowledge in the present trends in automobiles.

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COURSE OBJECTIVES

- To gain knowledge on the principles and procedures for the design of power transmission components.
- To understand the standard procedure available for Design of transmission systems.
- To learn to use standard data and catalogues.


Unit–II Belt Drives of flat belts, V-Belts using manufacturer's table - Matched set of V-Belts, Chain drives for Power transmission design procedure.


Unit–V Gear Box: Standard Step ratio - Speed diagram - Kinematics layout - Design of six speed, twelve speed, eighteen speed gear box - calculation of actual speed.

TEXT BOOKS

REFERENCES

COURSE OUTCOMES

Upon completion of this course, the students will be able to:
1. Develop knowledge on the functions of various transmission elements.
2. Understand prerequisite for design of various transmission components.
3. Implement the basic engineering knowledge.
4. Work in the design team analyzing difficulties.
5. Design and develop solutions of various elements.
## COURSE OBJECTIVES

- To facilitate the understanding of total quality management principles and processes
- To understand the various tools and techniques of TQM.

### Unit-I
Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

### Unit-II
TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

### Unit-III
The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Benchmarking process; FMEA- stages, types.

### Unit-IV
TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

### Unit-V
Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

### TEXT BOOKS

### REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Learn the basics of TQM
2. Understand the principles of TQM
3. Understand six sigma concept
4. Learn the tools and techniques of TQM
5. Know quality standards

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Mapping of COs with POs

COURSE OBJECTIVES
- To understand the energy data from industries and carry out energy audit for energy savings
- To understand the world energy scenario.

Unit-I Introduction to energy & power scenario of world, National Energy consumption data, environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.

Unit-II Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.

Unit-III Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.

Unit-IV Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration & Air Conditioning systems, Cooling Towers, DG sets.

Unit-V Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

TEXT BOOKS
REFERENCES

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Understand the world power scenario
2. Learn the scope for energy conservation
3. Perform energy audit in thermal systems
4. Perform energy auditing for the energy consumption of industries.
5. Learn the energy economics

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COURSE OBJECTIVES
To impart knowledge to students in about an overall understanding of Automobile Engineering and to understand

- Classification and layouts of different vehicles
- Different types of Engines in use
- Different types of clutch, gear box and transmission used
- Different types of brakes, drivelines and wheels and tyres

Unit-I - Vehicle Classification and Layouts
Study various vehicle layouts as front engine & front wheel drive, front engine & rear wheel drive, rear engine & rear wheel drive. Classification based on controls positioning. Types of Chassis frames & construction of Chassis frame and vehicular Body

Unit-II - Engine Types (Based on Fuel Used)
Gasoline, Diesel, LPG, CNG, Bio-Diesel (Basic study)

Unit-III - Clutch, Transmission and Brakes
Functions and type of clutches, single plate, multiple plates, centrifugal. Vehicle motion, resistances during motion, accelerated and constant velocity motions, tractive force, gradeability, power required and engine characteristics, gear ratio requirement. Manual Gear Boxes - Sliding mesh, constant mesh, synchromesh, epicyclical gear boxes, gear ratios, Automatic transmission. Service Brakes - Function, Internal expanding brakes, shoes and lining material, properties, hydraulic braking system, brake oil, bleeding of brakes, pneumatic braking system and vacuum brakes. Auxiliary Brakes - Exhaust brakes, parking brake.
Unit-IV - Steering, Front Axle and Suspension
Steering requirements, steering gears box types, steering system and linkages, steering geometry, wheel alignment, toe-in, toe-out, caster, camber, power steering. Purpose of front and rear suspension, types of suspension system, coil spring, leaf spring, torsion bars, shock absorbers, air suspensions, independent suspension and McPherson strut.

Unit-V - Drive Line, Rear Axles and Wheels and Tyres
Propellers shaft, final drive types, Bevel, hypoid, Drive axles & differential, fully or semi-floating and three quarter floating, dead axle. Types of wheel, rims, tread patterns of tyre, tubeless tyres, specifications of tyres.

TEXT BOOKS

REFERENCES
2. Donald L Anglin, William H Crouse.

COURSE OUTCOMES
Upon completion of this course, students will be able to
1. Gain the basics of automobile
2. Learn the fuel injection systems used in CI and SI engines
3. Learn the transmission systems
4. Learn various braking systems used in automobiles
5. Gain knowledge in the present trends in automobiles.

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COURSE OBJECTIVES
The course should enable the students to:
- Know about the basics about the vehicle
- Understand the safety aspects in the vehicle.
- Know and understand the various safety aspects.
- To get the knowledge in sensors provided in the vehicle to avoid the crash and to detect the defects in the vehicle.

Unit-I Introduction

Unit-II Passive Safety Concepts
Unit-III Passive Safety Equipments and Convenience System
Seat belt, Seat belt tightener system and importance, collapsible steering column. Air bags and its activation. Designing aspects of automotive bumpers and materials for bumpers. Steering and mirror adjustment, central locking system, Tire pressure control system, rain sensor system, automated wiper system.

Unit-IV Active Safety
Antilock braking system, Stability Control. Adaptive cruise control, Lane Keep Assist System, Collision warning, avoidance system, Blind Spot Detection system, Driver alertness detection system.

Unit-V Vehicle Integration and Navigation System

TEXT BOOKS

REFERENCES
5. ARAI Safety standard

COURSE OUTCOMES
The students should be able to:
1. Importance of safety in a automobile.
2. Know about the concept of crumble zone, and also the effect of acceleration and deceleration of the vehicle in the compartment of the vehicle.
3. Know the various types of safety aspects such as active and passive safety, the active safety components and the working passive safety components such as air bags, seat belts
4. Know the working of the compartment while moving of the vehicle, about the collapsible steering and tiltable steering column, about the collision avoidance system, front and rear object detection.
5. Know about the rear vehicle detection system, and the braking system, the comfort and convenience system for the vehicle such as central locking system, garage door opening system and about the environment information system.

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<th>MEOESCN</th>
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COURSE OBJECTIVES
- To understand the basic concept of Hybrid, Electric Vehicles, energy Storage devices and controls.
- To learn the various energy storage devices
**Unit-I Introduction to Need for Alternative System**

**Unit-II Energy Storage Devices and Fuel Cells**
Electromechanical batteries- types of batteries –lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency and ultra-capacitors.
Fuel Cell- Fuel cell characteristics- Fuel cell types-Hydrogen fuel cell- Connecting cell in series-water management in the PEM fuel cell- Thermal Management of the PEM fuel cell

**Unit-III Electric Vehicles**
Electric vehicle layout, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system, safety and challenges in electric vehicles.

**Unit-IV Hybrid Vehicles**
Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, hybrid electric drive train design, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles.

**Unit-V Propulsion Motors and Controllers**
Types of electric motors – working principle of AC and DC motors. Characteristic of shunt, series and compound type of DC motors- permanent magnet and separately exited DC motors. AC single phase and 3-phase motor – inverters – DC and AC motor speed controllers.

**TEXT BOOKS**

**REFERENCES**

**COURSE OUTCOMES**
Upon completion of this course, students will have deep knowledge on
1. Need for alternative systems
2. Basic of hybrid and electric vehicles
3. Different energy storage devices
4. Concepts of hybrid electric drive train
5. Electric motors and controllers
COURSE OBJECTIVES

- To impart knowledge about various computational methods for fluid flow and heat transfer problems so as to enable the students to write computer programs for solving elementary fluid dynamics/heat transfer problems.
- Students will be exposed to governing equations required for CFD and their mathematical behavior.
- Students will be exposed to modeling of Fluid flow and heat transfer problem.

Unit-I - Governing Equations
Introduction — Various applications of CFD, Governing equations—continuity, momentum, energy equations, Boundary conditions

Unit-II - Fundamentals of Discretisation
Basics of FDM, FVM, FEM. Revision of Numerical Methods. Discretisation of Computational Domain

Unit-III - One Dimensional Unsteady State Problems

Unit-IV - Introduction to Convection
Upwind Differencing, False Diffusion, Significance of Peclet number.

Unit-V - Algorithms in CFD
Simple, Flow chart for Simple, Predictor-Corrector Methods, MAC Algorithm, TERM PROJECT.

TEXT BOOK

REFERENCES

COURSE OUTCOMES
At the end of the course student can able to
1. Gain deep knowledge on the governing equations used in CFD
2. Understand the fundamentals of CFD
3. Able solve simple problems
4. Understand various algorithms used
5. Able to solve problems in CFD
COURSE OBJECTIVES
To understand the basics of finite element analysis and its applications in engineering and to familiarize the

- Basics of Finite Element analysis
- Weighed Residual Methods for static analysis
- Different elements like truss, beam, triangular, quadrilateral and brick elements.
- Analysis of one dimensional and two dimensional problems with the help of software.

Unit-I - Introduction to Finite Element Analysis
Basics of FEA, historical background, FEM applications. General field problems in engineering. Modeling — discrete and continuous models, difficulties involved in solution- relevance and place of FEM. Boundary and initial value problems.

Unit-II - Calculus of Variations
Variational formulation in finite elements, Weighted residual methods-Galerkin method, sub domain method, method of least square and collocation method, numerical problems.

Unit-III - Static Analysis
General procedure of FEM, skeletal and continuum structures, descritization of domain, basic types of elements- truss, beam, triangular, quadrilateral and brick elements- shape functions, Rayleigh and Ritz method, formulation of element stiffness matrices -Isoparametric elements.

Unit-IV - Finite Element Analysis of One Dimensional Problems
One dimensional second order equations-generalized coordinate approach, derivation of element equation- assembly of element equation- imposition of boundary conditions- solution of equation- Cholesky method- extension of the method to fourth order equation- time dependent problems from heat transfer and solid mechanics-heat transfer through simple fins, composite wall, bending of beams.

Unit-V - Finite Element Analysis of Two Dimensional Problems
Global and natural coordinates, second order equations involving scalar valued function- model equation - variational formulation - finite element formulation through generalized coordinate approach — convergence criteria for chosen models interpolation functions- element matrices-problems on bending of plates and heat transfer in two dimensions.

TEXT BOOKS

REFERENCES
COURSE OUTCOMES
At the end of the course student can able to
1. Gain the basics of finite element analysis
2. Formulate problems in FEA
3. Understand the procedure of FEM
4. Analyze one dimension and two dimension problems
5. Understand the subject for a lifelong learning

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COURSE OBJECTIVES
• To effectively manage energy in buildings
• To learn the basics of natural ventilation and air conditioning
• To determine the various building loads

Unit-I Introduction
requirement analysis – Future building design aspects – Criticality of resources and needs of
modern living

Unit-II Landscape and Building Envelopes
Energy efficient Landscape design - Micro-climates – various methods – Shading, water bodies-
Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints,
Insulation, Design methods and tools.

Unit-III Heating, Ventilation and Air-Conditioning
Natural Ventilation, Passive cooling and heating - Application of wind, water and earth for cooling,
evaporative cooling, radiant cooling – Hybrid Methods – Energy Conservation measures, Thermal
Storage.

Unit-IV Heat Transmission in Buildings
Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall
and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Solar temperature;
Decrement factor; Phase lag. Design of daylighting; Estimation of building loads: Steady state
method, network method, numerical method, correlations; Computer packages for carrying out
thermal design of buildings and predicting performance.

UNIT-V Passive Cooling & Renewable Energy in Buildings
Passive cooling concepts: Evaporative cooling, radiative cooling; Application of wind, water and
earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air
tunnel. Introduction of renewable sources in buildings, Solar water heating, small wind turbines,
stand-alone PV systems, Hybrid system – Economics.

TEXT BOOKS
REFERENCES

COURSE OUTCOMES
Upon completion of the course, students will be able to
1. Understand the needs for modern living
2. Select proper materials for an effective energy management
3. Effectively manage energy in buildings
4. Understand the basics of HVAC system
5. Calculate the various building loads effectively

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COURSE OBJECTIVES
- To emphasize the current energy status and role of renewable energy sources.
- To familiarize various aspects of Solar energy and utilization
- To familiarize various aspects of Biomass energy and utilization
- To familiarize other renewable energy sources

Unit-I – Introduction

Unit-II - Solar Energy

Unit-III - Wind Energy
Introduction-Availability- Wind power plants, Power from the wind, Wind energy conversion systems, site characteristics, Wind turbines types – Horizontal and vertical axis-design principles of wind turbine – Blade element theory, Magnus effect- Performance. Wind energy Applications – Hybrid systems, Wind energy storage, Safety and environmental aspects.

Unit-IV - Biomass Energy

Unit-V - Other Renewable Energy Sources
TEXT BOOKS

REFERENCES

COURSE OUTCOMES
Upon completion of the course, students will be able to:
1. Emphasis the current energy status and role of renewable energy sources.
2. Understand the various aspects of Solar energy and its utilization
3. Realize the significance of wind energy
4. Understand the bio energy conversion techniques
5. Learn the renewable energy resources

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<td>• To learn various pollution norms</td>
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<td>• To learn the various methods to curtail industrial pollution</td>
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<td>• To learn the principles of water treatment</td>
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Unit-I - Sustainability
Industrial activity and environment, industrialization and sustainable development indicators of sustainability-sustainability strategies. Barriers to sustainability, Pollution prevention in achieving sustainability

Unit-II - Environmental Regulations
Prevention vs control of industrial pollution, Environment policies and Regulations to encourage pollution prevention, Environment friendly chemical processes, Regulations for clean environment and implications for industries

Unit-III - Pollution
Definition of pollutant, types of pollution; Air, Water, Land, noise- adverse effects of pollutants eco system and human health - need for effluent treatment and toxicity, control. Water standards for portable, agricultural and left-off streams- air standards for cities, industrial areas, resorts.
Unit-IV - Air Pollution Control Methods

Unit-V - Principles of Water Treatment
Primary, secondary and tertiary treatments - advanced waste water treatments; recovery of metals from process effluents

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
Upon completion of the course, students will be able to
1. Know the various methods available to suppress industrial pollution
2. Know the effects of water and air pollution
3. Know the various environmental regulations
4. Know the methods of mitigating air pollution
5. Know the basic principles of water treatment

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COURSE OBJECTIVES
- To enable the student to gain a fair knowledge on various power plants & their related instruments.
- To get detailed knowledge on thermal power plant.
- To learn the measurements of various parameter in power plant and their control.

Unit-I - Overview of Power Generation
Brief survey methods of power generation hydro, thermal, nuclear, solar and wind power- Importance of instrumentation in power plants –Layout of Thermal power plant – Complete layout of Boiler and Turbine – Process and instrumentation diagram of thermal power plant – distributed digital control system in power plants.

Unit-II - Measurements in Power Plants
Use of transducers in electrical measurements-current, voltage, power, power factor - function of synchroscope – measurement of non-electrical parameters – flow of feed water, fuel, air and steam - measurement of steam pressure and temperature – Drum level measurement.
Unit-III - Analysers in Power Plants

Unit-IV - Control Loops in Boiler
Combustion control – air/fuel ratio control- furnace draft control – drum level control – steam temperature control and attemperation –super heater control - Deaerator control - interlocks in boiler operation. UNIT-V - TURBINE

Unit-V - Turbine Monitoring and Control
Speed measurement, vibration and eccentricity measurement, shell temperature monitoring and control – lubricating oil temperature control – cooling system, protection and interlocks in turbines.

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
Upon completion of the course, students will be able to
1. Gain detailed knowledge on thermal power plant.
2. Learn the measurements of various parameter in power plant and their control.
3. Understand the use of various analyzers in power plant
4. Know the various controls used in power plants
5. Learn the methodology of controlling turbines

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COURSE OBJECTIVES
- To study the basics of fluid power systems
- To learn the various hydraulic and pneumatic systems
- To study the applications of hydraulic and pneumatic systems

Unit-I - Basics of Fluid Power Systems

Unit-II - Hydraulic Valves and Actuators
Unit-III - Pneumatic Systems and Components

Unit-IV - Design of Hydraulic and Pneumatic Circuits
Fluid Power Circuit Design- Speed control, synchronizing, Sequential circuit design for simple applications using cascade method. Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Accumulators: Types, application circuits, sizing of accumulators, Intensifier circuit.

Unit-V - Application, Maintenance and Trouble Shooting

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
Upon completion of the course, students will be able to
1. Understand the basics of fluid power systems
2. Learn the working of various hydraulic and pneumatic systems
3. Realize the applications of hydraulic and pneumatic systems
4. Design hydraulic circuits
5. Trouble shoot hydraulic devices
COURSE OBJECTIVES
- To study the basics of thermodynamics
- To learn the various gas power cycles
- To study the basics of heat transfer and refrigeration

Unit-I - Basic Concepts of Thermodynamics
System - Ideal gas laws - Perfect gas, thermodynamic equilibrium, property, state, process, path and cycle, zeroth law of thermodynamics - Point and path functions - Quasi static process, reversible and irreversible processes. First law of thermodynamics, energy, work, heat, PMM I, applications of First law to closed and open systems. Pressure - Volume diagrams, steady flow process, application of steady flow energy equation.

Unit-II - Second Law of Thermodynamics
Limitations of first law, statements of second law of Thermodynamics, PMM II, Clausius inequality, heat engine, heat pump, refrigerator, Carnot cycle, Carnot theorem, entropy, temperature - Entropy diagram, entropy changes for a closed system. Third law of thermodynamics.

UNIT-III - Gas Power Cycles
Otto, Diesel, dual cycles: Efficiency, mean effective pressure, comparison. Introduction to Brayton cycle - Reheat and regeneration.

Unit-IV - Refrigeration and Air-Conditioning

Unit-V - Heat Transfer

TEXT BOOKS

REFERENCES
COURSE OUTCOMES
Upon completion of the course, students will be able to
1. Know the basics of thermodynamics
2. Understand the various laws in thermodynamics
3. Learn the various gas power cycles and their applications
4. Understand the basics of refrigeration and air conditioning
5. Understand the various modes of heat transfer

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COURSE OBJECTIVES
- To familiarize various forms of energy
- To understand energy management concepts
- To learn the methods of energy audit and usage of instruments
- To analyze and report the outcome of energy audit

Unit-I - Fundamentals of Energy
Basics of energy and its various forms: Conventional and non-conventional sources. Different fuels and its energy contents. Renewable energy - solar energy, wind energy, bio energy, hydro energy, geothermal energy, wave energy, tidal energy and OTEC.

Unit-II - Energy Management
Energy management- various approaches, cost effectiveness, bench marking, optimization of energy requirement and maximization of system efficiencies. Fuels and energy substitution.

Unit-III - Energy Audit
Energy audit – need, preliminary audit, detailed audit, methodology and approach. Instruments for audit, monitoring energy and energy savings.

Unit-IV - Assessment and Reporting
Evaluation of saving opportunities – determining the savings in INR, non-economic factors, conservation opportunities, estimating cost of implementation.

Unit-V Energy Audit Reporting - the plant energy study report, importance, effective organization, report writing and presentation.

TEXT BOOKS
1. Energy Management Audit & Conservation by Barun Kumar De Publisher: Vrinda Publications 2007

REFERENCES
1. Energy Management: W.R.Murphy, G.Mckay (Butterworths).
COURSE OUTCOMES
Upon completion of the course, students will be able to
1. Gain knowledge on the fundamentals of energy
2. Understand various energy management concepts
3. Learn the methods of energy audit and usage of instruments
4. Assess the saving opportunities
5. Analyze and report the outcome of energy audit

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COURSE OBJECTIVES
To encourage the students to learn
- Energy conservation principles.
- Energy conservation in steam systems.
- Energy conservation in fluid flow machinery.
- Electrical energy conservation measures.

Unit-I - Energy Conservation Principles
Energy scenario, principles of energy conservation, resource availability, energy savings, current energy consumption in India, roles and responsibilities of energy managers in industries.

Unit-II - Energy Conservation in Steam Systems
Power plant components, conservation measures in steam systems, losses in boiler, methodology of upgrading boiler performance - blow down control, excess air control, pressure reducing stations, condensate recovery, condensate pumping, thermo compressors, recovery of flash steam, air removal and venting, steam traps, cooling towers.

Unit-III - Energy Conservation in Fluid Machinery
Centrifugal pumps, energy consumption and energy saving potentials, design consideration, minimizing over design. Fans and blowers - specification, safety margin, choice of fans, controls and design considerations. Air compressor and compressed air systems, selection of compressed air layout, energy conservation aspects to be considered at design stage.

Unit-IV - Electrical Energy Conservation
Potential areas for electrical energy conservation in various industries, conservation methods, energy management opportunities in electrical heating, lighting system, cable selection, energy efficient motors, factors involved in determination of motor efficiency, adjustable AC drives, variable speed drives, energy efficiency in electrical system.

Unit-V - Energy Management
Organizational background desired for energy management persuasion, motivation, publicity role, tariff analysis, industrial energy management systems, energy monitoring, auditing and targeting, economics of various energy conservation schemes – energy policy and energy labeling.

TEXT BOOKS
REFERENCES

COURSE OUTCOMES
Upon completion of the course, students will be able to
1. Learn the energy conservation principles
2. Know the modes of energy conservation in steam systems
3. Identify methods for energy conservation in a hydraulic system
4. Understand the electrical conservation measures.
5. Learn the concepts of energy management

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COURSE OBJECTIVES
- To learn the operation of solar thermal energy systems
- Study of solar thermal power plants
- To study the components of solar photovoltaic power plants
- Utilization of solar energy in buildings

Unit-I - Solar Radiation
Sun and earth geometry, solar radiation-beam and diffuse radiations, measurement of solar radiation – pyranometer, pyrheliometer, sunshine recorder. Solar collectors and applications.

Unit-II - Solar Thermal Systems
Flat plate and evacuated tube collectors, domestic hot water and process heat systems, solar cooker, solar dryer, solar desalination and solar pond.

Unit-III - Solar Power Plant
Principles of solar parabolic concentrators-trough and dish types, compound parabolic concentrators, fresnel lens collectors, central receiver plant, direct steam generation systems, solar furnaces.

Unit-IV - Solar Photovoltaics
Solar photovoltaic theory, mono and polycrystalline silicon technologies, PV modules and integrated systems, implementation and maintenance.

Unit-V - Solar-Conscious Buildings
Orientation and design of buildings, passive solar heat- thermal capacity, insulation, solar cooling-refrigeration and air-conditioning, space heating, sensible and latent heat energy storages in buildings.

TEXT BOOKS
REFERENCES

COURSE OUTCOMES
Upon completion of the course, students will be able to
1. Understand the basic components and measuring devices
2. Know the operation of solar thermal energy systems
3. Understand the components of solar power plants
4. Emphasize the advantages of photovoltaic power plants
5. Learn the methods to effectively utilize solar energy in buildings

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COURSE OBJECTIVES
- It deals with the difference cogeneration schemes and techno economics of cogeneration.
- It introduces difference ways heat recovery systems and thermodynamics aspects of waste heat recovery.

Unit–I Co-Generation:
Introduction-principles of thermodynamics, combined cycles, topping, bottoming, organic rankine cycles, advantages of cogeneration technology.

Unit–II Application and Techno Economics Of Cogeneration:
Cogeneration application in various industries like cement, sugar mill, paper mill etc. Sizing of waste heat boilers-performance calculations, part load characteristics, selection of co-generational technologies-financial considerations- operating and investments-costs of co-generation.

Unit–III Waste Heat Recovery
Introduction-principles of thermodynamics and second law- sources of waste heat recovery-diesel engines and power plant.

Unit–IV Waste Heat Recovery Systems
Recuparators, regenerators, economizers plate heat exchangers. Waste heat boilers-classification, location, service conditions and design considerations. Unfired combined cycle, supplementary fired combined cycle, fired combined cycle.

Unit–V Applications And Techno Economics
Applications in industries-fluidized bed heat exchangers, heat pipe exchangers-heat pumps and thermic fluid heaters. Selection of waste heat recovery technologies-financial considerations, operations and investment costs of waste heat recovery.
TEXT BOOKS

REFERENCES

COURSE OUTCOMES
Upon completion of the course, students will be able to
1. Learn the significance of co-generation
2. Understand the economics of co-generation
3. Learn the thermodynamics of waste recovery
4. Learn the various systems used for waste heat recovery
5. Familiar with the economics of waste heat recovery

Course Objectives
- To develop your ability in formulating suitable maintenance strategies to achieve reliable a manufacturing system and achieve continuous system availability for production.
- To equip you with essential system diagnosis techniques so that you can identify and take appropriate actions on error symptoms and causes of failures.
- Apply safe working practices and understand the principles of preventive and first-line maintenance.
- Understand the principles of power transmission systems; remove and refit bearings, keyed shafts, belts & chains; install & align shafts; tension drive train components and to empower you with the skills to manage manufacturing system and man safely.

Unit–I Need for Maintenance - Types of maintenance - Maintenance organisation charts for large, medium and small size plants - Basic functions of maintenances. Preventive maintenance - Need for preventive maintenance - Starting of preventive maintenance programme - Equipment record - Check list - Inspection - What to inspect - Frequency of inspection aids to good preventive maintenance.

Unit–II Maintenance of Ball, Roller and Tapered Bearing - Maintenance of Belt, Chain, Gears, Pulleys, Shafting and Fasteners.


Unit–IV Devices for safeguarding machines - points to be considered in designing the guards - Enclosures, covers and barricades - Safeguarding of fast and loose pulleys, chain and rope drives,
revolving machines, pressure plates and self acting machines - Remote tripping and starting devices.

**Unit–V** Safety Engineering - Accident Prevention - Various steps to accomplish accident prevention - Safety measures and safety precaution in workshops - Protection of eyes - Protection against dangerous fumes - Protection against fire - Wage incentive to satisfy workman compensation.

**TEXT BOOKS**
1. Morrow, Industrial Maintenance

**REFERENCES**

**COURSE OUTCOMES**
Upon completion of the course, students will be able to
1. Understand the various types of maintenance
2. Understand the relationship of key concepts in reliability engineering and application to maintenance strategies in a manufacturing environment.
3. Learn the maintenance technique for mining equipments
4. Establish maintenance strategies according to system characteristics and design transition programs to implement these strategies.
5. Manage the manufacturing organization with highest possible availability with safety.

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**COURSE OBJECTIVES**
- To create awareness on air pollution due to I.C. engines and its effects on human health.
- To study the different emission formation mechanism of engines.
- To study the methods of reducing or eliminating the harmful gases from engine.
- To study the different norms and legislations to put a check over the air pollution.

**Unit–I** Atmospheric pollution from internal combustion engines– Global warming – Green house effect- Sources of automotive pollution – effects of pollutions on health and environment – fuels – types of hydrocarbons-properties of fuels and testing, fuel additives.

**Unit–II** Pollution formation mechanism- SI and CI engine– oxides of nitrogen, Zeldovich mechanism, carbon monoxide, hydrocarbon formation and different types of smoke, smog, particulate emission, soot formation.

Unit–IV Emission measurements-Non dispersive infrared gas analyser, gas chromatography, Chemiluminescent analyser and flame ionisation detector – smoke measurement – Particulate measurement – high volume sampler – micro dilution tunnel – noise measurement and control.

Unit–V Fuel modification-GDI, HCCI and CRDI-driving cycles for emission measurement – chassis dynamometer – constant volume sampling (CVS) system – National and international emission norms, driving cycles.

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
1. Learn the sources of pollution from IC engines
2. Understand the various types of engine pollution.
3. Learn the various mechanisms of emission control.
4. Know the various emission measuring equipments.
5. Acquire the knowledge of emission standards and fuel modification in engines.
HONOURS ELECTIVE COURSES

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COURSE OBJECTIVES

- To impart fundamental mathematical concepts related to computational heat transfer.
- To impart fundamental mathematical concepts about fluid flow and heat transfer.
- To train students in the usage of computational codes and develop new ones.

Unit-I

Unit-II Applications in Heat Condition and Convection

Control Volume Approach - Steady and Unsteady One Dimensional Conduction - Two and Three Dimensional Situations - Solution Methodology.

Unit-III Convection and Diffusion

Upwind Scheme - Exponential Scheme. Hybrid Scheme - Power Law Scheme : Calculation of the Flow Field - Simpler Algorithm.

Unit-IV Finite Element Method Concept

Unit-V

TEXT BOOKS
REFERENCES

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<th>MEHE SCN</th>
<th>STEAM ENGINEERING</th>
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COURSE OBJECTIVES
- To impart the basics of steam engineering
- To impart knowledge on various boiler codes
- To study the methods to analyse the boiler performance

Unit-I: Introduction-Fundamentals of steam generation, Quality of steam, Use of steam table, Mollier Chart Boilers, Types, Mountings and Accessories, Combustion in boilers, Determination of adiabatic flame temperature, quantity of flue gases, Feed Water and its quality, Blowdown; IBR, Boiler standards

Unit-II: Piping & Insulation-Water Line, Steam line design and insulation; Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria, Refractory-types, selection and application of refractory, Heat loss.

Unit-III: Steam Systems Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Steam Engineering Practices; Steam Based Equipments / Systems.

Unit-IV: Boiler Performance Assessment-Performance Test codes and procedure, Boiler Efficiency, Analysis of losses; performance evaluation of accessories; factors affecting boiler performance.

Unit-V: Energy Conservation and Waste Minimization- Energy conservation options in Boiler; waste minimization, methodology; economical viability of waste minimization - Instrumentation & Control Process instrumentation; control and monitoring. Flow, pressure and temperature measuring and controlling instruments, its selection

TEXT BOOKS:
1. T. D. Estop, A. McConkey, Applied Thermodynamics, Parson Publication
2. Domkundwar; A Course in Power Plant Engineering; Dhanapat Rai and Sons.

REFERENCES:
2. Book II - Energy Efficiency in Thermal Utilities; Bureau of Energy Efficiency
4. P. Chatopadhyay; Boiler Operation Engineering: Questions and Answers; Tata McGraw Hill Education Pvt Ltd, N Delhi
COURSE OBJECTIVES

- To explore recent trends, combustion modes and add on devices of automotive engines persisting in transportation system.
- To reveal formation of pollution strategies of emission and control in in-cylinder combustion and after burn conditions.
- To understand measurement of exhaust emission using chassis dynamometer and trends in vehicle emission standards.

Unit-I Advanced Engines

Unit-II SI and CI Engine Combustion

Unit-III Pollutant Formation
Pollutant formation in SI Engine - Unburned HC formation - HC oxidation in the cylinder and exhaust - exodus of HC contribution of different sources - Flame quenching in SI engines kinetics of NO and NO2 formation – CO and CO2 – Pollutant formation in CI Engines Formation of HC in CI engines – effect of nozzle design and other variable - NO and NO2 formation in premixed and diffusion combustion periods. Formation of CO and kinetic effects - effect of engine variables - Composition of particulates - soot formation - soot structure - stoichiometric considerations, nucleation, growth and oxidation

Unit-IV Emission Control Systems
Strategies for emission control - emissions control inside the engine - EGR, crankcase and evaporative emission control - Exhaust gas after treatment - thermal and catalytic reactors - elements of reactors, catalysts and substrates – oxidation and reduction – Three way catalytic reactors - closed loop feedback control - catalyst deactivation mechanism - cold start HC control - Lean de-NOx catalysts - NOx traps and SCR- Diesel particulate filters (DPF) - DPF regeneration

Unit-V Measurement of Emissions
Measurement of emissions - instrumentation for CO, HC, NOx, PM and smoke emissions - chassis dynamometer – isokinetic sampling - constant volume sampling (CVS) system – development of driving cycles – driving cycle tests procedures – European, US and Japan driving cycles - trends in vehicle emission standards - emission limits - national and international emission norms
TEXT BOOKS

REFERENCES

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COURSE OBJECTIVES
• Familiarizing with management, especially with management in energy sector engineering.
• Fundamentals of product strategy management. Studying methods of energy accounting and energy auditing in energy sector, industry and final consumption.
• Finding opportunities to increase the rational use of energy.


Unit-V: Energy Management: Importance of Energy Management, Energy Economics - Discount Rate, Payback Period, Internal Rate of Return, Life Cycle Costing (5)

TEXT BOOKS
REFERENCES

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COURSE OBJECTIVES
- This course introduces to the students the different types of vibrations,
- To learn the causes of vibrations and means of damping it out.

**Unit-I Single Degree Freedom:**

**Unit-II Forced Vibration** - constant harmonic excitation – effect of rotating and reciprocating unbalance – Vibration isolation and transmissibility – vibration measuring instruments.

**Unit-III Two degree of Freedom Systems:**
Principal modes of Vibration -spring mass system. -Double pendulum two rotor system – Vibration of geared systems –combined rectilinear and angular modes-undamped dynamic vibration absorber.

**Unit-IV Multi degree freedom systems** – influence numbers and Maxwell’s reciprocal theorem – Matrix method - stiffness matrix, dynamic matrix– Natural frequencies and principal modes by matrix iteration.


**TEXT BOOKS**
2. V. Ramamurthi, Mechanical Vibration Practice With Basic Theory- Narosa Publishing house, 2000

REFERENCES
1. TSE S. Morse Ivan & Hinkle T., Mechanical Vibrations, PHI
COURSE OBJECTIVES

- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT-I Fundamentals of Robot
Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT-II Robot Drive Systems and End Effectors
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, 90 Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT-III Sensors and Machine Vision

UNIT-IV Robot Kinematics and Robot Programming
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT-V Implementation and Robot Economics
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots. PERIODS Upon completion of this course, the students can able to apply the basic engineering

TEXT BOOKS
REFERENCES

MINOR ELECTIVES COURSES

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<th>MEMI SCN</th>
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COURSE OBJECTIVES

To make the student understand the basic concepts and applications of the following. Basics and fundamental laws of Thermodynamics.

- Properties of steam
- Internal combustion engines.
- Heat transfer, refrigeration and air conditioning.
- Metrology and mechanical measurements.

Unit–I: Thermodynamics Basic concepts of thermodynamics - System properties, state and equilibrium - Process and cycle - Work - Heat and other forms of energy - Zeroth law and application - First law - Statements - Applications to closed and open systems - General energy equation and application - Second law - Statements - Reversibility, Carnot cycle and theorems - Clausius inequality - Concept of entropy - Availability and irreversibility.


Unit–IV : Refrigeration - Units of refrigeration - Refrigerants and their properties - Types of refrigeration system - Air, vapour compression and vapour absorption systems - simple problems in Air and Vapour compression only – Psychometric and Psychometric processes. Air conditioning - Summer and winter air conditioning.

TEXT BOOKS

REFERENCES

MEMI SCN | INSTRUMENTATION AND CONTROL | L | T | P | C
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COURSE OBJECTIVES
- To provide a basic knowledge about measurement systems and their components
- To learn about various sensors used for measurement of mechanical quantities
- To learn about system stability and control
- To integrate the measurement systems with the process for process monitoring and control


Unit–III Measurements of Pressure and flow - Measurements of high pressure and low pressure - Measurements of flow by obstruction meters - Velocity probes - Hot wire anemometer - Calibration of pressure gauges and flow meters - Time constant of pressure gauges.

Unit–IV Elementary ideas of automatic control - Open and closed systems, on-off, proportional, and floating modes, reset and rate actions. Basic combined modes for pneumatic, hydraulic and electrical systems.

Unit–V Transfer function - Stability - Routh's criterion - Analysis of second order systems – System response to step – step, pulse - ramp inputs. Introduction to computerized measurement and control systems (Description only)

TEXT BOOKS
2. Benjamin Kuo, Automotive Control Engineering, EEE Publications.
REFERENCES
5. Nagarth and Gopal, Control Engineering, Wiley Eastern Ltd.
8. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes,

MEMI SCN | ELEMENTS OF HEAT TRANSFER | L  | T  | P  | C  |
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COURSE OBJECTIVES
- The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
- Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
- The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Unit-I: Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, Composite Medium, critical insulation thickness. Extended surfaces

Unit-II: Lumped system approximation and Biot number, Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

Unit-III: Heat convection, basic equations, boundary layers- Forced convection, external and internal flows-Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer- Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Unit-IV: Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann’s law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method. Radiation Shields

Unit-V: Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and e-NTU methods. Boiling and Condensation heat transfer, Pool boiling curve. Introduction mass transfer, Similarity between heat and mass transfer.

TEXT BOOKS
REFERENCES

MEMI SCN | ELEMENTS OF MACHINE DESIGN | L | T | P | C
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COURSE OBJECTIVES
- To familiarize the various steps involved in the Design Process.
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data.
- To learn to use catalogues and standard machine components.


TEXT BOOKS

REFERENCES
COURSE OBJECTIVES
To provide an overview of power plants and the associated energy conversion issues

Unit-I Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Unit-II Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit-III Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Unit-IV Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

Unit-V Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

TEXT BOOKS

REFERENCES

COURSE OUTCOMES
Upon completion of the course, the students will be able to
1. Understand the principles of operation of coal based power plant
2. Learn the working of gas power plants
3. Basics of nuclear reactors
4. Understand various non conventional power plants
5. Gain knowledge on power plant economics.

COURSE OBJECTIVES:
- To impart the knowledge about the engine chassis, transmission, steering, suspension systems, rear axles and final drive of Automobiles.
- To Study the concept of electrical system, sensors and fuel injection system in automobiles.
UNIT I

UNIT II

UNIT III
Front axle and steering geometry - Principle of power steering - steering mechanism – Recirculating ball mechanism - cam & double pin steering gear boxes - Camber angle, Caster angle, King pin inclination - Types of frames and suspension systems. Independent suspension - Rear suspension - Pneumatic suspension.

UNIT IV

UNIT V

TEXT BOOKS

REFERENCE BOOKS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
1. Identify the different systems in an automobile
2. Understand different auxiliary, sensors, fuel injection and transmission systems in automobiles.