DEPT. OF MECHANICAL ENGINEERING
# LIST OF NEW COURSES

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<th>S. No.</th>
<th>Course Code</th>
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Course Objectives: To impart knowledge on
1. Basic equations that govern the fluid flow, heat transfer and combustion processes.
2. Various discretization methods and solving methodologies to solve complex problems in the field of heat transfer and fluid dynamics.
3. Formulation of explicit and implicit algorithms for solving the Navier Stokes equations.

Course Outcome: After completing the course the student will be able to
1. Formulate the required governing equations for flow and heat transfer problems.
2. Discretize the governing equations of flow and heat transfer problems.
3. Solve the diffusion equations.
4. Solve the diffusion-convection equations.
5. Use appropriate algorithms to solve the discretized equations.
6. Apply turbulence models to accurately predict the variables based on the flow characteristics.

MODULE 1 FORMULATION OF GOVERNING EQUATIONS (8 Lecture Hours)
Basics of Heat Transfer, Fluid flow – Mathematical description of fluid flow and heat transfer – Conservation of mass, momentum, energy and chemical species - Classification of partial differential equations – Initial and Boundary Conditions


MODULE 3 DIFFUSION PROCESSES (8 Lecture Hours)

MODULE 4 CONVECTION – DIFFUSION PROCESSES (8 Lecture Hours)
One dimensional convection – diffusion problem, Central difference scheme, upwind scheme – Hybrid and power law discretization techniques – QUICK scheme.

MODULE 5 FLOW PROCESSES (7 Lecture Hours)
Discretization of incompressible flow equations – Pressure based algorithms, SIMPLE, SIMPLER & PISO algorithms

MODULE 6 TURBULENCE AND ITS MODELING (7 Lecture Hours)
Description of turbulent flow, free turbulent flows, flat plate boundary layer and pipe flow. Algebraic Models, One equation model, k - ε & k - ω models standard and high and low Reynolds number models.

Text Books:
Reference Books:

18ME2041 TURBO MACHINERY

Course Objectives: To impart knowledge on
1. Basic laws and hydraulic turbines.
2. Working of the hydraulic pumps.

Course Outcome: After completing the course the student will be able to
1. Explain basic concepts of turbo machines and visualize dimensional analysis.
2. Describe the working of Pelton, Francis and Kaplan along their performance parameters.
3. Discuss the operation of centrifugal pumps, centrifugal and axial compressors.
4. Analyze the effect of cavitation in turbines and pumps.
5. Evaluate the performance of steam turbines.
6. Evaluate the performance of gas turbines

MODULE 1 INTRODUCTION (8 Lecture Hours)
Introduction - Classification - Dimensional analysis - Specific speed – Conservation of mass, momentum and energy and equations.

MODULE 2 HYDRAULIC TURBINES (8 Lecture Hours)
Hydraulic turbines; Pelton, Francis, and Kaplan turbines - Turbine efficiencies - Cavitation in turbines.

MODULE 3 HYDRAULIC PUMPS (8 Lecture Hours)
Centrifugal pumps; theory, components, and characteristics - Cavitation - Axial flow pumps - Pump system matching.

MODULE 4 COMPRESSORS (7 Lecture Hours)
Centrifugal and axial flow compressors; slip, surging and choking.

MODULE 5 STEAM TURBINES (7 Lecture Hours)
Construction and working principle - impulse and reaction turbines, performance calculations

MODULE 6 GAS TURBINES (7 Lecture Hours)
Gas turbine; Brayton cycle and multi-staging - Power and efficiency calculations.

Text Books:

Reference Books:

18ME2042 DESIGN OF HEAT EXCHANGERS

Course Objectives: To impart knowledge on
1. Thermal and stress analysis on various parts of the heat exchangers.
2. Sizing and rating of the heat exchangers for various applications.
3. Design of evaporative condensers and cooling towers.

Course Outcome: After completing the course the student will be able to
1. Understand the fundamentals of heat exchangers.
2. Analyze the friction and pressure loss in the estimation of stress in heat exchangers.
3. Design of shell and tube heat exchangers.
4. Design of compact and plate heat exchangers.
5. Design condensers and evaporators.
6. Select suitable cooling tower accessories for given application.

**MODULE 1 – FUNDAMENTALS OF HEAT EXCHANGERS (8 Lecture Hours)**

**MODULE 2 – FLOW AND STRESS ANALYSIS (8 Lecture Hours)**

**MODULE 3 – DESIGN ASPECTS (8 Lecture Hours)**

**MODULE 4 – COMPACT AND PLATE HEAT EXCHANGERS (7 Lecture Hours)**

**MODULE 5 – CONDENSERS AND EVAPORATORS (7 Lecture Hours)**
Design of surface and evaporative condensers –Design of Shell and Tube, Plate type evaporators.

**MODULE 6 – COOLING TOWERS(7 Lecture Hours)**
Packings, Spray design, Selection of pumps, fans and pipes, Testing and Maintenance, Experimental Methods.

**Text Books:**

**Reference Books:**

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**Course Objectives:** To impart knowledge on
1. Combustion, fuel supply systems, ignition, lubrication and cooling systems of SI and CI engines.
2. Testing, performance and emissions of IC engines.
3. Alternate fuels and recent developments in IC Engines.

**Course Outcome:** After completing the course the student will be able to
1. Perform calculations for designing the combustion chambers of IC engines.
2. Estimate the mixture requirements for fuel injection systems
3. Predict the energy requirement for ignition, quantity of lubricating oil and cooling water requirements.
4. Test and analyze performance of SI and CI engines.
5. Predict concentrations of primary exhaust pollutants and adapt emission control norms.

**MODULE 1 – COMBUSTION IN SI AND CI ENGINES (8 Lecture hours)**
Stages of combustion in S.I engine-Effect of engine variables on ignition lag, flame propagation and knock or detonation-S.I engine combustion chamber design. Stages of Combustion in C.I engine-variables affecting delay period-C.I engine combustion chambers- Cold starting of C.I engines.
MODULE 2-FUEL SUPPLY SYSTEMS IN SI AND CI ENGINES (8 Lecture hours)

MODULE 3 – IGNITION, LUBRICATION AND COOLING (8 Lecture hours)

MODULE 4 - TESTING AND PERFORMANCE OF IC ENGINES (7 Lecture hours)
Basic measurements- speed, fuel consumption, air consumption, indicated power, brake power, friction power, exhaust smoke, exhaust emission-Performance of S.I and C.I engines. Heat balance.

MODULE 5 – ENGINE EMISSIONS AND CONTROL (7 Lecture hours)

MODULE 6 – DUAL FUEL AND MULTIFUEL ENGINES (7 Lecture hours)

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Course Objectives: To impart knowledge on
1. Working principle of refrigeration and air-conditioning cycle
2. Fundamentals of psychrometric processes
3. Applications of refrigeration and air-conditioning equipment.

Course Outcome: After completing the course the student will be able to
1. Understand various refrigeration systems
2. Demonstrate the working of refrigeration equipment.
3. Understand various psychrometric processes
4. Estimate the space cooling load
5. Design the air-conditioning equipments
6. Select suitable refrigeration and air-conditioning systems for various applications.

MODULE 1 – REFRIGERATION AND AIRCONDITIONING SYSTEMS (8 Lecture Hours)

MODULE 2 – REFRIGERATION AND AIRCONDITIONING EQUIPMENT (8 Lecture Hours)

MODULE 3 – LOW TEMPERATURE REFRIGERATION (8 Lecture Hours)
Cascade Refrigeration system – manufacture of solid carbon dioxide – liquefaction of air, hydrogen, and helium – production of low temperature by adiabatic demagnetization of a paramagnetic salt
MODULE 4 – PSYCHROMETRY AND COMFORT CHART (7 Lecture Hours)

MODULE 5 – COOLING LOAD ESTIMATION (7 Lecture Hours)
Types of load – heat transmission through building - Solar radiation – infiltration – internal heat sources (sensible and latent) – design of space cooling load as per ASHRAE/ ISHRAE standards-outside air and fresh air load – estimation of total load – design of air conditioning cycles, Summer and winter air conditioning systems.

MODULE 6 – APPLICATIONS (7 Lecture Hours)
Applications to refrigeration systems – ice plant – food storage plants – milk – chilling plants – refrigerated cargo ships, central air conditioning systems – applications: car, train, industry, stores, and public buildings

Text Books:

Reference Books:

Course Objectives: To impart knowledge on
1. Isentropic flow, Fanno and Rayleigh flow
2. Phenomenon of shock waves and its effect on flow.
3. Concepts of Aircraft propulsion and Rocket propulsion.

Course Outcome: After completing the course the student will be able to
1. Understand the basic concepts of gas dynamics.
2. Analyze the effect of variable area on the fluid flow.
3. Analyze the effect of friction and heat transfer on the fluid flow.
4. Determine the effect of shock waves on the fluid flow.
5. Evaluate the performance of aircraft engines.
6. Evaluate the performance of rocket engines.

MODULE 1 – BASIC CONCEPTS OF GAS DYNAMICS (7 Lecture Hours)
Energy equation for flow processes, stagnation state, velocity of sound, critical states, various regions of flow, Mach number, critical Mach number, Mach cone, Crocco number, Effect of Mach number on compressibility.

MODULE 2 – ISENTROPIC FLOW WITH VARIABLE AREA (8 Lecture Hours) Isentropic flow with variable area – T-S diagram and h-s diagrams showing nozzle and diffuser process Mach number variation, area ratio as a function of Mach number, Impulse function, mass flow rate, flow through nozzles, flow through diffusers.

MODULE 3 – FANNO AND RAYLEIGH FLOW (8 Lecture Hours) Flow in constant area ducts with friction, Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length. Flow in constant area ducts with heat transfer, Raleigh line, Raleigh flow equation, variation of flow properties and maximum heat transfer.

MODULE 4 – FLOW WITH SHOCK WAVES (8 Lecture Hours) Flow with normal shock waves, governing equations, Prandtl-Meyer equation, Mach number downstream of the normal shock, static pressure ratio, temperature ratio, density ratio and stagnation pressure ratio across the shock, entropy change, Flow with oblique shock waves.

MODULE 5 – AIRCRAFT PROPULSION (7 Lecture Hours)
Theory of aircraft propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle of ram jet, turbojet, turbofan and turbo prop engines.

**MODULE 6 – ROCKET PROPULSION (7 Lecture Hours)**
Rocket propulsion – Types of rocket engines, basic theory of equations, thrust equations, effective jet velocity, specific impulse, characteristic velocity, rocket engine performance, solid and liquid propellant rockets – Applications – space flights and space crafts.

**Text Books:**

**Reference Books:**

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<td>SOLAR THERMAL POWER ENGINEERING</td>
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**Course Objectives:** To impart knowledge on
1. Solar thermal energy and radiation
2. Liquid flat-plate collector, solar air heaters, concentrating collectors
3. Applications of solar water heating, industrial process heating

**Course Outcome:** After completing the course the student will be able to
1. Understand commercial energy sources, energy alternatives.
2. Analyze different solar energy option.
3. Apply empirical equations for predicting solar radiation.
4. Evaluate the performance of flat plate collectors, concentrating collectors, solar air heater.
5. Estimate the cost of solar process systems and gain knowledge on storages.
6. The different applications of solar energy.

**MODULE 1 – INTRODUCTION (8 Lecture Hours)**
Introduction: Man and energy, world’s production, energy sources, India’s production and reserves, energy alternatives, basic heat transfer concepts.

**MODULE 2 – SOLAR ENERGY (8 Lecture Hours)**
Thermal conversion – collection and storage, thermal applications, photo voltaic conversion, wind energy, energy from biomass, ocean thermal energy conversion, observations.

**MODULE 3 – SOLAR RADIATION (8 Lecture Hours)**
Sun, Solar Spectrum, solar constant and radiation, measuring instruments, sun-earth angles, solar radiation data, empirical equations, solar radiation on tilted surfaces.

**MODULE 4 – SOLAR COLLECTORS (7 Lecture Hours)**
Introduction, Liquid flat plate collector, concentrating collectors, air heaters, types of heaters, performance analysis, overall cost coefficient, numerical problems.

**MODULE 5 – SOLAR ENERGY STORAGE AND ECONOMICS (7 Lecture Hours)**
Sensible heat storage, liquid media storage, solid media storage, dual media storage Cost of solar process systems, uncertainties in economic analysis.

**MODULE 6 – APPLICATIONS OF SOLAR ENERGY (7 Lecture Hours)**
Solar water heating, building heating, cooling, industrial process heat, solar ponds.

**Text Books:**

**Reference Books:**

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**Course objectives:** To impart knowledge on

1. Various sources of power generation and engineering analysis of power plants.
2. Economics of power plants and methods of optimum utilization of electrical energy.
3. Environmental effects of power plants.

**Course Outcomes:** After completing the course the student will be able to

1. Determine the efficiency of a modified Rankine power cycle.
2. Explain the layout, construction and working of steam power plant.
3. Recognize various methods of power generation from nuclear power plant.
4. Analyze the performance of diesel engine cycle and gas turbine cycles.
5. Recognize various methods of power generation from renewable energy sources.
6. Understand the power plant economics and environmental hazards.

**MODULE 1 POWER CYCLES (7 Lecture Hours)** Simple Rankine cycle, modified Rankine cycle – Reheating – Regeneration, analysis, pressure and temperature limits - Binary vapour cycle and combined cycle.


**MODULE 4 DIESEL AND GAS TURBINE POWER PLANT (8 Lecture Hours)** Diesel, Dual and Brayton Cycle – Analysis, Diesel Engine power plant: components and layouts, Gas Turbine Power Plant: components and layouts. Open and closed cycle plants – combined gas turbines and steam power plants.

**MODULE 5 POWER FROM RENEWABLE ENERGY (8 Lecture Hours)** Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems, MHD concepts of energy conversion.

**MODULE 6 ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS (7 Lecture Hours)** Power tariff types, Load distribution parameters, load curve, energy audit. Comparison of site selection criteria, relative merits and demerits, Capital and operating cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

**Text Books:**

**References Books:**
Course Objectives: To impart knowledge on
1. Basic concepts of product design, product features and its architecture.
2. Applicability of product design and development in industrial applications
3. Key reasons for design or redesign.

Course Outcome: After completing the course the student will be able to
1. Select an appropriate product design and development process.
2. Understand the integration of customer requirements in product design.
3. Select appropriate creative thinking method.
4. Apply suitable approach to various decision making methods.
5. Understand various aspects of design such as product architecture.
6. Develop the methods to minimize the cost.

MODULE 1 – INTRODUCTION TO PRODUCT DESIGN (8 Lecture Hours)
Need for developing products – the importance of engineering design – types of design – the design process – relevance of product lifecycle issues in design – designing to codes and standards - societal considerations in engineering design – generic product development process – various phases of product development-planning for products – establishing markets - market segments - relevance of market research.

MODULE 2 – CUSTOMER NEEDS (8 Lecture Hours)

MODULE 3 – CREATIVE THINKING (8 Lecture Hours)

MODULE 4 – DECISION MAKING (7 Lecture Hours)

MODULE 5 – PRODUCT ARCHITECTURE (7 Lecture Hours)
Introduction to embodiment design – product architecture – types of modular architecture – steps in developing product architecture.

MODULE 6 – DESIGN AND COST ANALYSIS (7 Lecture Hours)

Text Books:

Reference Books:
**Objectives:** To impart knowledge on
1. Composite materials and their applications.
2. Fabrication, analysis, and design of composite materials and structures.
3. Prediction of the mechanical response of multi layered materials and structures.

**Course Outcomes:** After completing the course the student will be able to
1. Evaluate the properties of composites
2. Predict the properties of fiber reinforced composite materials.
3. Design a composite laminate for a given load condition.
4. Know the environmental effects of different composites.
5. Analyze the stresses using laminated plate theories.
6. Compare and contrast various processing techniques for MMCs.

**MODULE 1 INTRODUCTION TO COMPOSITES (7 Lecture Hours)**
General Characteristics, applications, Fibers- Glass, Carbon, Ceramic and Aramid fibers.

**MODULE 2 ENVIRONMENTAL EFFECTS (7 Lecture Hours)**

**MODULE 3 CERAMIC MATRIX COMPOSITES(7 Lecture Hours)**

**MODULE 4 MECHANICS AND PERFORMANCE (7 Lecture Hours)**
Stress analysis of laminated Composite beams, plates, shells- vibration and stability. Characterization of composite products – laminate design consideration- bolted and bonded joints design examples-failure mode Predictions.

**MODULE 5 POLYMER MATRIX COMPOSITES (8 Lecture Hours)**

**MODULE 6 METAL MATRIX COMPOSITES (8 Lecture Hours)**

**Text Books:**

**Reference Books:**
4. Handbook on composites materials ASM handbook on composites
Course Objectives: To impart knowledge on
1. Concepts of mathematical modeling of engineering problems
2. Finite element and the finite element procedure for 1-D, 2-D and 3-D elements.
3. Higher order elements and iso-parametric element formulation problems.

Course Outcome: After completing the course the student will be able to
1. Outline the various FE techniques used for different applications and problems.
2. Reproduce conservation of energy principle, variational principle and methods of weighted residual for developing finite element models
3. Develop the shape function, strain displacement-relation, stiffness matrix and consistent load vector for structural members.
4. Analyze scalar and vector variable problems for 2-D elements
5. Formulate and construct the shape function for an iso-parametric element.
6. Choose appropriate GDE for the thermal and fluid flow problems and solve them.

MODULE 1 INTRODUCTION TO MATHEMATICAL MODELLING AND FEA (8 Lecture Hours)

MODULE 2 ONE DIMENSIONAL PROBLEMS (8 Lecture Hours) FEA Process– Discretization – Element types- One Dimensional Second Order Equations- Linear and Higher order Elements – Boundary Conditions- aspect ratio- Pascal’s Triangle- Derivation of Shape functions and Stiffness matrices and force vectors for spar and beam elements- Assembly of Matrices - Solution of structural problems- Global, local and natural coordinate systems

MODULE 3 2-D SCALAR VARIABLE PROBLEMS (8 Lecture Hours)
Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Quadrilateral elements- Convergence and Continuous criteria- Area Coordinate system

MODULE 4 2-D VECTOR VARIABLE PROBLEMS (7 Lecture Hours)
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements

MODULE 5 HIGHER ORDER ELEMENTS (7 Lecture Hours)
Introduction to Higher Order Elements- Shape Function for Quadratic Element- Shape Function for Cubic Element- Natural Coordinate system- Isoparametric elements- Lagrangean elements- Serendipity Element- Numerical integration and application to plane stress problems

MODULE 6 THERMAL AND FLOW ANALYSIS IN FEA (7 Lecture Hours)

Text Books:

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<th>18ME2051</th>
<th>PRINCIPLES OF MECHANICAL VIBRATIONS</th>
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**Course Objectives:** To impart knowledge on
1. Formulating mathematical model for vibration problems
2. Analyzing the vibration behavior of mechanical systems subjected to loading
3. Measurement of vibration and the equipments used for collecting response data.

**Course Outcomes:** After completing the course the student will be able to
1. Classify the systems of vibration and formulate equations of motion for vibratory systems.
2. Solve vibration problems with multiple degrees of freedom.
3. Suggest methods to control vibration
4. Perform vibration tests and acquire data from vibration measuring instruments.
5. Present the theoretical and the experimental principles of mechanical vibrations to gain practical understanding in the field of vibration
6. Recognize unwanted noise in machines and proficient with instrumentation used in noise control tests

**MODULE 1 VIBRATION OF SINGLE DEGREE OF FREEDOM SYSTEM** (8 Lecture Hours)

**MODULE 2 VIBRATION OF TWO AND MULTI DEGREE FREEDOM SYSTEMS** (8 Lecture Hours)
Equations of motion for Two Degree of freedom systems – generalized coordinates – dynamic vibration absorber – semi definite systems – Multi degree of freedom system

**MODULE 3 NUMERICAL METHODS TO SOLVE VIBRATION PROBLEMS** (8 Lecture Hours)
Numerical methods in vibration problems to calculate natural frequencies – Matrix iteration technique – Stodola’s method, Holzer’s method. Introduction to smart materials for vibration control.

**MODULE 4 ENGINEERING ACOUSTICS** (7 Lecture Hours)
Basic physical acoustics – acoustic levels and spectra – decibels, sound power, Sound pressure, power and intensity – Character of noise – Addition of two noise sources – Noise source identification. Noise radiation from vibrating bodies sound – properties of the various sources that create noise – Noise in machines and machine elements.

**MODULE 5 EXPERIMENTAL METHODS IN TESTING VIBRATION** (7 Lecture Hours)

**MODULE 6 NOISE MEASUREMENT AND STANDARDS** (7 Lecture Hours)
Introduction to Acoustic Standards- Acoustic and Noise sensors, instrumentation- measurement and noise control instruments- noise propagation.

**Text books:**

Reference books:

Course Objectives:
1. Various factors influencing the manufacturability of components and the use of tolerances in manufacturing
2. Application of various forging, casting, welding and machining Processes
3. Various assembly methods and design for assembly guidelines

Course Outcome: After completing the course the student will be able to
1. Perform designing of components considering manufacture ability.
2. Apply design concepts for manufacturing, assembly.
3. Design the components suitable for various manufacturing process such casting and welding.
4. Design the components suitable for various manufacturing process such forging and machining.
5. Describe how a product can be designed for the ease of manufacturing and assembly.
6. Apply the principles of design for assembly.

MODULE 1 INTRODUCTION TO DFM (8 Lecture Hours)
Significance of design, Design factors, The basic design - Factors influencing choice of materials and manufacturing; Process capability mean, Median, Variance mode, Standard deviation, Normal distribution; Process capability; Tolerance – symbols and definitions

MODULE 2 FORM DESIGN - CASTING (8 Lecture Hours)
Influence of loading, Materials, Production methods on form design; Casting considerations, Grey iron castings; Steel castings, Aluminum casting requirements and rules for casting; Form design of pressure die castings

MODULE 3 FORM DESIGN - WELDING (8 Lecture Hours)
Welding considerations, welding processes; Requirements and rules for welding; Redesign of components for casting-pattern-mold, Parting Line; Redesign of components for welding; Case studies in form design-simple problems in form design.

MODULE 4 FORM DESIGN - FORGING (7 Lecture Hours)
Forging considerations hammer forging drop forging; Requirements and rules for forging; Choice between casting, forging and welding; Redesign of components for Forging.

MODULE 5 FORM DESIGN - MACHINING (7 Lecture Hours)
Machining considerations Drills, Milling-Keyways Dwells and Dwelling Procedure, Countersunk Head screws; Requirements and rules for Machining considerations and Reduction of machined areas; Redesign of components for Machining; Simplification by separation and Simplification by amalgamation.

MODULE 6 DESIGN FOR ASSEMBLY (7 Lecture Hours)
DFA; Factors Determining assembly methods and processes; Product Design factors independent of methods and processes; Assembly Precedence, Standardization; Design factors dependent on Assembly methods, Introduction-Single Station Assembly; Line Assembly, Hybrid Systems, Manual Assembly Lines, Flexible Assembly Lines; Design factors dependent on Assembly processes, Factors influencing Production rate to Facility Ratio, Parts Presentation, Manual Assembly.
Text Books:

Reference Books:

Course Objectives: To impart knowledge on
1. Application of basic theories of friction, wear and lubrication.
2. Frictional behavior of commonly encountered sliding interfaces.
3. Various testing methods for tribological properties.

Course Outcomes: After completing the course the student will be able to
1. Apply concepts of friction mechanisms and analyze performance of design components based on relative motion.
2. Identify wear mechanism on macro-scale in metals.
3. Select lubricants based on the applications.
4. Outline the methods to improve surface engineering.
5. Generate performance reports of the lubrications using tribo testing methods.
6. Understand the fundamentals of tribology and associated parameters.

MODULE 1 FRICTION (8 Lecture Hours)

MODULE 2 WEAR (8 Lecture Hours)

MODULE 3 LUBRICANTS, FILM LUBRICATION THEORY AND LUBRICATION TYPES (8 Lecture Hours)

MODULE 4 SURFACE ENGINEERING (8 Lecture Hours)

MODULE 5 DYNAMIC TRIBOLOGY (7 Lecture Hours)
Dynamic testing machines and test methods, dry sand–rubber wheel test.

MODULE 6 EXPERIMENTAL METHODS (7 Lecture Hours)
Text books:

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<th>18ME2054</th>
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Course objectives: To impart knowledge on
1. Use of standard parts in design
2. Develop proficiency in the development of jigs and fixtures
3. Use design principles to design jigs and fixtures and press tools

Course Outcomes: After completing the course the student will be able to
1. Understand the principles of location, clamping and mechanical actuation.
2. Develop jigs and fixtures for different operations.
3. Adopt standard procedure for the design of jigs, fixtures.
4. Analyze tolerances and specify appropriate tolerances for the design of jigs and fixtures and dies.
5. Design and develop bending, forming and drawing dies.
6. Apply recent developments in tool design.


MODULE 2 JIGS (8 Lecture Hours) Design of jigs for given component – Types of jigs – Post, Turnover, Channel, latch, box, angular post jigs.

MODULE 3 FIXTURES (7 Lecture Hours) General principles of milling, lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixture systems – Quick change fixtures.


MODULE 6 ADVANCED PRESS TOOLS (7 Lecture Hours) Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine blanking dies – recent trends in tool design – computer aided sheet metal forming. Tools for high velocity forming and pressure die casting.

Text Books:

Reference Books:
Course Objectives: To impart knowledge on
1. Various computer aided design tools for industrial applications.
2. Graphical entities of CAD.
3. Application of computers in manufacturing sectors.

Course Outcome: After completing the course the student will be able to
1. Demonstrate the basic structure and components of CAD.
2. Outline the process of representing graphical entities in a CAD environment.
3. Construct the geometric model using different techniques to represent a product.
4. Illustrate various techniques and devices involved in CAD hardware.
5. Analyze the models for design solutions using FEM.
6. Discuss the various computer aided tools implemented in various industrial applications.

MODULE 1 INTRODUCTION (7 Lecture Hours)
Introduction to CAD, Scope and applications in mechanical engineering, Need for CAD system, use of computer, Computer fundamentals, Computer aided design process, CAD configuration, CAD tools, advantages and limitations in CAD, CAD Standards – IGES, GKS and PDES, CAD/CAM integration.

MODULE 2 COMPUTER GRAPHICS (8 Lecture Hours)

MODULE 3 GEOMETRIC MODELLING (8 Lecture Hours)

MODULE 4 CAD HARDWARE (8 Lecture Hours)
Introduction to hardware specific to CAD, Product cycle, CRT, Random scan technique, raster scan technique, CAD specific I/O devices, DVST, Raster display, Display systems, sequential scanning and interlaced scan.

MODULE 5 FINITE ELEMENT METHOD (7 Lecture Hours)
Introduction to FEM, Principle of minimum potential energy, steps involved in FEM, discretization, types of nodes and elements, elemental stiffness matrix, elemental strain displacement matrix, types of force, elemental force matrix, assembly, shape function, introduction to 2 dimensional FEM.

MODULE 6 OPTIMIZATION AND NEW TECHNIQUES OF CAD (7 Lecture Hours)

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**Course Objectives:** To impart knowledge on
- Different techniques used in micro and nano manufacturing.
- Conventional techniques used in micro manufacturing
- Non-conventional micro-nano manufacturing and finishing approaches

**Course Outcome:** After completing the course the student will be able to
- Understand different techniques used in micro and nano manufacturing.
- Summarize conventional techniques used in micro manufacturing.
- Explain about non-conventional micro-nano manufacturing and finishing approaches.
- Demonstrate micro and nano finishing processes.
- Understand micro and nanofabrication techniques and other processing routes in micro and nano manufacturing.
- Analyze different techniques used in micro joining and the metrology tools in micro and nano manufacturing

**MODULE 1 **INTRODUCTION TO PRECISION ENGINEERING (8 Lecture Hours)
Precision engineering, macro milling and micro drilling. Micro-electromechanical systems – merits and applications. Micro-photography – applications

**MODULE 2** MICROMACHINING (8 Lecture Hours)
Introduction to mechanical micromachining, Micro drilling – process, tools and applications

**MODULE 3** NON-CONVENTIONAL MICRO-NANO MANUFACTURING (8 Lecture Hours)

**MODULE 4** MICRO AND NANO FINISHING PROCESSES(7 Lecture Hours)

**MODULE 5** MICRO FABRICATION – (7 Lecture Hours)
MODULE 6 – LASER MICRO WELDING (7 Lecture Hours)

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Course Objectives: To impart knowledge on
1. Conventional fusion welding and solid state welding processes
2. Modern welding techniques based on the power source
3. Design of weld joints, weldability and testing of weldments

Course Outcomes: After completing the course the student will be able to
1. Summarize different welding processes and its applications.
2. Suggest welding processes for ferrous and non-ferrous alloys.
3. Enumerate the various applications, advantages and types of welding processes.
4. Adapt different types of welding process for effective welding of structural components and complex shapes.
5. Design welding joints & test weldments for its quality.
6. Relate the principles of metallurgy during the welding process.

MODULE 1 FUSION WELDING PROCESSES (8 Lecture Hours)
Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, Gas Tungsten Arc Welding, Gas Metal Arc Welding, Plasma arc welding and Electro slag welding processes – Fundamental, principles, advantages, limitations and applications. Dissimilar materials welding.

MODULE 2 SOLID STATE WELDING PROCESSES (8 Lecture Hours)
Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes – Fundamental, principles, advantages, limitations and applications.

MODULE 3 NON-CONVENTIONAL WELDING PROCESSES (8 Lecture Hours)
Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes, Thermit Welding – Fundamental, principles, advantages, limitations and applications.

MODULE 4 MODERN WELDING PROCESSES (7 Lecture Hours)

MODULE 5 DESIGN AND TESTING OF WELDMENTS (7 Lecture Hours)
Various weld joint designs – Weldability of Aluminum, Copper, and Stainless steels. Destructive and non-destructive testing of weldments.

MODULE 6 WELDING METALLURGY (7 Lecture Hours)
Physical metallurgy of welding, various zones in weldments, Effect of temperature on metals, Metallurgical defects associated with welding process – causes and remedies.
Text books:

Reference books:

Course Objectives: To impart knowledge on
1. Structure of microprocessors and their applications in mechanical devices
2. Principle of automatic control and real time motion control systems, with the help of electrical drivers and actuators
3. Micro-sensors and their applications in various fields

Course Outcome: After completing the course the student will be able to
1. Summarize and recall the overview of mechatronics applications.
2. Demonstrate knowledge of electrical circuits and logic design.
3. Develop and formulate engineering solutions and techniques to solve design problems.
4. Design mechatronic components and systems.
5. Classify and Select various micro-sensors and microprocessors for a specific problem.
6. Develop PLC programs for a given task.

MODULE 1 INTRODUCTION TO MECHATRONICS (8 Lecture Hours)

MODULE 2 SENSORS AND TRANSDUCERS (7 Lecture Hours)
Classification, Development in Transducer technology, Optoelectronics- Shaft encoders, CD Sensors, Vision System.

MODULE 3 DRIVES AND ACTUATORS (8 Lecture Hours)
Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems.

MODULE 4 SMART MATERIALS (7 Lecture Hours)
Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation.

MODULE 5 MICROMECHATRONIC SYSTEMS (8 Lecture Hours)
Micro sensors, Micro actuators. Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.

MODULE 6 PROGRAMMABLE LOGIC CONTROLLER (7 Lecture Hours)

Text Books:
Reference Books:

Course Objectives: To impart knowledge on
1. Fundamentals of chip formation, metal cutting theories and nomenclature of cutting tools.

Course Outcome: After completing the course, the student will be able to
1. Understand mechanism and theories of metal cutting and implement it during machining.
2. Select the appropriate cutting tool based on the operation to be done.
3. Understand thermal characteristics and controlling the heat distribution in machining.
4. Analyze tool materials and prolonging the tool life.
5. Measure cutting forces during metal cutting processes.
6. Identify and analyse the tool wear, vibration and chatter.

MODULE 1 METAL CUTTING FUNDAMENTALS (8 Lecture Hours)

MODULE 2 TOOL NOMENCLATURE OF CUTTING TOOL (7 Lecture Hours)
Nomenclature of single point tool - Systems of tool Nomenclature and Conversion of rake angles - Nomenclature of multi point tools like drills, milling cutters and broaches.

MODULE 3 THERMAL ASPECTS OF MACHINING (8 Lecture Hours)
Thermodynamics of chip formation - Heat distributions in machining-Effects of various parameters on temperature - Method of temperature measurement in machining - Hot machining - cutting fluids, Surface finish and integrity

MODULE 4 TOOL MATERIALS AND TOOL LIFE (7 Lecture Hours)

MODULE 5 CUTTING FORCES AND ECONOMICS OF MACHINING (8 Lecture Hours)
Forces in turning, drilling and milling - specific cutting pressure- measurement of cutting forces. Concepts of machinability and machinability index - Economics of machining, Machining Time – Estimation of machining time in different machining operations.

MODULE 6 TOOL WEAR MECHANISMS AND CHATTER IN MACHINING (7 Lecture Hours)
Reasons for failure of cutting tools and forms of wear-mechanisms of wear - chatter in machining - Factors effecting chatter in machining - types of chatters-Mechanism of chatter based on Force Vs Speed graph.

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Course Objectives: To impart knowledge on
1. basic fundamentals of Safety Engineering and Management
2. recognition, investigation, analysis, and control of hazards
3. management's role in safety and assess the importance.

Course Outcome: After completing the course the student will be able to
1. understanding the importance of safety in process industries
2. Understanding the ethical issues that may arise from industrial processes.
3. Communicate the difference between Hazard and Risk.
4. Be able to express Safety in terms of Risk and to recognize unacceptable/inappropriate levels of Risk.
5. Be able to Assess & identify the potential hazards in process industries
6. Appreciation and applying safety procedures in a process industries.

MODULE 1 – SAFETY TRAINING (8 Lecture Hours)
Safety Procedures; Periodic Advice and checking to follow Safety Procedures & Rules; Proper selection and replacement of Handling Equipment; plant layout Personnel Safety and Protective Equipments; Occupational health and safety

MODULE 2 – MACHINE GUARDING (8 Lecture Hours)
Principles of Machine Guarding - Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices

MODULE 3 – INDUSTRIAL ATMOSPHERIC CONTAMINANTS AND HEALTH HAZARDS (8 Lecture Hours)

MODULE 4 INDUSTRIAL TOXICOLOGY AND INDUSTRIAL HYGIENE SURVEY (7 Lecture Hours)
Modes of Entry of Toxic Substances Into The Human Body – Long Term And Short Term Effects – Industrial Toxicology. Threshold Limit Values, Kinds Of Exposure Standards, Pollutant Concentrations, Industrial Hygiene Survey – Diagnosis – Remedial Measures

MODULE 5 SAFETY AND RISK (7 Lecture Hours)
Effective steps to Implement Safety Procedures; Periodic Advice and checking to follow Safety Procedures & Rules; Proper selection and replacement of Handling Equipment; plant layout Personnel Safety and Protective Equipments; Occupational health and safety

MODULE 6 INDUSTRIAL ILLUMINATION AND INDUSTRIAL PLANT SANITATION (7 Lecture Hours)

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**Course objectives:** To impart knowledge on
1. Work study for the improvement of productivity.
2. Planning and management of materials and operations in floor level and plan.

**Course Outcome:** After completing the course the student will be able to
1. Apply work study techniques to improve working condition and productivity.
2. Design an industrial system to optimize various factors of production.
3. Analyze the past data for production planning and control.
4. Identify suitable plant layout to minimize material handling and to improve productivity.
5. Control quality of production using statistical process control and reliability tools.
6. Appraise the human and ergonomics impact on the modern industrial engineering approaches

**MODULE 1 - WORK STUDY AND PRODUCTIVITY (8 Lecture Hours)**
Introduction to industrial engineering – objectives and functional areas of Industrial engineering
Method Study (Motion Study): Definition, objectives, micro motion study, therbligs, operation chart, flow process chart, man machine chart, SIMO chart. Time Study (Work measurement): uses of time study, procedure, standard time, performance rating, allowances, Methods of time study, Number of cycles to be timed. Productivity–Importance, Measurement of productivity, productivity indices, productivity improvement, Productivity bargaining

**MODULE 2 - PRODUCTION PLANNING AND CONTROL (8 Lecture Hours)**
Types of production – job, batch, mass and continuous production – Introduction to PPC, planning, Routing, scheduling, master schedule and subsidiary schedule, dispatching–functions, Follow up, control boards, idle machine time

**MODULE 3 - PLANT LAYOUT (8 Lecture Hours)**
Product layout, process layout, cellular manufacturing system, factors influencing layout. Factors governing flow pattern, travel chart, line balancing, work station design, tools and techniques for plant layout, advantages of scientific layout

**MODULE 4 - QUALITY AND RELIABILITY ENGINEERING (7 Lecture Hours)**

**MODULE 5 - MODERN MANAGEMENT (7 Lecture Hours)**

**MODULE 6 – Human factors and ergonomics (7 Lecture Hours)**

**Text books:**
Reference books:

18ME2062 MODERN VEHICLE TECHNOLOGY

Course objectives: To impart knowledge on
1. Basic principles of engines used for automobiles and different systems.
2. Various transmission and drive line units of automobiles.
3. Importance of sensors and fuel injection systems.

Course Outcomes: After completing the course the student will be able to
1. Identify the importance and functions of vehicle chassis, components of IC Engines and cooling systems.
2. Describe the types of steering and suspension systems.
3. Demonstrate the functions of clutch and braking systems.
4. Recognize and select drives for transmission.
5. Summarize the working principles of sensors and actuators.
6. Express the functions and components of fuel injection and ignition systems.

MODULE 1 INTRODUCTION (8 Lecture Hours)

MODULE 2 STEERING AND SUSPENSION (8 Lecture Hours)

MODULE 3 BRAKES AND WHEEL (8 Lecture Hours)

MODULE 4 AUTOMOTIVE CLUTCH (7 Lecture Hours)
Clutches – Need, types – Single and Multiple Disc Clutches, Diaphragm Clutch, Centrifugal Clutch, Overrunning Clutch, Fluid Coupling, Torque Converters. Differential: need and types; Four wheel drive.

MODULE 5 AUTOMOTIVE TRANSMISSION (7 Lecture Hours)
Gear box: Need, types of gear transmission – sliding mesh, constant mesh and synchromesh gearboxes; Gearshift mechanisms; Epicyclic transmission. Universal joint – constant velocity joint – propeller shaft – Hotchkiss drive – Torque tube drive; Four wheel axles: Types – stub axle.

MODULE 6 SENSORS AND ENGINE ELECTRONICS (7 Lecture Hours)
Types of sensors – vehicle position sensor, sensors for speed, throttle position, exhaust Oxygen Level, Manifold Pressure, Crankshaft Position, Coolant Temperature, Exhaust Temperature, Air-mass flow for engine application. Solenoids, Stepper-Motors, & Relay. Multi point fuel injection (MPFI), Gasoline Direct Injection (GDI); Common Rail Direct Injection (CRDI); Variable Timing Ignition (VTI), On-board Diagnostics; Electronically controlled Automatic Transmission System.

Text Books:

References Books:
Course Objectives: To impart knowledge on
2. Commercial rapid prototyping system models to perform activities such as part building, materials used etc.
3. Mechanical properties and geometric issues relating to specific rapid prototyping applications.

Course Outcome: After completing the course the student will be able to
1. Differentiate between conventional and rapid manufacturing approach.
2. Demonstrate the knowledge of Rapid Manufacturing technologies.
3. Understand the need and place for RP in an integrated manufacturing environment.
4. Get exposed to commercial Rapid Prototyping systems.
5. Possess knowledge on Rapid Prototyping software.

MODULE 1 INTRODUCTION  (7 Lecture Hours)

MODULE 2 REVERSE ENGINEERING AND CAD MODELING  (8 Lecture Hours)
Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation,

MODULE 3 LIQUID BASED RAPID PROTOTYPING SYSTEMS  (8 Lecture Hours)

MODULE 4 SOLID BASED RAPID PROTOTYPING SYSTEMS  (7 Lecture Hours)

MODULE 5 POWDER BASED RAPID PROTOTYPING SYSTEMS  (7 Lecture Hours)

MODULE 6 RAPID TOOLING  (8 Lecture Hours)
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Course Objectives: To impart knowledge on
1. Automation in the of field machine tool based manufacturing
2. Various elements of manufacturing automation, CAD/CAM, sensors, pneumatics, hydraulics and CNC
3. Basics of product design and the role of manufacturing automation

Course Outcomes: After completing the course the student will be able to
1. Relate automation to Industries in general and manufacturing processes in specific.
2. Summarize how automation in industries is implemented using computer aided manufacturing techniques.
3. Enumerate CAD technologies on various applications related to automation.
4. Adapt low cost automation principles and apply them to solve industrial issues pertaining to manufacturing.
5. Analyze design processes and numerically estimate optimized conditions for design and manufacturing.
6. Relate with implementation of robots to solve high end manufacturing problems in industries.

MODULE 1 INTRODUCTION TO AUTOMATION (8 Lecture Hours)

MODULE 2 COMPUTER AIDED AUTOMATION (8 Lecture Hours)

MODULE 3 COMPUTER AIDED DESIGN (8 Lecture Hours)

MODULE 4 LOW COST AUTOMATION (7 Lecture Hours)
Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies.

MODULE 5 INTRODUCTION TO MODELING AND SIMULATION (7 Lecture Hours)
Product design, process route modeling, Optimization techniques, Case studies & industrial applications.

MODULE 6 INDUSTRIAL ROBOTICS (7 Lecture Hours)
Robot anatomy, control systems in robots, end effectors for manufacturing and assembly, sensors in robots, Industrial application.
Text books:

Reference books:

Course Objectives: To impart knowledge on
1. Traditional process planning and methods of computer aided process planning
2. Importance and procedure of costing
3. Elements of costing, budgeting and decision making

Course Outcome: After completing the course the student will be able to
1. Apply traditional process planning and computer aided process planning
2. Estimate the cost of a process and product
3. Assess the elements of cost and ascertain the cost of a product
4. Evaluate the depreciation of a product over the time period/usage
5. Develop a budget and operate the same in a manufacturing set-up
6. Estimate the manufacturing cost of various manufacturing processes

MODULE 1 PROCESS PLANNING (7 Lecture Hours)

MODULE 2 ESTIMATION AND COSTING (7 Lecture Hours)

MODULE 3 ELEMENTS OF COSTS (8 Lecture Hours)

MODULE 4 COST ECONOMICS (8 Lecture Hours)
Budget – Essentials of budgeting – Types of Budgets – Budgetary control – Objectives – Benefits – Measures of cost economics – Make or buy decision and Analysis.

MODULE 5 PRODUCT COST ESTIMATION (8 Lecture Hours)

MODULE 6 MACHINING TIME CALCULATION (7 Lecture Hours)
Estimation of Machining Time – Importance of Machine Time Calculation – Calculation of Machining Time for different Lathe operations. Drilling and Boring – Machining Time Calculation for milling, shaping and planning – Machining Time Calculation for grinding.

Text Books:

Reference Books:

<table>
<thead>
<tr>
<th>Course objectives: To impart knowledge on</th>
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<tbody>
<tr>
<td>1. Architecture and instruction set of typical 8-bit microprocessor.</td>
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<td>2. Assembly Language Programming using macro-assembler.</td>
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<td>3. Procedures for input-output techniques and programmable support chips used in microprocessor based systems.</td>
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</table>

Course Outcomes: Ability to
1. Paraphrase the basics of microprocessor.
2. Articulate on the working of 8-bit microprocessor.
3. Re-enact Assembly Language Programming.
4. Reviewing interrupts in microprocessor.
5. Examine about programmable peripheral interface.
6. Assess programmable interval timer.

MODULE 1 INTRODUCTION OF MICROCOMPUTER SYSTEM (7 Lecture Hours)
CPU, I/O devices, clock, memory, bussed architecture, tristate logic, address bus, data bus and control bus, Development of semiconductor memory, internal structure and decoding, memory read and write timing diagrams, MROM, ROM, EPROM, EEPROM, DRAM.

MODULE 2 ARCHITECTURE, OPERATION & CONTROL (8 Lecture Hours)
Intel 8085A microprocessor, Pin description and internal architecture. Timing and control MODULE, op-code fetch machine cycle, memory read/write machine cycles, I/O read/write machine cycles, interrupt acknowledge machine cycle, state transition diagram.

MODULE 3 INSTRUCTION SET & ASSEMBLY LANGUAGE PROGRAMMING (9 Lecture Hours)
Addressing modes; Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set, macro RTL and micro RTL flow chart of few typical instructions; Unspecified flags and instructions. Interfacing of memory chips, address allocation technique and decoding; Interfacing of I/O devices, LEDs and toggle-switches as examples, memory mapped and isolated I/O structure;

MODULE 4 INTERRUPTS AND I/O TECHNIQUES (8 Lecture Hours)
Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; Handling multiple interrupts. Input / Output techniques: CPU initiated unconditional and conditional I/O transfer, device initiated interrupt I/O transfer.

MODULE 5 PROGRAMMABLE PERIPHERAL INTERFACE (7 Lecture Hours)
Intel 8255, pin configuration, internal structure of a port bit, modes of operation, bit SET/RESET feature, programming. ADC and DAC chips and their interfacing

MODULE 6 PROGRAMMABLE INTERVAL TIMER (6 Lecture Hours)
Intel 8253, pin configuration, internal block diagram of counter and modes of operation, counter read methods, programming, READ-BACK command of Intel 8254.

Text books:

Reference books:

Course objectives: To impart knowledge on
1. Basic principles of engines used for automobiles and different systems.
2. Importance of sensors and fuel injection systems.
3. Engine exhausts emission control and alternate fuels. 

Course Outcomes: After completing the course the student will be able to
1. Understand different types of internal combustion engines.
2. Demonstrate the functions of clutch and gear box systems.
3. Describe the types of steering and suspension systems.
4. Summarize the construction and operating principles of brakes and tyres.
5. Express the functions and components of fuel injection and ignition systems.
6. Analyze the performance and emissions of alternate fuels.

MODULE 1 INTRODUCTION (8 Lecture Hours)
Types of automobiles, vehicle construction and layouts, chassis, frame and body, IC engines-components, function and materials, construction types, engine cylinder arrangements – Piston rings – Cylinder liners – Valves and Actuating mechanisms – Inlet and Exhaust manifolds, variable valve timing (VVT).

MODULE 2 AUTOMOTIVE TRANSMISSION SYSTEMS (8 Lecture Hours)
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.

MODULE 3 STEERING AND SUSPENSION SYSTEMS (8 Lecture Hours)

MODULE 4 BRAKES AND WHEEL (7 Lecture Hours)

MODULE 5 AUTOMOTIVE FUEL INJECTION SYSTEM (7 Lecture Hours)
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, engine emission control by 3-way catalytic converter system. Emission norms (Euro & BS).

MODULE 6 ALTERNATIVE FUELS (7 Lecture Hours)
Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in Automobiles, water and air as fuels, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles.

Text Books:

References Books:

### Course Objectives

1. Need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
2. TQM Principles and techniques and possible applications of the same in manufacturing and service sectors.
3. Various tools and techniques of TQM.
Course Outcome: After completing the course the student will be able to
1. Apply TQM concepts in a selected enterprise.
2. Apply TQM principles in a selected enterprise.
3. Evaluate the various tools and techniques of TQM.
4. Assess the failures and their effect on the system through FMEA
5. Implement quality circle and Benchmarking in manufacturing and service sectors
6. Apply QMS and EMS in any organization.

MODULE 1 INTRODUCTION (8 Lecture Hours)
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Definition of TQM - Basic concepts of TQM - Gurus of TQM (Brief introduction) - TQM Framework - Barriers to TQM - Benefits of TQM.

MODULE 2 TQM PRINCIPLES (8 Lecture Hours)
Leadership - The Deming Philosophy, Quality council, Quality statements and Strategic planning - Customer Satisfaction - Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal - Continuous process improvement - Juran Trilogy, PDSA cycle, 5s and Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating and Relationship development.

MODULE 3 TQM TOOLS & TECHNIQUES I (8 Lecture Hours)

MODULE 4 TQM TOOLS & TECHNIQUES II (7 Lecture Hours)
Quality circles - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures - Cost of Quality - BPR.

MODULE 5 QUALITY MANAGEMENT SYSTEM (7 Lecture Hours)

MODULE 6 ENVIRONMENTAL MANAGEMENT SYSTEM (7 Lecture Hours)

Text Books:

Reference Books:
Course Objectives: To impart knowledge on
1. Energy conservation
2. Energy auditing
3. Energy management

Course Outcome: After completing the course the student will be able to
1. State the importance of energy conservation
2. Discuss the present status of national energy scenario
3. Apply various energy auditing methods
4. Analyze the energy conservation areas in thermal systems
5. Estimate the energy conservation areas in electrical systems
6. Choose the different financial management methods

MODULE 1 ENERGY CONSERVATION (8 Lecture Hours)
Introduction – energy conservation – importance – energy savings – opportunities – energy policy – present energy scenario – conventional and non-conventional energy - energy consumption pattern in India and worldwide – energy sector overview - energy measurement

MODULE 2 ENERGY CONSERVATION IN THERMAL AND ELECTRICAL SYSTEMS (8 Lecture Hours)

MODULE 3 ENERGY AUDITING (8 Lecture Hours)
Introduction – basic components of an energy audit - Types of energy audit – energy auditing services – specialized audit tools –commercial audits - Residential audit – energy saving opportunities.

MODULE 4 ENERGY CONSERVATION AND AUDITING IN INDUSTRIES (7 Lecture Hours) Energy conservation and auditing in steel and iron industry – foundry industry – chemical industry – textile industry – thermal power plants – cement industry – ceramic industry.


Text Books:

Reference Books:
Course Objectives: To impart knowledge on
1. The elements of Mechatronics systems
2. Selection of sensors and actuators
3. Application of mechatronics systems in automation

Course Outcomes: After completing the course the student will be able to
1. Recognize the emerging trends in mechatronics and interpret the principle of sensors.
2. Illustrate the working principles of valves, pneumatic and hydraulic drives.
3. Inference the suitable microprocessor or microcontroller for a real time application.
4. Classify and select an appropriate sensor for a given task.
5. Build a PLC program and a ladder logic program for an industrial application.
6. Identify and use an appropriate drive for an industrial application.

MODULE 1 INTRODUCTION TO MECHATRONICS (8 Lecture Hours)

MODULE 2 PNEUMATIC AND HYDRAULIC ACTUATORS (8 Lecture Hours)
DCVS, FCVs, special valves like Servo and Proportional Controls Valves, different types of Pumps and Motors – computation of performance of them.

MODULE 3 8085 MICROPROCESSOR AND 8051 MICROCONTROLLER (8 Lecture Hours)

MODULE 4 SENSORS AND TRANSDUCERS (7 Lecture Hours)
Classification, Development in Transducer technology, Optoelectronics - Shaft encoders, CD Sensors, Vision System.

MODULE 5 PROGRAMMABLE LOGIC CONTROLLERS (7 Lecture Hours)

MODULE 6 ACTUATORS AND MECHATRONIC SYSTEM DESIGN (7 Lecture Hours)

Text Books:

Reference Books:
3. Robot programming skills and Actuating systems

Course Outcome: After completing the course, the student will be able to
1. Identify the robot types and configurations.
2. Evaluate the complete robot and can identify the control system acting on it.
3. Compute the kinematic equations to select an actuator for robot configurations.
4. Categorize the suitable sensor and implement for appropriate robot application.
5. Design the robot Program for an industrial application.
6. Develop the robot for a unique operation.

MODULE 1 BASIC CONCEPTS OF ROBOTICS AND AUTOMATION (8 Lecture Hours)
Basic Concepts such as Definition, three laws, DOF, Misunderstood devices etc., Elements of Robotic Systems i.e. Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc. Automation - Concept, Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.

MODULE 2 ROBOT END EFFECTORS AND SENSORS (7 Lecture Hours)
Types of Grippers, Design aspect for gripper, Force analysis for various basic gripper system. Sensors for Robots: - Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.

MODULE 3 DRIVES AND CONTROL SYSTEMS (8 Lecture Hours)

MODULE 4 KINEMATICS AND DYNAMICS (7 Lecture Hours)
Transformation matrices and their arithmetic, link and joint description, Denavit – Hardenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods. Velocities and Static forces in manipulators: -Jacobians, singularities, static forces, Jacobian in force domain. Dynamics: - Introduction to Dynamics, Trajectory generations.

MODULE 5 MACHINE VISION AND PROGRAMMING LANGUAGES (8 Lecture Hours)
Vision System Devices, Image acquisition, Masking, Sampling and quantization, Image Processing Techniques, Noise reduction methods, Edge detection, Segmentation. Robot Programming: - Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types such as RAIL and VAL II etc, Features of type and development of languages for recent robot systems.

MODULE 6 ARTIFICIAL INTELLIGENCE AND PLANT AUTOMATION (7 Lecture Hours)

Text Books:

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<th>18ME2072</th>
<th>FLUID POWER APPLICATIONS</th>
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**Course Objectives:** To impart knowledge on
1. Applications of hydraulics and pneumatics for automation.
2. Components of hydraulics and pneumatics.
3. Design of hydraulics and pneumatics circuits.

**Course Outcome:** After completing the course the student will be able to
1. Recognize the symbols used in hydraulics and pneumatics circuits.
2. Identify the components used in hydraulics and pneumatics systems.
3. Design hydraulic circuits for industrial applications.
4. Design pneumatics circuits for machine tool applications.
5. Develop low cost automation circuits for material handling applications.

**MODULE 1 HYDRAULIC COMPONENTS (9 Lecture Hours)**

**MODULE 2 PNEUMATIC COMPONENTS (9 Lecture Hours)**
Introduction to Pneumatics-Compressors-types-Air treatment-FRL MODULE-Air dryer-Control valves-Logic valves-Time delay valve and quick exhaust valve-Pneumatic Sensors—types-characteristics and applications.

**MODULE 3 FLUID POWER CIRCUITS (8 Lecture Hours)**

**MODULE 4 ELECTRO - PNEUMATICS AND HYDRAULICS (8 Lecture Hours)**
Relay, Switches-Solenoid-Solenoid operated valves-Timer-Counter-Servo and proportional control-Microcontroller and PLC based control-Design of electro-pneumatic and hydraulic circuits.

**MODULE 5 APPLICATION, MAINTENANCE AND TROUBLE SHOOTING (6 Lecture Hours)**

**MODULE 6 Fluid Logic Control Systems (7 Lecture Hours)**
Introduction – Principles of Fluid logic control --- Basic Fluid Devices-- fluidic elements – Fluidic sensors-- MPL control systems- MPL control of Fluid power circuits-- Basic concepts of PLC.

**Text Books:**

**Reference Books:**
**Course Objectives:** To impart knowledge on
1. Basics of manufacturing processes and the various processing techniques in advanced materials.
2. Different advanced manufacturing processes including machining, forming, welding and foundry.
3. Manufacturing technologies in the competitive environment.

**Course Outcome:** After completing the course the student will be able to
1. Understand different manufacturing processes and the economic considerations.
2. Understand the theory of metal cutting and the sciences of advanced machining processes.
3. Learn the theories of advanced metal forming.
4. Know about the process of metal casting in detail.
5. Understand the physics of arc welding and theory of advanced welding techniques.
6. Demonstrate an understanding of competitive manufacturing environment.

**MODULE 1 INTRODUCTION TO MANUFACTURING** (7 Lecture Hours)

**MODULE 2 ADVANCED MACHINING PROCESSES** (8 Lecture Hours)
Introduction to basic machining operations and types. Mechanics of orthogonal metal cutting, theory of orthogonal metal cutting. Mechanics of oblique metal cutting. Analysis of machining processes such as USM, AJM, ECM, EDM, LBM, and EBM.

**MODULE 3 ADVANCED FORMING PROCESSES** (8 Lecture Hours)

**MODULE 4 ADVANCED FOUNDRY PROCESSES** (7 Lecture Hours)
Introduction to metal casting processes, Purpose of the gating system, Components of gating system and its functions, Functions, types and applications of the riser, metal mould, continuous, squeeze, vacuum mould, evaporative pattern, and ceramic shell casting.

**MODULE 5 ADVANCED WELDING PROCESSES** (7 Lecture Hours)

**MODULE 6 MANUFACTURING IN A COMPETITIVE ENVIRONMENT** (8 Lecture Hours)

**Text Books:**

**Reference Books:**
Course Objectives: To impart knowledge on
1. Various renewable energy sources.
2. Power generation techniques of renewable energy systems.
3. The application and environmental aspects of renewable energy systems.

Course Outcome: After completing the course the student will be able to
1. Identify the various renewable energy sources.
2. Summarize the application of solar energy systems.
3. Develop technology to convert waste biomass into useful energy.
4. Evaluate the performance of wind energy systems.
5. Estimate power production from tidal and ocean energy systems.
6. Understand the energy conversion from geothermal and hydrogen sources.

MODULE 1 - NON–CONVENTIONAL ENERGY SOURCES (8 Lecture Hours)
Introduction, non–conventional energy systems, world energy features, non–conventional energy sources and their availability, prospectus of renewable energy sources, advantages and disadvantages of renewable energy sources, history of energy consumption pattern.

MODULE 2 - SOLAR ENERGY SYSTEMS (8 Lecture Hours)
Solar radiation, solar radiation measurements, flat plate collectors, solar air heaters, concentrating collectors, solar water heating, solar space heating, solar refrigeration, solar photo voltaic cells, solar cooking, solar chimney, calculation of collector efficiency, outlet temperature of fluid.

MODULE 3 - BIOMASS ENERGY SYSTEMS (8 Lecture Hours)

MODULE 4 - WIND ENERGY SYSTEMS (7 Lecture Hours)
The power in the wind, forces on the blades and thrust on turbines, wind energy conversion, site selection considerations, basic components of wind energy conversion systems, classification of wind energy conversion systems, wind energy collectors, performance of wind energy machines, application of wind energy, environmental impacts. Determination of power available in the wind.

MODULE 5 - TIDAL ENERGY AND OCEAN THERMAL ENERGY (7 Lecture Hours)
Ocean thermal energy conversion – calculation of power output from turbine. Tidal energy – determination of power available in the tidal energy, types. Wave energy conversion devices, small, mini, micro hydro systems.

MODULE 6-GEOTHERMAL AND HYDROGEN ENERGY (7 Lecture Hours)
Classification of Geothermal areas-calculation of hot water temperature and pressure. Hydrogen energy, fuel cells, magnetohydrodynamic systems.

Text books:

Reference books:
Course objectives: To impart knowledge on
1. Performance of SI and CI Engines.
2. Understand recent trends in engine technology
3. Engine exhausts emission control and alternate fuels.

Course Outcomes: After completing the course the student will be able to
1. Classify different types of internal combustion engines.
3. Identify recent technology trends in engine.
4. Understand friction reduction and light weighting technologies.
5. Predict concentrations of primary exhaust pollutants
6. Analyze the performance and Emissions of alternate fuels.

MODULE 1 INTRODUCTION TO IC ENGINES (8 Lecture Hours)
Basic components and terminology of IC engines, working of four stroke/two stroke - petrol/diesel engine, classification and application of IC engines, Valve timing diagrams, Port timing diagrams. Engine performance and emission parameters.

MODULE 2 SPARK IGNITION ENGINES (8 Lecture Hours)
Mixture requirements of air-fuel ratio, Fuel injection system, Monopoint, Multipoint & Direct injection - Stages of combustion, Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers, New technologies employed in 3 way catalytic converter, stoichiometric and lean combustion.

MODULE 3 COMPRESSION IGNITION ENGINES (8 Lecture Hours) Diesel Fuel Injection Systems, Stages of combustion, Knocking, Factors affecting knock, Direct and Indirect injection systems, Combustion chambers, Fuel Spray behavior, Spray structure and spray penetration, Air motion, Introduction to Turbo charging, Advanced trends in Diesel oxidation catalyst (DOC), and Diesel particulate filter (DPF).

MODULE 4 POLLUTANT FORMATION AND CONTROL (7 Lecture Hours)

MODULE 5 ALTERNATIVE FUELS (7 Lecture Hours)

MODULE 6 AUTOMOTIVE FUEL INJECTION SYSTEM (7 Lecture Hours)
Air assisted Combustion, Supercharging, Adiabatic combustion, friction reduction, light weighting, composite engine materials, Current trends in multi point fuel injection system, Gasoline Direct Injection Systems, Hybrid Electric, downsizing and de-rating of engines.

Text Books:

Reference Books:
Course Objectives: To impart knowledge on
1. Various computer aided design tools for industrial applications.
2. Graphical entities of Computer Aided Design.

Course Outcome: After completing the course the student will be able to
1. Demonstrate the basic structure and components of CAD.
2. Outline the process of representing graphical entities in a CAD environment.
3. Construct the geometric model using different techniques to represent a product.
4. Understand the mathematical representation of solids.
5. Illustrate various techniques and devices involved in CAD hardware.
6. Analyze the models for design solutions using FEM.

MODULE 1 – INTRODUCTION (7 Lecture Hours)
Introduction to CAD, Scope and applications in mechanical engineering, Need for CAD system, use of computer, Computer fundamentals, Computer aided design process, CAD configuration, CAD tools, advantages and limitations in CAD, CAD Standards – IGES, GKS and PDES, CAD/CAM integration.

MODULE 2 – COMPUTER GRAPHICS (8 Lecture Hours)

MODULE 3 – CURVES AND SURFACES (8 Lecture Hours)

MODULE 4 – MATHEMATICAL REPRESENTATION OF SOLIDS (7 Lecture Hours)

MODULE 5 – CAD HARDWARE (7 Lecture Hours)
Introduction to hardware specific to CAD, Product cycle, CRT, Random scan technique, raster scan technique, CAD specific i/o devices, DVST, Raster display, Display systems, sequential scanning and interlaced scan.

MODULE 6 – FINITE ELEMENT METHOD (8 Lecture Hours)
Introduction to FEM, Principle of minimum potential energy, steps involved in FEM, discretization, types of nodes and elements, elemental stiffness matrix, elemental strain displacement matrix, types of forces, elemental force matrix, assembly, shape function, introduction to 2 dimensional FEM.

Text Books:

Reference Books:
Course objectives: To impart knowledge on
1. Working principle of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics.
3. Various fuel cells and it performance based on the requirements in industries.

Course Outcomes: After completing the course the student will be able to
1. Evaluate the performance of fuel cells under different operating conditions.
2. Identify the importance and functions of fuel cell and its types.
3. Demonstrate the functions of fuel cell systems.
4. Understand hybrid fuel cell systems.
5. Describe the working process of gas turbine system.
6. Recognize the recent technology trends in fuel cell.

MODULE 1 INTRODUCTION TO FUEL CELL (8 Lecture Hours)

MODULE 2 FUEL CELL TYPES (8 Lecture Hours)
Construction and operation of Fuel cells - Solid Oxide Fuel Cell (SOFC) - Alkaline Fuel Cell (AFC) - Direct Methanol Fuel Cell (DMFC) - Proton Exchange Membrane Fuel Cell (PEM) - Molten Carbonate Fuel Cell (MCFC) - relative merits and demerits.

MODULE 3 FUEL CELL SYSTEMS (8 Lecture Hours)
Introduction to fuel cell power conditioning systems - Various options - Fuel cell systems fuelled by Natural gas (PEFC, PAFC, MCFC systems) - Coal fuelled fuel cell system - Combined fuel cell and Gas turbine system - Hybrid fuel cell systems-Hybrid electric vehicles.

MODULE 4 FUEL CELL THERMODYNAMICS (7 Lecture Hours)

MODULE 5 FUEL PROCESSING AND HYDROGEN STORAGE (7 Lecture Hours)

MODULE 6 APPLICATION OF FUEL CELL AND ECONOMICS (7 Lecture Hours)
Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell. Future trends in fuel cell.

Text Books:

References Books:

Course Objectives: To impart knowledge on
1. Use of basic concept in engineering experimentation and analysis.
2. Proficiency in handling digital devices in advanced measurement techniques.
3. Error and uncertainty in measurements in thermal and mechanical systems.
**Course Outcomes:** After completing the course the student will be able to

1. Understand the basic concept of engineering experimentation.
2. Analyze various experimental techniques.
3. Understand the use of digital devices in measurements.
4. Apply instruments for advanced measurement techniques and analysis.
5. Carry out Error and uncertainty analysis of thermal system and mechanical systems.
6. Apply the concept of measurement of displacement, velocity, acceleration, force, and torque.

**MODULE 1: EXPERIMENTAL PLANNING (8 Lecture hours)**
Planning of experiments, various stages in experimental investigations; preliminary, intermediate and final, steady state and transient techniques, selection of measuring devices based on static, dynamic characteristics and allowable uncertainties, basics of TAGUCHI method for design of experiments.

**MODULE 2: INSTRUMENTATION & MEASUREMENTS (8 Lecture hours)**
Fundamental elements of a measuring instrument, static and dynamic characteristics, principles of temperature measurement, calibration of thermocouple, RTD, Orifice plate and Pressure gauge, design of temperature measuring instruments, thermo positive elements, thermocouples in series & parallel, pyrometry, steady state and transient methods of measuring heat flux, measurement of thermal radiation and associated parameters, measurement of turbulence, measurement of thermal conductivity of solids, liquids and gases, measurement of thermo-physical properties.

**MODULE 3: ADVANCEMENT IN MEASUREMENTS (8 Lecture hours)**
Data logging and acquisition, use of sensors for error reduction, elements of micro computer interfacing, intelligent instruments and their use, Basics of P, PI, PID controllers, pneumatic and hydraulic controllers, electronic controllers.

**MODULE 4: ADVANCED MEASUREMENT TECHNIQUES AND ANALYSIS (7 Lecture hours)**
Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, Telemetry in measurement, Orsat apparatus, Gas Analyzers, Smoke meters, gas chromatography, spectrometry.

**MODULE 5: UNCERTAINTY IN MEASUREMENTS (7 Lecture hours)**
Uncertainty in measurements: Errors in instruments, Analysis of experimental data and determination of overall uncertainties in experimental investigation, uncertainties in measurement of measurable 06 15 parameters like pressure, temperature, flow etc. under various condition.

**MODULE 6: TRANSDUCERS AND MECHANICAL MEASUREMENT (7 Lecture hours)**

**Text Books:**

**Reference Books:**

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<th>18ME2079</th>
<th>MEMS AND MICRO SYSTEM FABRICATION</th>
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**Course Objectives:** To impart knowledge on

1. Operation of micro devices, micro systems and their applications.
2. Design the micro devices, micro systems.
3. Various MEMS fabrication processes.

**Course Outcome:** After completing the course the student will be able to

1. Provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
2. Educate on the rudiments of Micro fabrication techniques.
3. Introduce various sensors and actuators
4. Identify different materials used for MEMS.
5. Choose different applications of MEMS to disciplines beyond Electrical and electronics engineering
6. Choose various applications of MEMS to disciplines beyond Mechanical engineering

MODULE 1 INTRODUCTION (9 Lecture Hours)
Intrinsic Characteristics of MEMS – Energy Domains and Transducers - Sensors and Actuators –
Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of
Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis –
Flexural beam bending - Torsional deflection.

MODULE 2 SENSORS AND ACTUATORS-I (9 Lecture Hours)
Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor –
Comb drive devices – Micro Grippers – Micro Motors – Thermal Sensing and Actuation – Thermal expansion –
Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators –
Micromagnetic components – Case studies of MEMS in magnetic actuators – Actuation using Shape
Memory Alloys.

MODULE 3 SENSORS AND ACTUATORS-II (9 Lecture Hours)
Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements –
Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators –
piezoelectric effects – piezoelectric materials – Applications to Inertia, Acoustic, Tactile and Flow
sensors.

MODULE 4 MICROMACHINING (7 Lecture Hours)
Silicon Anisotropic Etching –Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching –
Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies –
97 Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction
methods – LIGA Process – Assembly of 3D MEMS – Foundry process.

MODULE 5 POLYMER AND OPTICAL MEMS (7 Lecture Hours)
Polymers in MEMS – Polimide – SU-8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene –
Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors - Optical MEMS – Lenses
and Mirrors – Actuators for Active Optical MEMS.

MODULE 6 MICROSYSTEM FABRICATION PROCESSES (7 Lecture Hours)
Introduction, Phololithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour
Deposition, Etching.

Text Books:
   Delhi, 2002.

Reference Books:
3. Thomas M.Adams and Richard A.Layton, “Introduction MEMS, Fabrication and

<table>
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<tr>
<th>18ME2080 INTRODUCTION TO FOOD PROCESS ENGINEERING AND TECHNOLOGY</th>
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Course Objectives: To impart knowledge on
1. Principles of food preservation.
2. Advancement on food processing.
3. Materials and types for food packaging.
Course Outcomes: After completing the course the student will be able to
1. Understand different methods of processing foods.
2. Select suitable packaging material for different food substances.
3. Understand Changes during storage and preservation.
4. Aware the Importance in treating waste products from food industry.
5. Familiarize the methods of food handling and storage.
6. Explain the working principle of food processing equipments.

MODULE 1 – PROCESSING OF FOOD AND ITS IMPORTANCE (8 Lecture Hours)
Source of food - food of plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds and fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods

MODULE 2 – METHODS OF FOOD HANDLING AND STORAGE (8 Lecture Hours)
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

MODULE 3 – LARGE-SCALE FOOD PROCESSING (8 Lecture Hours)
Milling of grains and pulses; edible oil extraction; pasteurization of milk; canning and bottling of foods; drying – traditional and modern methods of drying, dehydration of fruits, vegetables, milk, animal products etc.; preservation by use of acid, sugar and salt; pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods, principles of freezing and chilling, freezing equipment and methods, types of extruder.

MODULE 4 – FOOD PRESERVATION (7 Lecture Hours)
Objectives and techniques of food preservation, principle of canning of food items, thermal process, time calculations for canned foods, spoilage in canned foods, water activity of food and its significance in food preservation, dehydration and drying of food items, low temperature preservation, cold storage, cold chain, freezing, cryogenic freezing, preservation by fermentation, ionization radiation, use of preservative in foods, chemical preservative, bio-preservatives, antibiotics, lactic acid bacteria.

MODULE 5 FOOD PACKAGING (7 Lecture Hours)
Functions of packaging; type of packaging materials; selection of packaging material for different foods; selective properties of packaging film; methods of packaging and packaging equipments, mechanical strength of different packaging materials; printing of packages; barcodes & other marking; interactions between packaging material and foods; environmental and cost consideration in selecting packaging materials.

MODULE 6 FOOD WASTES AND WASTE DISPOSAL (7 Lecture Hours)
Classification and characterization of food industrial wastes from fruit and vegetable processing industry, beverage industry, fish, meat and poultry industry, sugar industry and dairy industry; solid and liquid waste; waste disposal methods – physical, chemical and biological; Economical aspects of waste treatment and disposal.

Texts Books

References Books
Course objectives: To impart knowledge on
1. New methodologies / technologies for effective utilization of renewable energy sources.
2. Different sources of energy and new energy storage technologies
3. Various power plants and Modern energy applications

Course Outcomes: After this course students will be able to
1. Understand the future energy requirements
2. Recognize the various renewable energy resources available
3. Design an energy conversion systems for maximum conversion efficiency
4. Select a suitable power plants for power generation based on the resource available
5. Select the suitable energy storing methods.
6. Apply the suitable energy conversion technology in real time application

MODULE 1. CURRENT ENERGY SCENARIO  (8 Lecture hours)
Overview of global/ India’s energy scenario, Current energy requirements, growth in future energy requirements, Review of conventional energy resources, Coal, gas and oil reserves and resources, Tar sands and Oil, Shale, Nuclear energy Option -present day environmental issues – pollution due to conventional power plants-need for modern energy technologies

MODULE 2. RENEWABLE ENERGY RESOURCES (7 Lecture hours)
Energy sources, sun as the source, classification of energy sources of energy, renewable resources; Sources of clean energy - Nuclear fission and fusion, Geothermal energy, Bio energy, Geothermal, Wind, Hydropower, Solar radiation: measurements and prediction. Ocean energy resources

MODULE 3. ENERGY CONVERSION TECHNOLOGIES. (8 Lecture hours)

MODULE 4. POWER PLANTS (7 Lecture hours)
Layout of Steam power plant . Hydel power plant – Pumped and storage type, Diesel power plant, MHD power plant, Nuclear power Plants-types, Gas turbine Power Plants, Selection of turbines, Geo thermal power plant, OTEC Power plants

MODULE 5. ENERGY STORAGE TECHNOLOGIES. (8 Lecture hours)
Introduction, Need of Energy storage, Different modes of energy storage, Technology Types– Mechanical energy storage: flywheels, compressed air, and pumped hydro; Electrical and Magnetic Energy storage: Batteries, Capacitors, electromagnets, Chemical energy storage. Basics of Sensible heat storage, Stratified storage, Rock bed storage, Thermal storage in buildings, Earthstorage, Aquifers storage. Basics of Latent heat storage, Phase change materials (PCM)

MODULE 6. MODERN ENERGY APPLICATIONS (7 Lecture hours)
Harvesting the energy of vibrations, Hyper loop, hydrogen fueled cars, heat pump water heaters, Chinas hydrogen tram, emissive energy harvester, alternative energy gadgets, alternative electrical heating, compressed air as energy.

Text books:
1. AngristS.W., Direct Energy Conversion. 4th Ed. Allyn And Bacon, Boston, 1982

Reference books:
Course Objectives: To impart knowledge on
1. Hydrologic cycle, sedimentation and coagulation.
2. the sources of organic and inorganic solids that pollute wastewater and ion exchange and lime-soda processes,
3. Effective methods used to inactivate viruses

Course Outcome: After completing the course the student will be able to
1. Understand the continuing processes that make up the water or hydrologic cycle.
2. Describe the treatment processes like sedimentation and coagulation.
3. Identify the sources of organic and inorganic solids that pollute wastewater.
4. Describe the ion exchange and lime-soda processes for removing hardness from water
5. Apply effective methods used to inactivate viruses
6. Determine the industrial waste water treatments methods.

MODULE 1 INTRODUCTION - WATER, THE BASIC RESOURCE (7 Lecture Hours)

MODULE 2 WATER COLLECTION, TREATMENT, AND DISTRIBUTION (8 Lecture Hours)
Collecting surface water and ground water – dams, reservoirs and rain harvesting. Transmission of water. Treatment types. Distribution. Primary, secondary and tertiary treatment

MODULE 3 PHYSICAL PROPERTIES OF WATER (8 Lecture Hours)

MODULE 4 CHEMICAL PROPERTIES OF WATER (7 Lecture Hours)
Atoms and molecules; Acids, bases, and salts; Ionization; Alkalinity and acidity; Hardness of water; Unwanted chemicals; Dissolved oxygen

MODULE 5 BIOLOGICAL PROPERTIES OF WATER (7 Lecture Hours)

MODULE 6 SANITATION AND WASTE WATER TREATMENT (7 Lecture Hours)
Protecting Surface Waterand Groundwater Resources - Sanitation and Wastewater Treatments. Municipal and industrial waste water treatments. Regulations and Laws on sanitation and waste water management.

Text Books:

Reference Books:
Course Objectives: To impart knowledge on
1. Health care and technology, workplace safety and safety protocols.
2. First AID practices, CPR procedure and operation of medical instruments.
3. Lab equipments, instruments and bio materials.

Course Outcome: After completing the course the student will be able to
1. Understand various health care systems and policies.
2. Recognize the importance of workplace safety and safety protocols.
3. Practice first aid, CPR and health assessment.
4. Operate important medical instruments
5. Employ lab equipments and instruments for medical health procedures.
6. Appraise the applications of engineering and biomaterials for health care.

MODULE 1 INTRODUCTION TO HEALTH CARE (7 Lecture Hours)
History of health care and health care delivery systems, medical advancements in health care, techniques to prevent the spread of disease, infection control measures, aseptic technique, patient isolation and universal precautions, patient safety, ethical and legal issues in health care, Health Information Portability and Accountability Act (HIPAA), confidentiality, patient privacy. Awareness on health care insurances.

MODULE 2 WORKPLACE SAFETY AND PERSONAL WELLNESS (7 Lecture Hours)
Occupational Safety and Health Administration (OSHA) standards, body mechanics, fire safety and other patient safety protocols. Safety first, reducing worker injury and disability. Basic medical terminology specific to the area of laboratory, pharmacology, and hospital care.

MODULE 3 FIRST AID, CPR AND HEALTH ASSESSMENT (7 Lecture Hours)
Health assessment - different types of temperatures and their averages ranges, an oral temperature. Different pulse points and radial and carotid pulse, measure of respirations and blood pressure. Ratio of weight to height. Emergencies in health care, first aid, cardiopulmonary resuscitation (CPR), CPR Standards, certified and standard first aid.

MODULE 4 INTRODUCTION TO MEDICAL INSTRUMENTS (8 Lecture Hours)

MODULE 5 LAB DEVICES, EQUIPMENTS AND INSTRUMENTS (8 Lecture Hours)

MODULE 6 ENGINEERING AND BIO MATERIALS USED FOR HEALTH CARE & MEDICAL APPLICATIONS (8 Lecture Hours)
Introduction to biomaterials, Requirements of Biomaterials, Classifications of Biomaterials, Mechanical properties of Biomaterials, Effects of processing on properties of Biomaterials, Tissue Engineering, Bio compatible materials, Titanium alloys, composite materials, Stainless Implant alloys, Cobalt base Implant alloys and Non Implant alloys. Shape memory alloys and polymers. FDA Standards.

Text Books:
2. David Allan, Karen Lockyer BS RHIT CPC, Medical Language for Modern Health Care 3rd Edition

**Reference Books:**

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<tr>
<th>19ME1001</th>
<th>INDUSTRIAL PRACTICE - I (FUNDAMENTALS OF CHASSIS DESIGN AND FABRICATION OF GO-KART)</th>
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**Course Objective:** To impart knowledge on
1. Design of a single seater Go - Kart vehicle and Automotive chassis and its applications
2. Steering and brake sub assembly working and application and Development of a single seater Go - Kart vehicle.
3. Powertrain tuning and Test run for optimization

**Course Outcomes:** After completing the course students will be able to
1. Make selection of frame, steering and braking sub assembles for go kart application
2. Design a space frame and steering wheel for Go - Kart
3. Design of tyres, rims, of steering and rear axle
4. Fabricate a go kart space frame, rear axle and mount powertrain unit
5. Perform centrifugal clutch assembly, assemble the brake & steering unit on go kart
6. Understand brake bleeding procedure and test run of go kart and its optimization techniques.

**MODULE 1 – FRAMES, STEERING, BRAKES & POWERTRAIN (7 Lecture Hours)**
Definition of Automotive, automotive applications, Types of frames for different automotive applications. Selection of frame type for go-kart application, steering system types and application. Braking system fundamentals, working of drum & disc brakes, selection procedure, brake force & pressure calculations, types of transmission for go-kart application, working of centrifugal clutch.

**MODULE 2 - BASICS OF DESIGNING, GO-KART FRAME DESIGNING (6 Lecture Hours)**
CAD introduction and its application, 2-D sketching, 3-D part modeling, design of bottle, design of rim, design of tyre, design of steering wheel.
2-D sketch of frame, Convert to 3-D part, applying weldments, applying fixtures, iteration method of chassis design, confirming the chassis for fabrication session.

**MODULE 3 - DESIGN OF REAR AXLE & TORQUE REQUIRED CALCULATIONS, ASSEMBLY OF SUB-COMPONENTS ON FRAME (4 Lecture Hours)**
Design of rear axle, bearing & hubs, calculation procedure for torque required calculations.
Assembly of IC engine, assembly of centrifugal clutch, assembly of driver seat, assembly of steering arm and wheel, assembly of brake components, brake bleeding, vehicle testing and optimization.

**MODULE 4 - FABRICATION OF FRAME, REAR AXLE FABRICATION (6 Lecture hours)**
Cutting of pipes, bending of front impact members, bending of rear engine compartment, bending of cockpit frame, filing of members, welding of members.
Fabricating the rear axle and its mounting - bearing, hubs and wheel assembly

**MODULE 5 - STEERING COMPONENTS FABRICATION, POWERTRAIN (14 Lecture Hours)**
Fabrication of steering column, fabrication of steering arms and tie rods, fabrication of mechanical linkage of steering unit and assembly of all components.
Fabrication of engine frame, Assembly of engine, assembly of centrifugal clutch and its tuning.

**MODULE 6 - ASSEMBLY OF SUB-COMPONENTS ON FRAME, VEHICLE TESTING AND OPTIMIZATION (10 Lecture hours)**
Assembly of driver seat, assembly of steering arm and wheel, assembly of brake components, brake bleeding
Vehicle testing and optimization - turning radius measurement, braking distance measurement, test run by students.

**Text books:**

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<th>19ME1002</th>
<th>INDUSTRIAL PRACTICE - II (SUSPENSION AND STEERING DYNAMICS)</th>
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**Course objective:** To impart knowledge on
1. Design and development of a single seater all-terrain vehicle
2. Automotive suspension design & development
3. Steering and brake dynamics calculations

**Course outcomes:** After completing the course students will be able to
1. Draw front view swing arm diagram.
2. Draw side view swing arm diagram.
3. Develop bump steer stabilization.
4. Balance turning equation
5. Perform an assembly of suspension and steering system.
6. Analyze BPT stabilization.

**MODULE 1 SUSPENSION SYSTEM & BPT (4 Lecture Hours)**
Need of suspension system, theory of design for suspension system, four bar mechanism, types of suspension system available in market, selection procedure, BPT design & application.

**MODULE 2 FVSA / SVSA ASSEMBLY (6 Lecture Hours)**
Camber angle, CCR calculations, FVSA diagram, SVSA diagram

**MODULE III SUSPENSION DESIGN ASSEMBLY (4 Lecture Hours)**
Assembly of FVSA, SVSA, finalizing the length of UCA, LCA and angle of inclination for ATV application.

**MODULE 4 BPT & TURNING EQUATION (6 Lecture hours)**
Coordinates from BPT and its stabilization, tuning of steering mechanism via steering / turning equation, concept of drifting - advantages & disadvantages.

**MODULE 5 CAD DESIGN OF SUSPENSION SUB-ASSEMBLY (14 Lecture Hours)**
design of knuckle joints, design of double wishbone suspension system, design of spring, design of dampers, space frame design and its assembly with wishbone.

**MODULE 6 ASSEMBLY OF SUB-COMPONENTS ON FRAME (10 Lecture hours)**
Assembly of IC engine, assembly of clutch, assembly of driver seat, assembly of steering arm and wheel, assembly of brake components, brake bleeding, vehicle testing and optimization.

**Text books:**

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<th>19ME2001</th>
<th>INDUSTRIAL PRACTICE - III (DESIGN AND FABRICATION OF ALL TERRAIN VEHICLE)</th>
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**Course objective:** To impart knowledge on
1. Design & development of a single seater all-terrain vehicle
2. Fabrication of suspension sub assembly
3. Steering & braking sub assembly

**Course outcomes:** After completing the course students will be able to
1. Make a double wishbone suspension system.
2. Fabricate steering arms for ATV application.
3. Fabricate a space frame chassis.
4. Assemble all sub-assemblies on space frame
5. Analyze BPT optimization
6. Conduct test run of ATV.

**MODULE 1 SUSPENSION SYSTEM FABRICATION (4 Lecture Hours)**
Fabrication of UCA, fabrication of LCA according to CAD design.

**MODULE 2 FRAME FABRICATION (6 Lecture Hours)**
Fabrication of front compartment, fabrication of cockpit & hull area, fabrication of powertrain compartment.

**MODULE 3 FIREWALL & BASE PANEL INSTALLATION (4 Lecture Hours)**
Installation of firewall & aluminum base panel.

**MODULE 4 STEERING ASSEMBLY (6 Lecture Hours)**
Fabrication of steering arm, fabrication of steering column, fabrication of tie rods, assembly of rack & pinion gears, installation with wheel assembly.

**MODULE 5 INSTALLATION OF POWERTRAIN (14 Lecture Hours)**
Fabrication of engine mounting frame, fabrication of gearbox mounting frame, installing gearbox in the rear engineer compartment, installing drive shafts to wheel assembly, installing engine, installing clutch & acceleration wire & brake bleeding.

**MODULE 6 ASSEMBLY OF SUB-COMPONENTS ON FRAME (10 Lecture hours)**
Assembly of IC engine, assembly of clutch, assembly of driver seat, assembly of steering arm and wheel, assembly of brake components, vehicle testing and optimization.

**Text books:**

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<tr>
<th>19ME2002</th>
<th>INDUSTRIAL PRACTICE - IV (SMART ENGINE, TRANSMISSION TECHNOLOGIES AND BRAKE DYNAMICS)</th>
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**Course objective:** To impart knowledge on
1. Design and development of a formula III prototype vehicle.
2. Fabrication of suspension sub assembly for formula III prototype vehicle.
3. Steering & braking sub assembly for formula III prototype vehicle.

**Course outcomes:** After completing the course students will be able to
1. Perform balancing of g-g diagrams
2. Design friction circle
3. Perform balancing of BPT via coordinates of FBF and RBF.
4. Design of bodyworks
5. Perform stress analysis and FEA of frame
6. Analyze stress and FEA of suspension components

**MODULE 1 FVSA & SVSA DIAGRAM FOR FORMULA 3 PROTOTYPE (4 Lecture Hours)**
Drawing of FVSA, SVSA and its assembly procedure.

**MODULE 2 G-G DIAGRAM, FRICTION CIRCLE & ITS APPLICATION (6 Lecture Hours)**
Fundamentals of G-G diagram, Friction circle application and drawing

**MODULE 3 OPTIMIZATION OF SUSPENSION DRAWING (4 Lecture Hours)**
Group Discussion and optimization of suspension drawing with respect to bump steer calculations

**MODULE 4 DESIGN OF SUSPENSION SUB ASSEMBLY (6 Lecture hours)**
Design of suspension sub assembly components - knuckle joint, hub, wishbones, tie rod ends, studs.

**MODULE 5 DESIGN OF FRAME & ASSEMBLY (14 Lecture Hours)**
Design of space frame chassis for formula 3 prototype vehicle, suspension compartment design and assembly, disc brakes & caliper design and assembly. FEA analysis procedure, FEA of frame and suspension components

**MODULE 6 BODYWORKS DESIGN (10 Lecture hours)**
Design of spoilers, design of front nose, design of side ports, design of front wing, diffuser design and its application, flow simulation procedure.
Text books:

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<th>19ME2003</th>
<th>INDUSTRIAL PRACTICE - V (TESTING AND TUNING OF ENGINE AND TRANSMISSION SYSTEMS)</th>
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Course objective: To impart knowledge on
1. Design and development of a formula 3 prototype vehicle.
2. Fabrication of suspension sub assembly
3. Steering and braking sub assembly

Course outcomes: After completing the course students will be able to
1. Fabricate a double wishbone suspension system.
2. Fabricate steering arms for Formula 3 vehicle application.
3. Fabricate a space frame chassis.
4. Assemble all sub-assemblies on space frame
5. Perform bodyworks mounting
6. Perform the test run of Formula III prototype vehicle.

MODULE 1 SUSPENSION SYSTEM FABRICATION (4 Lecture Hours)
Fabrication of upper control arm (UCA) and Lower control arm (LCA) as per CAD design.

MODULE 2 FRAME FABRICATION (6 Lecture Hours)
Fabrication of front compartment, fabrication of cockpit & hull area, fabrication of powertrain compartment.

MODULE III FIREWALL & BASE PANEL INSTALLATION (4 Lecture Hours)
Installation of firewall & aluminum base panel.

MODULE 4 STEERING ASSEMBLY (6 Lecture hours)
Fabrication of steering arm, fabrication of steering column, fabrication of tie rods, assembly of rack & pinion gears, installation with wheel assembly.

MODULE 5 INSTALLATION OF POWERTRAIN (14 Lecture Hours)
Fabrication of engine mounting frame, fabrication of gearbox mounting frame, installing gearbox in the rear engineer compartment, installing drive shafts to wheel assembly, installing engine, installing clutch & acceleration wire & brake bleeding

MODULE 6 ASSEMBLY OF SUB-COMPONENTS ON FRAME (10 Lecture hours)
Assembly of IC engine, assembly of clutch, assembly of driver seat, assembly of steering arm and wheel, assembly of brake components, assembly of body kits, vehicle testing and optimization.

Text books:

<table>
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<tr>
<th>19ME2004</th>
<th>INDUSTRIAL PRACTICE - VI (FUNDAMENTALS OF DESIGN FOR ELECTRIC AND HYBRID VEHICLES)</th>
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Course objective: To impart knowledge on
1. Design and development of electric and hybrid vehicle
2. Battery technology and its applications
3. Motor, controllers and final drive design.

Course outcomes: After completing the course students will be able to
1. Design Electric and Hybrid vehicle architecture.
2. Design battery pack with Battery Management System (BMS).
3. Design and code Controller as per the powertrain.
4. Assemble complete powertrain with final drive.
5. Assemble battery pack with cooling system.
6. Assemble motor and controller heat management system.
 MODULE 1 INTRODUCTION TO EMOTOR AND CONTROLLER ELECTRIC MOBILITY (E-MOBILITY) (4 Lecture Hours)
Definition of E. Mobility, E mobility application, Introduction to electric powertrain, Types of Electric powertrain and its application, Introduction to Hybrid powertrain, Types of Hybrid Powertrain and its application.

 MODULE 2 E MOBILITY APPLICATION, INTRO.(6 Lecture Hours)
Powertrain fundamentals, working of Electric Powertrain, selection procedure, Torque & Power calculations, types of Final drive transmission, Controller Architecture, sensors and its usage.

 MODULE 3 N FUNDAMENTALS, WORKING OF ELECTRIC (5 Lecture Hours)
Working of Hybrid Powertrain, selection procedure, types of Hybrid Transmission, Controller Architecture, sensors and its usage, IC engine and motor coupling procedure, coupling design and its analysis.

 MODULE 4 D POWERTRAIN, SELECTION OF POWER PACK (6 Lecture hours)
Introduction to Electric power pack, working of electric power pack, power pack capacity calculation, selection of battery cells, battery cells layout, Introduction to battery management system, Design of battery management system, virtual system check.

 MODULE 5 VEHICLE PLATFORM AND HEAT MANAGEMENT SYSTEM (14 Lecture Hours) Introduction to vehicle platform, type of e vehicle platform, Design of vehicle platform, design of electric vehicle sub assembly, design of frame, compatible suspension, braking and steering design with user interface.

 MODULE 6 ION TO VEHICLE PLATFORM, T-VEHICLE (10 Lecture hours)
Assembly of motor, controller clutch, power pack, steering arm and wheel, brake components. Perform Vehicle wiring and circuit check.

Text books:

<table>
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<tr>
<th>19ME2005</th>
<th>INDUSTRIAL PRACTICE - VII (FABRICATION TECHNOLOGY FOR ELECTRIC AND HYBRID VEHICLES)</th>
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Course objective: To impart knowledge on
1. Fabrication of electric and hybrid vehicle.
2. Battery pack with Battery Management System (BMS).
3. Motor, controllers and final drive installation.

Course outcomes: After completing the course students will be able to
1. Fabricate an Electric and Hybrid vehicle architecture.
2. Fabricate battery pack with BMS.
3. Install and code Controller as per the powertrain.
4. Assemble complete powertrain with final drive.
5. Assemble battery pack with vehicle heat management system.
6. Perform vehicle testing and powertrain optimization.

 MODULE 1 STEERING AND POWERTRAIN OPTIMIZATION. ENGAGEMENT SYSTEM.RM. (6 Lecture Hours)
Fabrication of front suspension unit, front bulkhead, rear suspension box, types of pillars - A pillar, B pillar, C pillar, rear bulkhead and occupant restraint system.

 MODULE 2 B PILLAR, C PILLAR, REAR BULKHEAD (6 Lecture Hours)
Motor assembly and platform fabrication, controller unit platform fabrication, wiring harness fabrication with data collecting sensors.

 MODULE 3 ASSEMBLY AND PLATFORM FABRICATION, CONTROLLER UNIT PLATFORM (6 Lecture Hours)
Assembling of controller subcomponents, preparing controller code on system, burning controller code on unit, final controller check and installation of heat sink.

 MODULE 4 SUBCOMPONENTS, PREPARING PACK (6 Lecture hours)
Fabrication of cell platform, assembling cells in different design layout, connecting cells terminal, fabrication of battery management system, virtual system check.
MODULE 5 VEHICLE SUBSYSTEM ASSEMBLY ON PLATFORM (14 Lecture Hours)
Assembly of vehicle platform with electric power train, power train controller assembly and power pack assembly, assembly of suspension, braking and steering, installing user interface system.

MODULE 6 ASSEMBLY OF SUSPENSION, BRAKING AND STEERING (4 Lecture hours)
Dry vehicle circuit check, vehicle testing, and error fixing and performance optimization.

Text books:

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<th>19ME2006</th>
<th>THERMODYNAMICS</th>
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Course Objectives: To impart knowledge on
1. To learn about work and heat interactions, and balance of energy between system and its surroundings.
2. To learn about application of I law and II law to various energy conversion devices.
3. To evaluate the changes in properties of substances in various processes.

Course Outcome: After completing the course the student will be able to
1. Understand the basic concepts in thermodynamics and energy balance to systems and control volumes, in situations involving heat and work interactions.
2. Differentiate between high grade and low grade energies.
3. Evaluate changes in thermodynamic properties of pure substances.
4. Apply gas laws to solve problems related to gas mixtures.
5. Apply psychrometric chart to perform moist air process calculations
6. Recognize the significance of I law for reacting systems and heating value of fuels.

MODULE 1 – FUNDAMENTALS AND FIRST LAW OF THERMODYNAMICS (9 Lecture Hours)
Fundamentals - System and Control volume; Property, State and Process; 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. 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. 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; First law applications for system and control volume.

MODULE 2 – SECOND LAW OF THERMODYNAMICS AND ENTROPY (9 Lecture Hours)
Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; 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. Principle of increase of entropy; Illustration of processes in T-s coordinates. Irreversibility and Availability, Exergy balance equation and Exergy analysis.

MODULE 3 – PROPERTIES OF PURE SUBSTANCE (7 Lecture Hours)
Definition of Pure substance, Thermodynamic properties of pure substances in solid liquid and vapour phases, phase rule P-V, P-T, T-V, T-S, H-S diagrams, P-V-T surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes. Use of steam tables; Saturation tables; Superheated tables; Identification of states and determination of properties, Mollier’s chart.

MODULE 4 – PROPERTIES OF GAS MIXTURES (7 Lecture Hours)
Ideal Gases and ideal gas mixtures, Properties of ideal and real gases, equation of state, Avagadro’s law, Dalton’s law of partial pressure, compressibility, and compressibility chart.

MODULE 5 - PSYCHROMETRY (7 Lecture Hours)
Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point. Adiabatic mixing, evaporative cooling, problems.
MODULE 6 - COMBUSTION FUNDAMENTALS (6 Lecture Hours)

Text Books:

Reference Books:

Prerequisite: Thermodynamics
Course Objectives: To impart knowledge on
1. Various practical power cycles and heat pump cycles.
2. Analysis of energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
3. High speed compressible flow phenomena and refrigeration and air conditioning

Course Outcome: After completing the course the student will be able to
1. Estimate the performance of a steam generator.
2. Carry out analysis of various gas and vapour power cycles.
3. Conduct analysis of steam nozzles and turbines.
5. Apply principles of refrigeration and air conditioning for analysis and performance evaluation.
6. Analyze compressible flow phenomena


MODULE 2 - VAPOUR AND AIR-STANDARD CYCLES (8 Lecture Hours) Vapor power cycles - Rankine cycle with superheat, reheat and regeneration, Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling.

MODULE 3 - STEAM NOZZLES AND TURBINES (7 Lecture Hours) Flow of steam through nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles, compounding, Determination of work done and efficiency using velocity diagrams.

MODULE 4 - AIR COMPRESSORS (8 Lecture Hours) Reciprocating compressors, Work input representation on p-v diagram, Effect of clearance and volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. Staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.


MODULE 6 - COMPRESSIBLE FLOWS (7 Lecture Hours) Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow.

Text Books:
Reference Books:
# LIST OF COURSES

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Mechanical Engineering
17ME4001 APPLIED THERMAL ENGINEERING AND EXPERIMENTAL METHODS

Credits: 3:1:0

Course Objectives:
To impart Knowledge on
- Fundamentals of heat transfer, exergy analysis and optimization techniques for various energy systems.
- Measurement of thermo physical properties of fluids.
- Design and modelling of experiments.

Course Outcomes:
Ability to:
- Design various experimental systems based on the conservation laws of physics.
- Relate the knowledge in analyzing the heat transfer systems to the fundamental heat transfer laws.
- Identify high performance heat transfer fluids for thermal systems.
- Apply the knowledge of measurement techniques in the modern energy systems.
- Conduct the experiments and record data for further analysis.
- Demonstrate knowledge of various modelling techniques for optimization of experimental results.

UNIT I THERMAL SYSTEM DESIGN. First law and Second law analysis – principle of increase of entropy – Exergy analysis of thermal systems – heat pipes, heat exchanger, thermoelectric cooler.

UNIT II FLUID FLOW AND HEAT TRANSFER. Forced convection – Mass, Momentum and Energy equations – thermal boundary layer – Laminar and Turbulent flow through mini & micro channels.


UNIT IV EXPERIMENTAL METHODS. Pressure, temperature and flow measurements – Velocity. Methods of development of correlations – Uncertainty analysis in experiments. Data acquisition and processing. Regression analysis and curve fitting

UNIT V DESIGN OF EXPERIMENTS. Modeling of thermal equipment - system simulation (successive substitution - Newton - Raphson method) - optimization - linear programming, geometric programming- Examples applied to heat transfer problems and energy systems.

Text books:

Reference Books:

18ME2001 THERMODYNAMICS, REFRIGERATION AND AIR CONDITIONING
(Use of standard thermodynamic charts and tables are permitted)

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- The laws of thermodynamics and their applications on thermal systems.
- The working principle and applications of refrigeration and air conditioning systems.
- Psychrometric processes and cycles of air conditioning systems.
Course Outcomes:
Ability to
- Apply the basic concepts of thermodynamics to different thermal systems.
- Perform energy balance and exergy analysis for thermal systems.
- Evaluate the performance of refrigeration cycles.
- Analyse psychrometric processes and cycles of air conditioning systems.
- Estimate the energy requirements of cooling and heating equipment for simple air conditioning applications.
- Analyse the performance of air conditioning systems.

Course Description

**Basics of thermodynamics:** Thermodynamic System and Control Volume, Thermodynamic Properties, Processes and Cycles, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics, work transfer, heat transfer, specific heat and latent heat, first law of thermodynamics, First Law for a Closed System Undergoing a Cycle, Different Forms of Stored Energy, enthalpy, Steady Flow Process, Otto, diesel and dual cycles. **Entropy and properties of steam:** Second law of thermodynamics, cyclic heat engine, refrigerator and heat pump, reversibility and irreversibility, Carnot cycle, Carnot theorem, entropy principle, The Inequality of Clausius, first and second law combined, third law of thermodynamics, available energy, properties of steam. **Refrigeration cycles:** Refrigerants, refrigeration equipments, vapour compression refrigeration cycle, absorption refrigeration cycle, heat pump system, air refrigeration cycle, Liquefaction of Gases, production of solid ice. **Psychrometric and air conditioning systems:** Properties of atmospheric air, Psychrometric Chart, Psychrometric Processes, air conditioning equipments, comfort air conditioning, summer and winter air conditioning, cooling load estimation, air distribution and ducts. **Applications of refrigeration and air conditioning:** Domestic refrigerator and freezer, water coolers, ice manufacture, refrigerated trucks, cooling of milk, cold storages, room air conditioner, application of air conditioning in industry.

Text Books:

Reference Books:

18ME2002 REFRIGERATION AND AIR CONDITIONING LAB

Credits: 0:0:1

Course Objectives:
To impart knowledge on
- Refrigeration and air conditioning cycles.
- Refrigeration and air conditioning equipment.
- Working principle of heat pump.

Course Outcomes:
Ability to
- List the components and functions of a household domestic refrigerator.
- Describe the working principle of a water cooler.
- Compare the construction and working principle of window and split air conditioners.
- Analyse the performance of a refrigerator.
- Evaluate the performance of a heat pump.
- Determine the performance of an air conditioner.
List of Experiments
1. Performance test on Refrigeration cycle.
2. Performance test on Heat pump.
3. Performance test on Air Conditioning Cycle.
4. Determination of bypass and capacity factors in air conditioning test rig.
5. Experiments on psychrometric properties of air
6. On-site study of chilling or ice making and cold storage plants.

Reference Books:

18ME2003 THEORY OF MACHINES

Credits: 2:1:0

Course Objectives:
To impart knowledge on
- Fundamentals of mechanisms and principles involved in velocity and acceleration at any point in a link of a mechanism.
- Concepts of toothed gearing and kinematics of gear trains.
- The effects of friction in motion transmission and in machine components and balancing of rotating masses

Course Outcomes:
Ability to
- Illustrate fundamentals of different mechanisms.
- Analyse position, velocity and acceleration of links in mechanisms.
- Understand gear nomenclature and analysis of gear trains
- Design transmission elements considering frictional aspects
- Determine governing speed of various governors
- Balance rotating masses on same and different planes

Course Description

Text Books:

Reference Books:

18ME2004 MACHINE DESIGN
(Use of approved Data books are permitted)

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Stress analysis, theories of failure and material science in the design of machine components.
- Design of common machine elements such as shafts, fasteners, springs, belts and bearings.
- Solving simple, open-ended design problems involving cost, drawings and structural analysis.

Course Outcomes:
Ability to
- Apply basic stress and strain analysis techniques.
- Describe the design process, material selection and calculation of stresses and stress concentrations.
- Make use of standard theories of failure and analyse fatigue to develop safety factors for machine elements.
- Develop solid, hollow shafts and couplings.
- Examine cotter and knuckle joints and design helical and leaf springs.
- Design belt drives, screws and bearings.

Course Description


Text Books:

Reference Books:

Hand book:
18ME2005 MACHINE DRAWING LAB FOR AGRICULTURE

Credits: 0:0:1

Course Objectives:
To impart knowledge on
- The basic concepts of design of agricultural machineries.
- Detailed design and drawing of various components of agricultural machineries.
- Part drawing and assembly drawing.

Course Outcomes:
Ability to
- Identify the angles of projection and dimensioning methods.
- Select suitable standards for fasteners.
- Categorize different forms of screw threads.
- Distinguish between the square, hexagonal nuts and bolts.
- Compare various couplings and joints.
- Construct part drawing from assembled drawing.

List of experiments
1. First and third angle projection, different methods of dimensioning and Sectional drawing of simple machine parts.
2. Forms of screw threads and drawing of BSW, Square and Metric threads.
3. Drawing of square headed and hexagonal headed nuts and bolts & drawing of different types of keys.
4. Drawing of coupling (Sleeve / Flange).
5. Drawing of joints (Cotter / Knuckle).
6. Assembly drawing of simple agricultural equipment.

Reference Books:

18ME2006 HEAT AND MASS TRANSFER IN FOOD PROCESSING

Credits: 2:0:0

Course Objectives:
To impart knowledge on
- Fundamentals and principles of heat and mass transfer.
- Design of heat exchangers.
- Determination of heat transfer coefficient of different modes of heat transfer.

Course Outcomes:
Ability to
- Solve heat transfer problems by applying the principles of conduction, convection, radiation and mass diffusion.
- Design heat transfer systems with extended surfaces.
- Analyse heat exchanger performance.
- Develop empirical correlations to determine the heat transfer coefficient.
- Predict flow patterns in boiling and condensation processes.
- Estimate the diffusion and mass transfer coefficient for gasses and liquids.

Course Description
Effectiveness and efficiency of the fins; unsteady state heat conduction. **Convection:** Forced and free convection, dimensional analysis in convective heat transfer; Dimensionless numbers. **Radiation** emissivity, absorptivity, transmissivity, radiation through black and grey surfaces, determination of shape factors; **Condensation and boiling:** Film- and drop-wise condensation. **Heat Exchangers:** fouling factors, jacketed kettles, LMTD, classification of heat exchangers, heat exchanger design and application of different types of heat exchangers in dairy and food industry. **Mass transfer:** Fick’s law of diffusion, steady state diffusion of gases and liquids through solids, equimolal diffusion, isothermal evaporation of water into air, mass transfer coefficient, application in dairy and food industry.

**Text Books:**

**Reference Books:**

**18ME2007 HEAT TRANSFER LAB FOR AGRICULTURE**

**Credit:** 0:0:1

**Course Objectives:**
To impart knowledge on
- Heat transfer characteristics of various heat transfer apparatus.
- Design calculations of different modes of heat transfer.
- Heat transfer coefficients in thermal systems.

**Course Outcomes:**
Ability to
- Calculate and compare the thermal conductivity of different materials.
- Predict the convective heat transfer coefficient by free convection.
- Determine forced convective heat transfer coefficient using pin-fin.
- Analyze the performance parameters of parallel flow heat exchanger.
- Evaluate the performance parameters of counter flow heat exchanger.
- Estimate the emissivity of grey and black surfaces by radiation.

**List of Experiments**
1. Determination of thermal conductivity of lagged pipe.
2. Determination of thermal conductivity of composite wall.
3. Determination of free convection using a vertical cylindrical rod.
4. Determination of heat transfer coefficient using a fin-pin by forced convection.
5. Determination of heat transfer coefficient using a parallel and counter flow heat exchangers.
6. Determination of emissivity of the given test surface.

**Reference Books:**
18ME2008 CAD APPLICATIONS LAB

Credits: 0:0:2

Course Objectives:
To impart knowledge on
- Simple modelling software.
- Drawing commands using AutoCAD.
- Sectional views, 2D and 3D drawings using AutoCAD.

Course Outcomes:
Ability to
- Make use of basic drawing aids and modifying tools in AutoCAD.
- Construct and dimension lines and arcs using different methods.
- Create 2D drawings using various tool bars.
- Prepare sectional drawings for machine parts.
- Develop isometric drawing of primitive solids.
- Produce 3D drawings using various tool bars.

List of Experiments
1. Drawing Aids: Snap, Grid, Limits, Osnaps tool bars.
5. 2-D drawing of machine parts- Foot step bearing.
6. 2-D Sectional drawing of machine parts- Knuckle joint and stuffing box.
7. Isometric Drawings of primitive solids and combination of primitive solids.
8. Drawing of hexagonal nut, bolt and other machine parts.
11. Practice on 3-D Commands: revolving and joining.

Reference Books:

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Course Objectives: To impart knowledge on
1. Modern engineering tools necessary for engineering drawing
2. Drafting, analysis and to understand the operational functions.
3. Interpretation of technical graphics assemblies of machine components.

Course Outcome: After completing the course the student will be able to
1. Understand the engineering design and solid modelling.
2. Visualize the engineering components.
3. Perform basic geometrical constructions and multiple views of objects.
4. Develop orthographic projection of lines and plane surfaces.
5. Prepare projections and sections of simple solids
6. Prepare isometric and perspective projections of simple solids

LIST OF EXPERIMENTS
CONCEPTS AND CONVENTIONS (Not for Examination)
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.
PLANE CURVES: Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

SCALES: Scales: Construction of Diagonal and Vernier scales.

ORTHOGRAPHIC PROJECTIONS: Orthographic projections – principles, Principal planes-First angle projection-projection of points.


PROJECTION OF POINTS: Projections of points located in four different quadrants

PROJECTION OF LINES: Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces

PROJECTION OF PLANE SURFACES: Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method

PROJECTION OF SOLIDS: Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

SECTION OF SOLIDS: Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.


ISOMETRIC PROJECTIONS: Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones - combination of two solid objects in simple vertical positions and miscellaneous problems.

PERSPECTIVE PROJECTIONS: Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

Text Book:

Reference Book:

Co requisite: Engineering Drawing

Course Objectives: To impart knowledge on
1. To learn engineering design and its place in society
2. To get exposure to the visual aspects of engineering design and graphics standards
3. To apply graphics standards to create working drawings and communicate across industries.

Course Outcome: After completing the course the student will be able to
1. Design a system, component, or process to meet desired needs within realistic constraints and sustainability.
2. Communicate effectively with various stakeholders of engineering design industry
3. Apply techniques, skills, and modern engineering tools necessary for engineering practice
4. Extract mass, moment of inertia and center of gravity from 2D and 3D model data
5. Optimize material required in fabrication of parts.
6. Visualize assembly of system with fewer parts.

**MODULE I – USER INTERFACE (5 Lecture hours)**
Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command window, The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.

**MODULE II – CUSTOMIZATION, DRAWING AIDS, PAGE SETUP AND PRINTING (5 Lecture hours)**
Setting up of units, drawing limits, drawing paper size, scale settings and use of drawing template. Draw to PDF files the printer, Snap to objects manually and automatically using object snap settings; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Printing and saving drawings.

**MODULE III – DRAWING AND MODIFYING (5 Lecture hours)**
Drawing polylines, ellipses, polygons and use of spline curves. Adding and altering objects, moving and duplicating objects, modifying and maneuvering, hatching and sketching. Polar and rectangular arrays. Application of arcs to draw simple parts. Use of text fonts, formatting text and setting title box for drawing template.

**MODULE IV – DIMENSIONING ANNOTATIONS, LAYERING & OTHER FUNCTIONS (5 Lecture hours)**
ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths and weight through modifying existing lines (extend/lengthen).

**MODULE V – ISOMETRIC, ORTHOGRAPHIC AND 2D TO 3D (5 Lecture hours)**
Orthographic projection techniques; drawing isometric drawing from orthographic drawing and vice versa. Creating regions, converting polylines to single entity and 2D to 3D of simple objects. Modeling of simple parts and assemblies. Modifying solids using Boolean operations. Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface. Application of isometric, multi view, auxiliary, and section views. Spatial visualization exercises. Solid, surface, and wireframe models.

**MODULE VI – DEMONSTRATION OF A SIMPLE TEAM DESIGN PROJECT (5 Lecture hours)**
Use of Block commands to model repetitive objects in civil, mechanical, electrical and electronics and computer science industries and apply in a design project. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying color coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling.

**Text Book:**

**Reference Books:**
Course Objectives: To impart knowledge on
1. Statics with an emphasis on force equilibrium and free body diagrams.
2. Significance of centroid, centre of gravity and moment of inertia.
3. Principles to study the motion of a body and concept of relative velocity and acceleration.

Course Outcome: After completing the course the student will be able to
1. Determine the resultant force and moment for a given system of forces.
2. Determine the centroid and second moment of area of simple solids.
3. Apply fundamental concepts of kinematics and kinetics to the analysis of simple / practical problems.
4. Understand basic kinematics concepts – displacement, velocity and acceleration.
5. Understand basic dynamic concepts – force, momentum, work and energy.
6. Determine friction and its effects as per the laws of friction.

MODULE I – STATICS OF PARTICLE (8 Lecture Hours)

MODULE II – STATICS OF RIGID BODIES (8 Lecture Hours)
Centre of gravity and Centroid of composite plane figure – Moment of inertia – Parallel axis and Perpendicular axis theorem – Moment of inertia of composite planes – Mass moment of inertia of simple solid and composite bodies.

MODULE III – KINEMATICS OF PARTICLES (8 Lecture Hours)

MODULE IV – KINETICS OF PARTICLES (7 Lecture Hours)
Work Energy method – Applications of principle of work and energy – Impulse and momentum method - Motion of connected bodies. Impact of elastic bodies.

MODULE V – DYNAMICS OF RIGID BODIES (7 Lecture Hours)
Translation and Rotation about a fixed axis – Equations defining the rotation of a rigid body about a fixed axis – General plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

MODULE VI – FRICTION (7 Lecture Hours)

Text Books:

Reference Books:

Mechanical Engineering

<table>
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<th>Course Objectives: To impart knowledge on</th>
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<tr>
<td>1. Fitting joints, carpentry joints and plumbing practices.</td>
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<td>2. Process planning and procedures to develop models in foundry and smithy laboratories.</td>
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<tr>
<td>3. Sequence of operations adopted in welding and sheet metal laboratories to fabricate various joints and models.</td>
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<th>Course Outcome: After completing the course the student will be able to</th>
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<tbody>
<tr>
<td>1. Apply carpentry and fitting joints, to fabricate useful products.</td>
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<td>2. Prepare green sand moulds for different patterns.</td>
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<td>3. Make machine elements using forging technique.</td>
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<td>4. Use welding equipment’s to join the structures.</td>
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<tr>
<td>5. Design and fabricate the various objects in sheet metal using hand tools.</td>
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<td>6. Apply manufacturing process for typical engineering components.</td>
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LIST OF EXPERIMENTS
1. Making of middle lap joint in carpentry.
2. Making of V joint in Fitting.
3. Assembly of pipes, valves and other fittings in Plumbing.
4. Preparation of green sand mould for stepped cone pulley with core preparation.
5. Making of butt joint by arc welding process.
6. Preparation of J bends from square rod by smithy forging operation.
7. Making of Rectangular tray by sheet metal fabrication.

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<th>Course Objectives: To impart knowledge on</th>
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<tbody>
<tr>
<td>1. IC Engines, External Combustion Engines, Boilers.</td>
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<td>2. Power plants, metal forming, metal joining, machining process</td>
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<td>3. The application of CAD, CAM, MEMS and CIM.</td>
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<th>Course Outcome: After completing the course the student will be able to</th>
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<tr>
<td>1. Describe the working principle of Engines and Turbines.</td>
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<td>2. Classify Boilers and identify different types of engines.</td>
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<td>3. Distinguish conventional and non-conventional power plants.</td>
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<td>4. Examine various types of engineering materials.</td>
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<td>5. Select different types of metal forming and joining processes.</td>
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<td>6. Analyze metal machining processes.</td>
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MODULE I – ENGINES, BOILERS AND REFRIGERATION (8 Lecture Hours)

MODULE II – POWER PLANTS (8 Lecture Hours)

**MODULE III – ENGINEERING MATERIALS**  
(8 Lecture Hours)  

**MODULE IV – INTRODUCTION TO MANUFACTURING PROCESSES** (7 Lecture Hours)  

**MODULE V – INTRODUCTION TO MACHINE TOOLS**  
(7 Lecture Hours)  

**MODULE VI – INTRODUCTION TO CAD/CAM, MEMS AND CIM** (7 Lecture Hours)  

**Text Books:**

**Reference Books:**

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<th>18ME1006</th>
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**Course Objectives:** To impart knowledge on
1. Fitting joints, carpentry joints and plumbing practices.
2. Process planning and procedures to develop models in foundry and smithy laboratories.
3. Sequence of operations adopted in welding and sheet metal laboratories to fabricate various Joints and models.

**Course Outcome:** After completing the course the student will be able to
1. Apply carpentry and fitting joints, to fabricate useful products.
2. Prepare green sand moulds for different patterns.
3. Make machine elements using forging technique.
4. Use welding equipment’s to join the structures.
5. Design and fabricate the various objects in sheet metal using hand tools.
6. Apply manufacturing process for typical engineering components.

**LIST OF EXPERIMENTS**
1. Making of middle lap joint in carpentry.
2. Assembly of pipes, valves and other fittings in Plumbing.
3. Preparation of green sand mould for stepped cone pulley with core preparation.
4. Making of butt joint by arc welding process.

**Text Books:**

Mechanical Engineering
Course Objectives: To impart knowledge on
1. To learn engineering design and its place in society
2. To get exposure to the visual aspects of engineering design and graphics standards
3. To apply graphics standards to create working drawings and communicate across industries.

Course Outcome: After completing the course the student will be able to
1. Understand the engineering design and solid modelling.
2. Visualize the engineering components.
3. Design a system, component, or process to meet desired needs within realistic constraints and sustainability.
4. Communicate effectively with various stakeholders of engineering design industry
5. Apply techniques, skills, and modern engineering tools necessary for engineering practice
6. Visualize assembly of system with fewer parts.

USER INTERFACE AND CUSTOMIZATION (5 Lecture hours)
Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command window, The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.
Setting up of units, drawing limits, drawing paper size, scale settings and use of drawing template. Draw to PDF files the printer, Snap to objects manually and automatically using object snap settings;

DRAWING AIDS, PAGE SETUP AND PRINTING (5 Lecture hours)
Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Printing and saving drawings.

DRAWING AND MODIFYING (5 Lecture hours)
Drawing polylines, ellipses, polygons and use of spline curves. Adding and altering objects, moving and duplicating objects, modifying and maneuvering, hatching and sketching. Polar and rectangular arrays. Application of arcs to draw simple parts. Use of text fonts, formatting text and setting title box for drawing template.

DIMENSIONING ANNOTATIONS, LAYERING & OTHER FUNCTIONS (5 Lecture hours)
ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths and line weight through modifying existing lines (extend / lengthen).

ORTHOGRAPHIC PROJECTIONS: (5 Lecture hours)
Orthographic projections – principles, Principal planes - First angle projection, Conversion of isometric view into orthographic views.

PROJECTION OF POINTS: (5 Lecture hours)
Projections of points located in four different quadrants.

PROJECTION OF LINES: (5 Lecture hours)
Projection of straight lines (only First angle projections) parallel to both planes, inclined to one plane and parallel to the other, inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces.

PROJECTION OF PLANE SURFACES: (5 Lecture hours)
Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

PROJECTION OF SOLIDS: (5 Lecture hours)
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

SECTION OF SOLIDS: (5 Lecture hours)
Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.
DEVELOPMENT OF SURFACES: (5 Lecture hours)

ISOMETRIC PROJECTIONS: (5 Lecture hours)
Principles of isometric projection – isometric scale – Isometric views of simple solids and truncated solids - Prisms, pyramids, cylinders, cones - combination of two solid objects in simple vertical positions and miscellaneous problems.

Text Book:

Reference Book:

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<th>18ME2009</th>
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Co requisite: Fluid Mechanics and Machines

Course Objectives: To impart knowledge on
1. The calibration of flow measurement devices and calculation of losses due to friction and pipe fittings.
2. The working principles of Pumps.
3. The working of different types of hydraulic turbines.

Course Outcomes: After completing the course the student will be able to
1. Determine friction factor.
2. Calibrate venture meter.
3. Calibrate orifice meter.
5. Determine minor losses in pipes.
6. Conduct load test on pelton wheels.

LIST OF EXPERIMENTS
1. Determination of Darcy’s friction factor.
2. Calibration of venturi meter.
3. Calibration of orifice meter.
4. Determination of minor losses in pipes.
5. Performance of single stage centrifugal pump.
6. Load test on Pelton wheel.
7. Performance of Turbine- Kaplan, Francis, pumps-gear/centrifugal/reciprocating pumps

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<th>18ME2010</th>
<th>HEAT AND MASS TRANSFER</th>
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Pre requisite: Thermodynamics

Course Objectives: To impart knowledge on
1. To build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
2. To understand governing equations and solution procedures for the three modes, along with solution of practical problems using empirical correlations.
3. To provide knowledge on boiling and condensation heat transfer, analysis, design of heat exchangers and mass transfer.

Course Outcome: After completing the course the student 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 where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer.
3. Evaluate radiation heat transfer between black, gray surfaces and the surroundings.
4. Design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.
5. Apply boiling and condensation correlations to two phase flow processes.
6. Apply mass transfer correlations to process–based problems.

MODULE I –CONDUCTION (8 Lecture Hours)
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, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

MODULE II –CONVECTION (8 Lecture Hours)
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.

MODULE III –RADIATION (8 Lecture Hours)
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.

MODULE IV – HEAT EXCHANGER (7 Lecture Hours)
Types of heat exchangers, overall heat transfer coefficient, fouling, Analysis and design of heat exchangers using both LMTD and ε-NTU methods.

MODULE V – BOILING AND CONDENSATION (7 Lecture Hours)
Boiling and condensation heat transfer, pool boiling curve, types of condensation, correlations and simple problems.

MODULE VI – MASS TRANSFER (7 Lecture Hours)
Introduction mass transfer, Fick’s law of diffusion, equimolar counter diffusion, Convective mass transfer coefficient, non-dimensional number in mass transfer, evaporation process in the atmosphere. Similarity between heat and mass transfer

Text Books:

Reference Books:
Co requisite: Heat and Mass Transfer

Course Objectives: To impart knowledge on
1. The heat transfer characteristics of various heat transfer apparatus
2. The design calculations of different modes of heat transfer
3. Conducting the heat transfer experiments and practically learn how to find heat transfer coefficients

Course Outcome: After completing the course the student will be able to
1. Calculate and compare the thermal conductivity of different materials.
2. Predict the convective heat transfer coefficient by free convection.
3. Analyze the performance of forced convective heat transfer coefficient through pin – fin.
4. Evaluate the performance of radiation through black and gray bodies.
5. Analyze the performance parameters of parallel flow heat exchanger.
6. Analyze the performance parameters of counter flow heat exchanger.

LIST OF EXPERIMENTS
1. Measurement of thermal conductivity through a composite wall.
3. Determination of thermal conductivity in a guarded plate.
4. Measurement of heat transfer coefficient in a vertical cylindrical rod by free convection.
5. Measurement of heat transfer coefficient in a flat plate by natural convection.
9. Determination of emissivity of the given test surface.
10. Determination of Stefan–Boltzmann constant in radiation heat transfer.

Course Objectives: To impart knowledge on
1. Nature of stresses developed in simple geometries
2. Elastic deformation occurring in various simple geometries for different types of loading.
3. Stresses action on shafts, springs and cylinders

Course Outcome: After completing the course the student will be able to
1. Recognize various types loads applied on machine components
2. Understand the nature of internal stresses that will develop within the components
3. Analyse the stresses acting simple geometry of structures.
4. Evaluate the strains and deformation due to the elastic stresses developed.
5. Compute inertia, slopes and deflection in beams
6. Determine the torsional stresses of shaft and hoop stresses in cylinders

MODULE I – SIMPLE STRESSES  (8 Lecture Hours)
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.

MODULE II – BEAMS  (8 Lecture Hours)
Beams and types of transverse loading on beams - shear force and bending moment diagrams.
Types of beam supports- cantilevers, simply supported, and over-hanging beams.

MODULE III – LOAD ON BEAMS  (8 Lecture Hours)
Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.
Module IV – MOMENT OF INERTIA (7 Lecture Hours)
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.

Module V – TORSION (7 Lecture Hours)
Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

Module VI – STRESSES IN CYLINDER (7 Lecture Hours)
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:

Reference Books:

Co requisite: Strength of Materials

Course Objectives: To impart knowledge on
1. The evaluation of tensile properties steel
2. Evaluation of bending strength of wood
3. Evaluation of hardness, impact and shear strength of steel

Course Outcome: After completing the course the student will be able to
1. Evaluate ductility and tensile strength of mild steel.
2. Determine resilience of springs.
3. Evaluate bending strength of wood.
4. Evaluate strength of beams.
5. Evaluate impact strength.

LIST OF EXPERIMENTS
1. Tension test on mild steel
2. Test on springs (open coiled springs)
3. Static bending test on wood
4. Deflection tests on cantilever beams
5. Charpy Impact tests
6. Double shear and Rockwell Hardness tests on mild steel.

Reference books
Lab manual
Pre requisite: Strength of Materials

Course Objectives: To impart knowledge on
1. Relationship between the loads applied to a non-rigid body and the internal stresses and deformations induced in the body.
2. Different approaches to calculate slope and deflection for various types of beams.
3. Mohr’s circle method to find magnitude and direction of the principal stresses.

Course Outcome: After completing the course the student will be able to
1. Understand stress and strain relations in simple solids.
2. Estimate stress and strain values in simple solids subjected thermal loads.
3. Analyze the different types of loading and the consequent deflection.
4. Determine maximum stress and angular deflection of solid and hollow shafts.
5. Evaluate stress and strain using Mohr’s circle.
6. Apply concepts of failure theories to determine safe design.

MODULE I – STRESSES AND STRAINS (8 Lecture Hours)

MODULE II – SIMPLE BENDING AND TYPES OF BEAMS (7 Lecture Hours)
Cantilever, simply supported, overhanging: Shear Force and Bending Moment Diagrams Theory of simple bending.

MODULE III – DEFLECTION OF BEAMS (8 Lecture Hours)
Deflection of beams by Double integration method – Macaulay’s method – Area moment theorems for computation of slopes and deflections in beams – Conjugate beam method.

MODULE IV – TORSION OF SHAFTS (8 Lecture Hours)
Introduction to Torsion – derivation of shear strain – Torsion formula – stresses and deformations in circular and hollow shafts – Stepped shafts – shafts fixed at the both ends – Stresses in helical springs. Bending stress and shear stress in beams.

MODULE V – BI-AXIAL STRESS SYSTEM (7 Lecture Hours)
Biaxial state of stress – Stress at a point – stresses on inclined planes – Principal stresses and Principal strains and Mohr’s circle of stress. Thin cylinders and shells – deformation of thin cylinders and shells.

Module VI – THEORY OF COLUMNS (8 Lecture Hours)
Theory of columns – Long column and short column - Euler’s formula – Rankine’s formula - Secant formula - beam column

Text Books:

References Books:
Mechanical Engineering

18ME2015 | KINEMATICS AND THEORY OF MACHINES | L T P C
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**Course Objectives:** To impart knowledge on
1. Displacement, velocity and acceleration at any point in a rigid link of a mechanism
2. Cam profiles to give required follower motion and gear combinations to meet the transmission requirements.
3. Turning moment diagram of flywheels and control of machines by governors and gyroscopes.

**Course Outcome:** After completing the course the student will be able to
1. Determine mobility, position, velocity and acceleration of links in mechanism.
2. Design cam profiles to meet the motion requirements in mechanisms.
3. Determination of forces on parts of slider-crank mechanism and design of flywheel.
4. Predict balancing mass requirement in rotary and reciprocating unbalanced systems.
5. Determine frequency of translational and longitudinal vibration.
6. Apply the use of governors to control speed and gyroscopes to navigate.

**MODULE I – KINEMATICS OF SIMPLE MECHANISM** (12 Lecture Hours)
Basics of Mechanisms - Basic kinematic concepts and definitions - Description of some common mechanisms - Design of quick return crank-rocker mechanisms Kinematics of Linkage Mechanisms - Displacement, velocity and acceleration analysis of simple mechanisms - Coincident points - Coriolis component of Acceleration.

**MODULE II – KINEMATICS OF CAM** (10 Lecture Hours)

**MODULE III – STATIC FORCE ANALYSIS AND FLYWHEEL** (10 Lecture Hours)

**MODULE IV – DYNAMIC ANALYSIS AND BALANCING** (10 Lecture Hours)
Dynamic analysis of Slider–crank mechanism. Balancing - Static and dynamic balancing - Partial balancing of reciprocating masses of in-line, V and radial engines.

**MODULE V – MECHANICAL VIBRATIONS** (10 Lecture Hours)

**MODULE VI – GOVERNORS AND GYROSCOPE** (8 Lecture Hours)
Mechanism for Control: Governors - Types - Characteristics - Effect of friction - Other Governor mechanisms. Gyroscopes - Gyroscopic effects in Automobiles, ships and airplanes.

**Text books:**

**Reference books:**

Mechanical Engineering
### Course Information

**Course Code:** 18ME2016  
**Course Title:** DESIGN OF MACHINE ELEMENTS  
**Credits:** L: 3  T: 0  P: 0  C: 3

**Pre-requisite:** Kinematics and Theory of Machines

**Course Objectives:** To impart knowledge on
1. Design principles and basic design procedures.
2. Using design data for the design of mechanical elements.

**Course Outcome:** After completing the course the student will be able to
1. Understand the standard design procedure for Design of machine elements.
2. Analyse stresses acting on components and determine the size based on theories of failure.
3. Design machine components for a given load condition using design data handbooks.
4. Decide specifications as per standards given in design data and select standard components to improve interchangeability.
5. Design and develop nonstandard machine components.
6. Prepare a detail design layout and drawing of machine.

### Modules

**Module I – STRESSES IN MACHINE MEMBERS**  
(8 Lecture Hours)  
Introduction to the design process, Design considerations - limits, fits and standardization, Factors influencing machine design, selection of materials based on physical and mechanical properties. Direct, bending, torsional and combined stress equations, Impact and shock loading. Failure theories.

**Module II – VARIABLE AND CYCLIC LOADS AND BEARINGS**  
(8 Lecture Hours)  

**Module III – SHAFTS AND COUPLINGS**  
(7 Lecture Hours)  

**Module IV – JOINTS AND SPRINGS**  
(7 Lecture Hours)  
Design of bolted, riveted and welded joints, Threaded fasteners, Cotter joints, Knuckle joints and pipe joints. Design of helical, leaf, disc and torsional springs under constant loads and varying loads. Design of Power Screws.

**Module V – DESIGN OF ENGINE COMPONENTS**  
(8 Lecture Hours)  
Design of piston, connecting rod, crankshaft, and flywheel.

**Module VI – BRAKES AND CLUTCHES**  
(7 Lecture Hours)  
Design of brakes, clutches – Single plate, Multiplate & Cone.

### Text Books:

### Reference Books:
Pre requisite: Kinematics and Theory of Machines, Design of Machine Elements

Course Objectives: To impart knowledge on
1. The concepts, procedures and the data, to design and analyze machine elements in power transmission systems.
2. Competency to specify, select and design the mechanical components for transmission systems.

Course Outcome: After completing the course the student will be able to
1. Identify the working principles of mechanical components employed in mechanical transmission systems.
2. Apply suitable theories and basic engineering principles and procedures to design the transmission elements.
3. Select appropriate engineering design data from standard data books for mechanical transmission components.
4. Design transmission systems based on the requirements.
5. Design and Draw speed reducer, multispeed gear box.
6. Evaluate the torque, power and other functional requirements of power transmission Elements.

MODULE I – BEARINGS
Bearings – Introduction, types and applications, Selection of bearings based on loads, Sliding contact bearing-terminology, design of Journal bearings, design of Rolling contact bearing.

MODULE II – BELTS, ROPE AND CHAIN DRIVES

MODULE III – SPUR, HELICAL AND BEVEL GEARS

MODULE IV – WORM AND SKEW GEARS
Worm gear – applications, advantages, efficiency of worm gear, design of worm gear, design of Skew gears. Design of a Ratchet & pawl mechanism.

MODULE V – GEAR BOX
Speed reducer- types and applications, design of speed reducer. Multispeed Gearbox – types, applications, layout of gear box, speed & kinematic diagrams, design of gearbox.

MODULE VI – GENEVA MECHANISM, CAM DRIVES AND POWER SCREWS

Text Books:

Reference Books:
Co requisite: Kinematics and Theory of Machines, Design of Machine Elements

Course Objectives: To impart knowledge on
1. The fundamental principles of dynamics.
2. Mechanical systems using a free body diagram.
3. Equations of motion for translational and rotational mechanical systems.

Course Outcome: After completing the course the student will be able to
1. Compute the moment of inertia of rigid bodies.
2. Demonstrate the working principles of gyroscope.
3. Determine balancing mass in the rotating systems.
4. Demonstrate the principles of kinematics and dynamics of machinery.
5. Use the measuring devices for dynamic testing.
6. Study the effect of dynamics on vibrations in single and multi–degree of freedom system.

LIST OF EXPERIMENTS
1. a) Study of gear parameters.
   b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
   b) Kinematics of single and double universal joints.
3. a) Determination of Mass moment of inertia of Fly wheel and Axle system.
   b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
   c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
4. Motorized gyroscope – Study of gyroscopic effect and couple.
5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
   b) Multi degree freedom suspension system – Determination of influence coefficient.
8. a) Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped Natural frequencies.
   b) Vibration Absorber – Tuned vibration absorber.
9. Vibration of Equivalent Spring mass system – undamped and damped vibration.
11. a) Balancing of rotating masses. (b) Balancing of reciprocating masses.
12. a) Transverse vibration of Free-Free beam – with and without concentrated masses.
   b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
   c) Determination of transmissibility.

Co requisite: Engineering Drawing, Design of Machine Elements

Course Objectives: To impart knowledge on
2. Sectional views of joints, connecting rod, plummer block, couplings, screw jack, vice and I.C engine parts.
3. Surface modelling and study parts drawings of an assembly.

Course Outcome: After completing the course the student will be able to
1. Investigate proper representation of mechanical parts by symbols and dimension with limits, fits.
2. Apply geometrical tolerances and represent surface finish and welding parameters.
3. Draw sectional views and sectional views of Cotter Joints & Knuckle joints, flange couplings.
4. Produce sectional and auxiliary views of Cylinder head, Piston, Connecting rod, camshaft and Crankshaft.
5. Interpret parts drawing of machine parts and do assembly of vice, lathe tailstock, Safety valves.
6. Apply surface modeling to body of hair drier, car and washing machine etc.

MODULE I – DRAWING STANDARDS AND CONVENTIONS (8 Lecture Hours)
Conventional representation of threaded parts, springs, gear. Abbreviations and symbols for use in technical drawings. Conventions for sectioning and dimensioning.

MODULE II – LIMITS, FITS AND TOLERANCES (8 Lecture Hours)

MODULE III – COMPUTER AIDED DRAFTING OF JOINTS AND VALVES (12 Lecture Hours)
Drawings of Cotter Joints & Knuckle joints, flange couplings and steam relief valves.

MODULE IV – COMPUTER AIDED DRAFTING OF I.C. ENGINE PARTS (12 Lecture Hours)
Cylinder head, Piston, Connecting rod, camshaft and Crankshaft.

MODULE V – COMPUTER AIDED ASSEMBLY DRAWINGS (12 Lecture Hours)
Preparation of Assembly drawing and detailed drawing of mechanical devices- plummer block, vice, lathe tailstock and Screw jack.

MODULE VI – COMPUTER AIDED SURFACE MODELING (8 Lecture Hours)
Surface modelling of automobile body and Appliances (electrical and domestic)

Text book:

Reference books:
3. Revised IS Codes 10711, 10713, 10714, 9609, 1165, 10712, 10712, 10715, 10716, 10717, 11663, 11668, 11669, 8043, 8000.
4. Pro/E Wildfire 5 manuals.

Course Objectives: To impart knowledge on
1. Principle, methods and applications of casting.
2. Working principle and applications of bulk forming and sheet metal.

Course Outcome: After completing the course the student will be able to
1. Select the appropriate casting process to produce complex parts.
2. Develop products with superior mechanical properties using bulk forming processes.
3. Perform various sheet metal operations on metal sheets.
4. Create permanent joints in working assemblies using welding techniques.
5. Suggest appropriate unconventional manufacturing process for the machining of difficult-to-machine materials.
6. Enhance the properties of components using powder metallurgy.

MODULE I – CASTING AND MOULDING (7 Lecture Hours)
Metal casting processes and equipment, casting allowances, special casting techniques, casting defects and remedial measures.
MODULE II – BULK FORMING (7 Lecture Hours)
Plastic deformation and yield criteria; Fundamentals of hot and cold working processes; load estimation for bulk forming and defects (forging, rolling, extrusion, drawing).

MODULE III – SHEET METAL FORMING (8 Lecture Hours)
Sheet metal characteristics; shearing, bending and drawing operations; Formability of sheet metal; Introduction to high energy rate forming (HERF).

MODULE IV – JOINING/FASTENING PROCESSES (7 Lecture Hours)
Physics of welding design considerations in welding. Solid and liquid state joining processes; Special welding techniques; brazing and soldering; defects in welding.

MODULE V – UNCONVENTIONAL MACHINING PROCESSES (8 Lecture Hours)
Abrasive jet machining; Ultrasonic machining; Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire- EDM; Laser Beam Machining, Plasma Arc Machining; Electron Beam Machining.

MODULE VI – POWDER METALLURGY AND MICRO SYSTEMS FABRICATION (8 Lecture Hours)
Powder metallurgy: production of metal powder; particle size, distribution and size; blending; iso-static pressing and other compacting and shaping processes; sintering; Secondary and finishing processes; impregnation; infiltration; applications. Photolithography, Ion Implantation and Diffusion; Oxidation, CVD, PVD, Etching; Overview of Micro Machining; Bulk Micro Machining; Surface Micro Machining; LIGA Process

Text Books:

Reference Books:
5. Kaushik Kumar, Divya Zindani, J. Paulo Davim, “Advanced Machining and Manufacturing Processes (Materials Forming, Machining and Tribology)” Springer, 2018

18ME2021
MANUFACTURING LABORATORY I
(METALLURGY, METROLOGY & MECHATRONICS)
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Co requisite: Manufacturing Processes

Course Objectives: To impart knowledge on
2. The principles of linear and angular measurement.
3. Fundamental systems of fluid power controls.

Course Outcome: After completing the course the student will be able to
1. Prepare samples for metallurgical studies following appropriate metallographic procedure and extract metallographic images.
2. Analyze various phases of Iron Carbon alloy.
3. Demonstrate measurements using linear and angular measuring instruments.
5. Assess the optimal components of pneumatic system.

LIST OF EXPERIMENTS
1. Use of Tool Maker’s Microscope.
2. Comparator and sine bar.
3. Surface finish measurement equipment.
4. Bore diameter measurement using micrometer and telescopic gauge.
5. Use of Autocollimator.
6. Determination of strength and permeability of foundry sand.
7. Identification of Cast Iron specimen (a) Grey Cast Iron (b) Spheroidal Graphite Iron (c) Malleable Cast Iron.
8. Sieve Analysis.
9. Identification of Heat Treated steels: (a) Annealed (b) Normalized (c) Hardened (d) Tempered steels and Case Hardened Steel.
10. Identification of brasses and bronzes and aluminum.
11. Basic pneumatic logic gate circuits.
12. Pneumatic material handling circuit.

Course Objectives: To impart knowledge on
1. The principles and applications of metal cutting.
2. Construction and working principles of lathe, milling, reciprocating machine tools, hole making and gear cutting operations.
3. Non-conventional machining and additive processes in industry & research.

Course Outcome: After completing the course the student will be able to
1. Select the machining processes suitable for machining a component.
2. Generate the process sequences for machining in machine tools to reduce the lead time.
3. Analyze and choose the optimized machining parameters.
4. Select cutting tools for the identified machining sequences.
5. Appraise the abrasive machining process based on the surface finish requirements.

MODULE I – THEORY OF METAL CUTTING (8 Lecture Hours)

MODULE II – TURNING AND RECIPROCATING MACHINE TOOLS (8 Lecture Hours)

MODULE III – MILLING, HOLE MAKING AND GEAR CUTTING (9 Lecture Hours)

MODULE IV – ABRASIVE PROCESSES (9 Lecture Hours)
Grinding wheel – designation and selection, types of grinding machines –Cylindrical grinding, surface grinding, centerless grinding, honing, lapping, super finishing, polishing and buffing.

MODULE V – NON-CONVENTIONAL MACHINING PROCESSES (9 Lecture Hours)
Need for Unconventional processes – Electrical discharge machining (EDM) – Dielectric fluid – electrode – wire EDM – Electrochemical Machining (ECM) – Electrochemical Grinding (ECG), Ultrasonic Machining (USM) – Abrasive Jet Machining (AJM) – Laser Beam Machining (LBM) – Plasma Arc Machining (PAM).

MODULE VI – ADDITIVE MANUFACTURING (7 Lecture Hours)
3D printing, Rapid prototyping and rapid tooling.
Text Books:

Reference Books:

Course Objectives: To impart knowledge on
1. Types of machine tools.
2. Metal cutting operations.
3. Selection of tools for machining operations.

Course Outcome: After completing the course the student will be able to
1. Demonstrate skills to machine cylindrical components using Lathe.
2. Demonstrate skills to machine V-block, rectangular block and key way using shaping/milling/slotting machine.
3. Demonstrate skills to cut spur gear using gear hobbing machine.
4. Demonstrate skills to do grinding operation in cylindrical grinding machine.
5. Interpret component drawings and select appropriate cutting tools.
6. Compare the dimensions of the components using measuring instruments.

LIST OF EXPERIMENTS
1. Step turning operation using Lathe.
2. Taper turning operation using Lathe.
4. Drilling and boring operation using Lathe.
5. External thread cutting operation using Lathe.
7. Machining rectangular block using shaper.
8. Machining V-block using shaper.
9. Machining rectangular block using milling machine.
10. Key way cutting using slotting machine.

Text/Reference Books:
Co requisite: Manufacturing Technology

Course Objectives: To impart knowledge on
1. NC programming for CNC turning and milling operation and execution.
2. Selection of tools for a machining operation.
3. Simulation and verification of machining processes.

Course Outcome: After completing the course the student will be able to
1. Know features and applications of CNC turning and machining centers.
2. Understand the CNC control in modern manufacturing system.
3. Prepare CNC Programming for different mechanical parts using G codes and M codes.
4. Implement the communication procedure for transmitting the CNC part program from an external computer to the control of the CNC machine tool.
5. Generate automated tool paths for a given engineering component.
6. Operate a modern industrial CNC machine tool for actual machining of simple and complex mechanical.

LIST OF EXPERIMENTS
1. Step turning and Taper turning in CNC.
2. Thread cutting in a CNC Turning Centre.
3. Face milling and step milling in Machining Centre.
4. Profile cut using linear and circular interpolation.
5. Pockingting and slotting in CNC.
7. Spiral cutting in a CNC 4–axis Trainer Mill.

Reference Books:
Lab manual

Course Objectives: To impart knowledge on
1. The properties and applications of various engineering materials.
2. Testing methods and procedures to find the mechanical properties of engineering materials.
3. Construction of phase diagrams and also the importance of iron-iron carbide phase diagram and different heat treatment.

Course Outcome: After completing the course the student will be able to
1. Identify crystal structures of common engineering materials.
2. Understand the principle of various microscopes.
3. Identify the various behaviors of materials and defects.
4. Analyze failures and predict service behavior of materials for various applications.
5. Interpret and determine the right compositions of metals.
6. Select the heat treatment process based on the metals.

MODULE I – CRYSTAL STRUCTURE
(7 Lecture Hours)
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.

MODULE II – MECHANICAL PROPERTY MEASUREMENT
(7 Lecture Hours)
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.

MODULE III – STATIC FAILURE THEORIES
(9 Lecture Hours)
Ductile and brittle failure mechanisms, Tresca, Von-miss, 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, S-N curve, endurance and
fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT).

**MODULE IV – PHASE DIAGRAMS** *(6 Lecture Hours)*
Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binaryphase 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.

**MODULE V – HEAT TREATMENT** *(7 Lecture Hours)*
Annealing, tempering, normalizing 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.

**MODULE VI – STEEL, COPPER ALLOYS & OTHERS** *(9 Lecture Hours)*
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 cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys.

**Text Books:**

**Reference Books:**

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**Course Objectives:** To impart knowledge on
1. To impart knowledge on the basic principles of engines used for automobiles and different systems.
2. To impart knowledge on the various transmission and drive line units of automobiles.
3. To broaden the importance of sensors and fuel injection systems.

**Course Outcome:** After completing the course the student will be able to
1. Identify the importance and functions of vehicle frame.
2. Describe the thermodynamic principles behind the working of petrol and Diesel.
3. Recognize the construction and working principles of SI and CI engines.
4. Express the functions and components of fuel injection and ignition systems.
5. Summarize the functions and components of engine cooling, lubrication and ignition systems.
6. Outline the functions and components of electric and hybrid vehicles.

**MODULE I - INTRODUCTION** *(8 Lecture Hours)*
Classification of vehicles, body and load - Layout of an automobile chassis, Function of major components of a vehicle and introduction to their different systems such as Frame, transmission systems - clutch and gear box, differential, braking system, steering and suspension systems.

**MODULE II - THERMODYNAMICS** *(7 Lecture Hours)*
Zeroth, First, second and third law of thermodynamics (concept only), Otto cycle, diesel cycle, fuel used properties of fuels, air requirement for complete combustion of fuel.
MODULE III - IC ENGINES  
(8 Lecture Hours)  
Concept of two stroke and four stroke petrol and diesel engines and their applications to automobiles. Various terms, Valves and Actuating mechanisms – Inlet and Exhaust manifolds. Specification of automobile engines.

MODULE IV - ENGINE LUBRICATION AND COOLING SYSTEMS  
(7 Lecture Hours)  
Lubrication of engine components, Lubrication system – wet sump and dry sump, crankcase ventilation, Types of cooling systems – liquid and air cooled, comparison of liquid and air cooled systems.

MODULE V - AUTOMOTIVE FUEL INJECTION & IGNITION SYSTEM  
(8 Lecture Hours)  
Automobile fuel system: Fuel tank, filters, spark plug, ignition systems (Battery and magneto ignition system), Current trends in multi point fuel injection system (MPFI), Gasoline Direct Injection (GDI), Common Rail Direct Injection (CRDI).

MODULE VI - AUTO INDUSTRY AND FUELS FOR HYBRID VEHICLES  
(7 Lecture Hours)  
History, leading manufacturers, development in automobile industry, trends, new products. Electric and Hybrid vehicles: types, applications. Pollution and environmental aspects – norms.

Text Books:  

Reference Books:  

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<th>FUNDAMENTALS OF THERMAL SCIENCES AND FLUID MECHANICS</th>
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Course Objectives: To impart knowledge on  
1. Work and heat interactions, balance of energy between system and its surroundings  
2. Application of I law and II law of thermodynamics to various energy conversion devices  
3. Application of mass and momentum conservation laws for fluid flows, measurement of velocity and pressure variations in various types of simple flows.

Course Outcome: After completing the course the student will be able to  
1. Apply energy balance to systems and control volumes, in situations involving heat and work interactions  
2. Evaluate the performance of energy conversion devices  
3. Apply gas laws to solve problems related to gas mixtures  
4. Determine fluid properties & analyze forces acting on immersed bodies.  
5. Mathematically analyze simple flow situations  
6. Determine rate of flow and calculate flow losses through pipes.

MODULE I – FUNDAMENTALS OF THERMODYNAMICS  
(8 Lecture Hours)  
System & Control volume; Property, State, Path, Process, thermodynamic cycle, thermodynamic equilibrium, quasi static process, concept of continuum, Temperature, Definition of thermal equilibrium and Zeroth law, Thermodynamic definition of work and heat - Displacement work; Path dependence of work and heat, illustrations for simple processes.

MODULE II – FIRST LAW OF THERMODYNAMICS  
(7 Lecture Hours)  
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, 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;

MODULE III – SECOND LAW OF THERMODYNAMICS  
(8 Lecture Hours)  
Heat engines, Refrigerator and heat pump, Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale ideal gases and ideal gas mixtures.
MODULE IV – FLUID PROPERTIES AND FLUID STATICS (7 Lecture Hours)
Units and dimensions- Definition of fluid, Properties of fluids, mass density, specific volume, specific gravity, viscosity, Newton’s law of viscosity, compressibility, Capillarity and surface tension, Fluid Statics: Pascal’s law –Measurement of pressure – Manometers.

MODULE V – EQUATIONS OF FLUID FLOW (8 Lecture Hours) Types of flow, Velocity and acceleration, Control volume- application of continuity equation and momentum equation, Incompressible flow, Euler’s equation – Bernoulli’s equation and its applications.

MODULE VI – FLOW THROUGH CIRCULAR CONDUITS (7 Lecture Hours)
concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Pipes connected in series and parallel, Need for dimensional analysis – methods of dimension analysis. Turbines, air compressors, R & AC, simple numerical only

Text Books:

Reference Books:

Course Objectives: To impart knowledge on
1. Basic principles of hydraulic and pneumatic systems.
2. Actuation modes and control systems.
3. Programming skills in PLC

Course Outcome: After completing the course the student will be able to
1. Understand the salient features and constructional details of both hydraulic and Pneumatic systems
2. Understand the various types of actuation modes and control system design procedures for design of circuits and to control them.
3. Understand the concepts of servo and proportional valves
4. Analyze various application circuits
5. Apply the above outcomes to design pneumatic and hydraulic circuits.
6. Build a PLC programme for a particular application

MODULE I – INTRODUCTION (5 Lecture Hours)
Introduction to fluid power, properties - hydraulic fluids, air. Selection of hydraulic fluids, comparison between hydraulics and pneumatics.

MODULE II – ELEMENTS OF HYDRAULIC SYSTEMS (7 Lecture Hours)

MODULE III – HYDRAULIC SYSTEM DESIGN AND APPLICATIONS (9 Lecture Hours)
MODULE IV – PNEUMATIC CONTROL (4 Lecture Hours)
Components, constructional details, filter, lubricator, regulator, constructional features, types of actuators, control valves for direction, pressure and flow, air motors, air hydraulic equipments.

MODULE V – PNEUMATIC CONTROL SYSTEM DESIGN (8 Lecture Hours)
General approach to control system design, symbols and drawings, schematic layout, travel step diagram, circuit, control modes, program control, sequence control, cascade method, Karnaugh-Veitch mapping.

MODULE VI – ADVANCED TOPICS IN HYDRAULICS AND PNEUMATICS (9 Lecture Hours)
Electro pneumatics, ladder diagram. Servo and Proportional valves - types, operation, application. Hydro-Mechanical servo systems. PLC programming for specific hydraulic and pneumatic applications.

Text Books:

Reference Books:

Course Objectives:
To impart knowledge on
1. Basic principles of hydraulic and pneumatic systems.
2. Actuation modes and control systems.
3. Simulation software for design of hydraulic and pneumatic circuits.

Course Outcome:
After completing the course the student will be able to
1. Understand constructional details of both hydraulic and Pneumatic systems.
2. Design and Simulation of Pneumatic and Hydraulic circuits using Fluid SIM software
3. Testing of simple pneumatic and hydraulic circuits using single and multiple actuators
4. Testing of electro pneumatic multiple actuator circuits
5. Testing of hydraulic regenerative circuit
6. Testing of electro hydraulic multiple actuator circuits

LIST OF EXPERIMENTS
1. Design of simple pneumatic and hydraulic circuits using basic components.
2. Construction and testing of multiple pneumatic actuator circuit using Cascade method.
4. Construction and testing of a hydraulic actuator regenerative circuit.
5. Co-ordinated motion of actuators using electro – hydraulic elements
6. Design and Simulation of hydraulic and pneumatic circuits using Fluid SIM
Course Objectives: To impart knowledge on
1. The fundamental principles of dynamics.
2. Equations of motion for translational and rotational mechanical systems.

Course Outcome: After completing the course the student will be able to
1. Compute the moment of inertia of rigid bodies.
2. Demonstrate the working principles of gyroscope.
3. Determine balancing mass in the rotating systems.
4. Demonstrate the principles of kinematics and dynamics of machinery.
5. Design components to meet desired needs within realistic constraints and sustainability.
6. Extract production drawing from solid model and assembly of components.

LIST OF EXPERIMENTS
1. Study of the effect of link length parameters on the output of a Four Bar Mechanism and Slider Crank Mechanism.
2. Determination of moment of inertia of connecting rod.
3. Static and dynamic balancing using rotating unbalanced test rig.
4. Preparation of cam displacement curve and determination of jump speed of the cam.
5. Study on epicyclic gear train and worm wheel reducers.
6. Modeling of engineering components using modeling software.
7. Extraction of Production drawing from solid model.
8. Assembly of engineering components using modeling software.

Course Objectives: To impart knowledge on
1. Displacement, velocity and acceleration at any point in a rigid link of a mechanism
2. Cam profiles to give required follower motion and gear combinations to meet the transmission requirements.
3. Different types of gears and gear trains

Course Outcome: After completing the course the student will be able to
1. Understand the fundamental concepts of kinematic links, kinematic pairs and kinematic chains
2. Apply Grashoff’s law for four bar, slider crank and common mechanisms
3. Calculate displacement, velocity and acceleration in simple mechanisms.
4. Analysis of planar mechanisms, force, moment and balancing of kinematic pairs
5. Design and calculate the velocity and motion of cams
6. Understand the fundamental concepts of various transmission devices

MODULE I – BASICS OF MECHANISMS (8 Lecture Hours)
Definitions: Link, Kinematic pair, Kinematic chain, Mechanism and Machine - Degree of freedom – Mobility – Kutzbach criterion - Grashoff’s law - Kinematic inversions: Four bar and slider crank mechanism - Mechanical advantage - Transmission angle - Description of common mechanisms, applications of mechanisms.

MODULE II – KINEMATIC ANALYSIS (7 Lecture Hours)
Displacement, velocity and acceleration analysis in simple mechanisms using graphical and analytical methods.

MODULE III – DESIGN/SYNTHESIS OF PLANAR MECHANISMS (8 Lecture Hours)
Number and dimensional synthesis – two and three positions (relative motion) synthesis of slider crank and four bar mechanisms. Design of simple planar linkages, Computer aided synthesis and analyses of simple planar mechanisms.

MODULE IV – FORCE ANALYSIS OF LINKAGES (7 Lecture Hours)
Free body diagrams, Inertia forces and moments, constraint forces, effect of friction and gravity. Static and dynamic force analyses of simple planar mechanisms. Balancing of planar linkages: static and dynamic balancing of planar mechanisms.
MODULE V – CAMS
(8 Lecture Hours)
Introduction to Cams - Classifications, law of cam design, cam function / follower motion schemes: uniform velocity, parabolic, simple harmonic motion, cycloid motion paths and introduction to high speed cams. Layout of plate cam profiles for different types of followers - knife-edged and roller.

MODULE VI – GEARS
(7 Lecture Hours)
Spur gear terminology and definitions. Fundamental law of toothed gearing and tooth forms. Helical, bevel, worm, and rack and pinion gears (basics only). Gear trains, epicyclic gear trains, differentials, automotive transmission gear trains, Harmonic and special gear drives.

Text books:

Reference Books

Course Objectives: To impart knowledge on
1. Nature of stresses developed in simple geometries
2. Elastic deformation occurring in various simple geometries for different types of loading.
3. Stresses action on shafts, springs and cylinders

Course Outcome: After completing the course the student will be able to
1. Describe the concepts of stress-strain relationships for homogenous, isotropic materials.
2. Calculate stresses and strains in members subjected to axial structural loads and thermal loads.
3. Determine the volumetric strain of the components and also derive the relationship between the elastic constants.
4. Explain the fundamentals of beams and also calculate the shear force and bending moment of beams.
5. Calculate the stresses and strains in members subject to flexural and torsional loadings.
6. Determine and illustrate principal stresses, maximum shearing stress, and the stresses acting on a structural member.

MODULE I – STRESSES AND STRAINS  (8 Lecture Hours) Stress and strain due to axial force, elastic limit, Hooke's law-factor of safety - stepped bars, uniformly varying sections, stresses in composite bar due to axial force and temperature.

MODULE II – CHANGES IN DIMENSIONS AND VOLUME  (7 Lecture Hours) Lateral strain - Poisson's ratio, volumetric strain, changes in dimensions and volume, shear stress, shear strain, relationship between elastic constants.

MODULE III – BENDING MOMENT AND SHEAR FORCE  (8 Lecture Hours) Relationship between load, shear force and bending moment - shear force and bending moment diagrams for cantilever, simply supported and overhanging beams under concentrated loads, uniformly distributed loads, uniformly varying loads, concentrated moments, maximum bending moment and point of contra flexure.

MODULE IV – FLEXURE IN BEAMS  (7 Lecture Hours) Theory of simple bending and assumptions - derivation of equation, section modulus, normal stresses due to flexure.

MODULE V – TORSION  (8 Lecture Hours) Theory of torsion and assumptions-derivation of the equation, polar modulus, stresses in solid and hollow circular shafts, power transmitted by a shaft, close coiled helical spring with axial load.
MODULE VI – PRINCIPAL STRESSES AND STRAINS (Two dimensional only (7 Lecture Hours))
State of stress at a point - normal and tangential stresses on a given plane, principal stresses and their planes, plane of maximum shear stress, analytical method, Mohr's circle method, application to simple problems.

Text books:

Reference books:

Course Objectives:
To impart knowledge on
1. Preparing drawings for various mechanical components using a commercially available 3D modeling software package
2. Using Finite Element Analysis software to solve various field problems in mechanical engineering
3. Optimizing and verifying the design of various machine elements

Course Outcomes:
After completing the course the student will be able to
1. get familiarized with the computer applications in design
2. prepare drawings for various mechanical components.
3. model and analyze various physical problems
4. select appropriate elements and give boundary conditions
5. solve structural, thermal, modal and dynamics problems.
6. conduct coupled structural and thermal analysis

List of Experiments:
1. Assembly of knuckle joint
2. Assembly of plummer block
3. Structural analysis of 2D Truss
4. Analysis of Bicycle frame
5. 2D static analysis of bracket
6. Thermal Analysis of 2D chimney
7. 3D Fin Analysis
8. 2-D Transient mixed boundary
9. Design optimisation
10. Velocity Analysis of fluid flow in a channel
11. Modal analysis of cantilever beam
12. Harmonic analysis of cantilever beam
13. Coupled structural and thermal analysis
14. Magnetic Analysis of solenoid actuator
Course Objectives: To impart knowledge on
1. Linear Programming techniques.
2. Job sequencing problems, Transportation and assignment problems.
3. Inventory models, PERT/CPM and Queuing theory.

Course Outcome: After completing the course the student will be able to
1. Correlate this subject knowledge with the engineering problems.
2. Construct flexible appropriate mathematical model to represent physical problem.
3. Schedule their engineering projects by using network analysis.
4. Analyze the transportation problem and optimize the resources and output.
5. Apply knowledge in solving their engineering queuing problems.
6. Develop their skills in decision making analysis by allocation of resources.

MODULE I - LINEAR PROGRAMMING PROBLEM (9 Lecture Hours)

MODULE II - TRANSPORTATION PROBLEM (9 Lecture Hours)
Transportation Model, finding initial basic feasible solutions using least cost method, Vogells’s approximation method and North–West corner method, moving towards optimality through MODI method, Resolving degeneracy in transportation.

MODULE III - ASSIGNMENT PROBLEM (8 Lecture Hours)
Solution of an assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

MODULE IV - NETWORK ANALYSIS (9 Lecture Hours)

MODULE V – INVENTORY MODELS (9 Lecture Hours)
Economic order quantity models-purchase models with and without shortage, production models with and without shortage-ABC analysis-Two Bin system.

MODULE VI – QUEUING MODELS (9 Lecture Hours)
Structure of queuing models-Attributes and components of queuing models-application of queuing models- Kendall’s Notation-Single service channel with finite and infinite queue size - Single service channel with finite and infinite population size.

Text Books:

Reference Books:

Mechanical Engineering
### Course Objectives:
To impart knowledge on
1. To learn the basics of mechanical engineering subjects
2. To analyze various concepts of the subjects
3. To have a conceptual knowledge on the overall subjects

### Course Outcome:
After completing the course the student will be able to
1. Prepare for Aptitude Tests.
2. Simplify the acquired knowledge for clearing competitive exams.
3. Solve technical problems.
4. Use the techniques and skills for engineering practices.
5. Identify, formulate and solve engineering problems.
6. Function on multidisciplinary areas.

#### MODULE I – APPLIED MECHANICS
(2 Lecture Hours)
Free-body diagrams and equilibrium - trusses and frames - virtual work - kinematics and dynamics of particles and of rigid bodies in plane motion - impulse and momentum (linear and angular) and energy formulations - collisions.

#### MODULE II – MECHANICS OF MATERIALS
(2 Lecture Hours)
Stress and strain - elastic constants - Poisson's ratio - Mohr’s circle for plane stress and plane strain - thin cylinders - shear force and bending moment diagrams - bending and shear stresses - deflection of beams - torsion of circular shafts - Euler’s theory of columns - energy methods - thermal stresses - strain gauges and rosettes - testing of materials with universal testing machine - testing of hardness and impact strength.

#### MODULE III – THERMODYNAMICS, REFRIGERATION AND AIR-CONDITIONING
(3 Lecture Hours)
Thermodynamic systems and processes - properties of pure substances - behavior of ideal and real gases - Zeroth and first laws of thermodynamics - calculation of work and heat in various processes - second law of thermodynamics - thermodynamic property charts and tables - availability and irreversibility - thermodynamic relations - Vapour and gas refrigeration and heat pump cycles - properties of moist air - Psychrometric chart, basic psychrometric processes.

#### MODULE IV – FLUID MECHANICS, TURBOMACHINERY AND I.C. ENGINES
(3 Lecture Hours)

#### MODULE V – MATERIALS, METROLOGY AND INSPECTION
(2 Lecture Hours)

#### MODULE VI – CIM AND INDUSTRIAL ENGINEERING
(3 Lecture Hours)
Basic concepts of CAD/CAM and their integration tools - Forecasting models - aggregate production planning – scheduling - materials requirement planning - Deterministic models - safety stock inventory control systems - Operations Research - Linear programming - simplex method – transportation assignment - network flow models - simple queuing models - PERT and CPM.

### Text Books:
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Course Objectives: To impart knowledge on
1. To learn about work and heat interactions, and balance of energy between system and its surroundings.
2. To learn about application of I law and II law to various energy conversion devices.
3. To evaluate the changes in properties of substances in various processes.

Course Outcome: After completing the course the student will be able to
1. Understand the basic concepts in thermodynamics and its application in different fields.
2. Apply energy balance to systems and control volumes, in situations involving heat and work interactions.
3. Evaluate the performance of energy conversion devices.
4. Differentiate between high grade and low grade energies.
5. Apply gas laws to solve problems related to gas mixtures.
6. Evaluate changes in thermodynamic properties of substances.

MODULE I – FUNDAMENTALS (7 Lecture Hours)
Fundamentals - System and Control volume; Property, State and 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.

MODULE II – FIRST LAW OF THERMODYNAMICS (7 Lecture Hours)
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.

MODULE III – FIRST LAW FOR FLOW PROCESSES (8 Lecture Hours)
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.

MODULE IV – SECOND LAW OF THERMODYNAMICS (7 Lecture Hours)
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.

MODULE V – ENTROPY AND SECOND LAW ANALYSIS (9 Lecture Hours)
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 T-s coordinates; 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.

MODULE VI – PROPERTIES OF PURE SUBSTANCE (8 Lecture Hours)
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 and determination of properties, Mollier’s chart. Basic Rankine cycle.

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Prerequisite: Thermodynamics

Course Objectives: To impart knowledge on
1. Various practical power cycles and heat pump cycles.
2. Analysis of energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
3. High speed compressible flow phenomena and refrigeration and air conditioning

Course Outcome: After completing the course the student will be able to
1. Recognize the significance of 1 law for reacting systems and heating value of fuels.
2. Carry out analysis of various gas and vapour power cycles.
3. Conduct analysis of steam nozzles and turbines.
4. Analyse compressible flow phenomena.
6. Apply principles of refrigeration and air conditioning for analysis and performance evaluation.

MODULE I - COMBUSTION FUNDAMENTALS (8 Lecture Hours)

MODULE II - VAPOUR AND AIR-STANDARD CYCLES (12 Lecture Hours)

MODULE III - STEAM NOZZLES AND TURBINES (12 Lecture Hours)
Flow of steam through nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles, compounding, Determination of work done and efficiency using velocity diagrams.

MODULE IV - COMPRESSIBLE FLOWS (10 Lecture Hours)
Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow.

MODULE V - AIR COMPRESSORS (9 Lecture Hours)
Reciprocating compressors, Work input representation on p-v diagram, Effect of clearance and volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Mechanical Engineering
Module VI - Psychrometry, Refrigeration and Airconditioning

Lecture Hours
Vapor compression refrigeration cycle, super heat, sub cooling – Performance calculations - refrigerants and their properties, Working principle and description of vapour absorption systems- Ammonia – Water, Lithium bromide – water systems. Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point

Text Books:

Reference Books:

18ME2038 THERMAL ENGINEERING LABORATORY

Co requisite: Thermodynamics

Course Objectives: To impart knowledge on
1. The performance evaluation of refrigeration, air conditioning systems and heat pumps
2. Performance evaluation of blower and compressor
3. Performance analysis of steam turbine

Course Outcome: After completing the course the student will be able to
1. Evaluate the performance of vapor compression refrigeration cycle
2. Evaluate performance of heat pump
3. Determine COP of air conditioning cycle
4. Evaluate performance of air blower
5. Evaluate performance of reciprocating air compressor
6. Evaluate performance of steam turbine

LIST OF EXPERIMENTS
1. Determination of coefficient of performance in a vapour compression refrigeration cycle
2. Determination of coefficient of performance in a heat pump apparatus
3. Determination of coefficient of performance in air-conditioning cycle
4. Determination of performance parameters on air blower
5. Determination of performance parameters on two stage reciprocating air compressor
6. Performance test and study on the steam turbine apparatus

Reference Book
Lab Manual

18ME2039 FLUID MECHANICS AND FLUID MACHINES

Course Objectives: To impart knowledge on
1. Fluid statics, kinematics and dynamics. Measurement of pressure, computations of hydrostatic forces on structural components and the concepts of Buoyancy.
2. Analysis of engineering problems involving fluids – such as those dealing with pipe flow, open channel flow, jets, turbines and pumps.
3. Various concepts in hydraulics, hydraulic machinery and hydrology.

Course Outcome: After completing the course the student will be able to
1. Apply principles of fluid statics, kinematics and dynamics.
2. Describe the terminology in fluid mechanics
3. Contrast the different types of fluid flow
4. Apply the continuity, momentum and energy principles
5. Apply dimensional analysis.
6. Examine the characteristics of a boundary layer.

**MODULE I – BASIC CONCEPTS AND DEFINITION**
(7 Lecture Hours)
Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

**MODULE II – FLUID STATICS**
(7 Lecture Hours)

**MODULE III – FLUID KINEMATICS**
(7 Lecture Hours)
Classification of fluid flow: steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates.

**MODULE IV – FLUID DYNAMICS**
(7 Lecture Hours)
Surface and body forces; Equations of motion - Euler’s equation; Bernoulli’s equation – derivation; Energy Principle; Practical applications of Bernoulli’s equation : Venturimeter, orifice meter and pitot tube.

**MODULE V - DIMENSIONAL ANALYSIS**
(7 Lecture Hours)
Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham’s π-Theorem.

**MODULE VI - BOUNDARY LAYER THEORY**
(10 Lecture Hours)
Flat plate, conduits, curved solid bodies, universal velocity profile, and momentum eddy concept – simple applications. Modern trends in application of computation to Boundary layer flows.

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**flow through pipes**

**Text Books:**

**Reference Books:**

**Course Objectives:** To impart knowledge on
1. Science of measurement and measuring machines commonly used.
2. Limits, fits and tolerances, geometric dimensioning aspects
3. Methods of acceptance test for conventional machine tools.

**Course Outcome:** After completing the course the student will be able to
1. Use different measuring instruments in industries.
2. Utilize geometrical dimensioning and tolerancing symbols and apply them in inspection and testing process.
3. Apply the concepts of laser metrology in quality control.
4. Examine the surface roughness of workpieces from various production processes.
5. Choose the modern manufacturing methods using advanced metrology systems.
6. Recommend calibration standards towards measuring instruments.

MODULE I – INTRODUCTION TO MECHANICAL MEASUREMENTS  (8 Lecture Hours)
Science of measurement: Mechanical measurement – types, measurement standards– terms used in rating instrument performance. Precision and Accuracy.

MODULE II – GEAR MEASURING MACHINES  (8 Lecture Hours)
Study of Measuring Machines, gear tooth measurement- measurement of gear profile, Isometric Viewing of Surface Defects, Image Shearing Microscope for Vertical Dimensions.

MODULE III – ELECTRON AND LASER MICROSCOPY  (7 Lecture Hours)

MODULE IV – CALIBRATION AND SURFACE ROUGHNESS MEASUREMENT  (7 Lecture Hours)
Acceptance tests for machine tools and surface finish measurements, calibration of machine tools, introduction to ball bar measurement, Measurement of surface roughness.

MODULE V – GEOMETRIC DIMENSIONING AND TOLERANCING  (8 Lecture Hours)

MODULE VI – METROLOGY FOR QUALITY  (8 Lecture Hours)
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 micro-scale machining, Inspection and workpiece quality.(7 hrs)

Text Books:

Reference books:

Course Objectives: To impart knowledge on
1. Application of fluid power symbols
2. Designing a suitable hydraulic or pneumatic circuits
3. Automating an industrial application.

Course Outcome: After completing the course the student will be able to
1. Recognize the standard symbols used in fluid power circuits.
2. Design and simulation of pneumatic and hydraulic circuits using fluid sim software
3. Testing of electro pneumatic and electro hydraulic multiple actuator circuits
4. Construct the hydraulic circuits for an industrial application.
5. Build a pneumatic circuit and apply them to real life problems.
6. Design and develop a plc controlled pneumatic circuit for industrial application.
LIST OF EXPERIMENTS:
1. Study of standard fluid power symbols.
2. Development of basic pneumatic logic circuits.
3. Design of pneumatic speed control circuits.
4. Application of time delay valve and pressure Sequence Valves in a pneumatic circuit.
5. Design of basic pneumatic circuit for material handling system circuit using Cascade method.
6. Design of electro–pneumatic circuit by using relay, limit switch and solenoids.
7. Design of Electro–pneumatic circuit for cascade system of sequence A+B+C+A–B–C–.
8. Construct hydraulic speed control circuits and actuator regenerative circuit.
11. Design and develop PLC controlled pneumatic logic circuits.
12. Simulation of PLC controlled pneumatic circuit for material handling unit.

Course Objectives: To impart knowledge on
1. Structure of microprocessors and their applications in mechanical devices
2. Principle of automatic control and real time motion control systems, with the help of electrical drives and actuators
3. Micro-sensors and their applications in various fields

Course Outcome: After completing the course the student will be able to
1. Get an overview of mechatronics applications
2. Demonstrate knowledge of electrical circuits and logic design.
3. Implement engineering solutions and techniques to solve design problems.
4. Design mechatronic components and systems.
5. Use of micro-sensors and microprocessors.
6. Develop PLC programs for a given task.

MODULE I – INTRODUCTION (8 Lecture Hours)

MODULE II – SENSORS AND TRANSDUCERS (7 Lecture Hours)
Classification, Development in Transducer technology, Optoelectronics- Shaft encoders, CD Sensors, Vision System.

MODULE III – DRIVES AND ACTUATORS (8 Lecture Hours)
Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems.

MODULE IV – SMART MATERIALS (7 Lecture Hours)
Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation.

MODULE V – MICROMECHATRONIC SYSTEMS (8 Lecture Hours)
Micro sensors, Micro actuators. Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.

MODULE VI - PROGRAMMABLE LOGIC CONTROLLER (7 Lecture Hours)

Text Books:
Reference Books:

Course Objectives: To impart knowledge on
1. Preparation of samples for metallurgical studies
2. Characterizing metal samples to understand microstructures
3. Basic knowledge on foundry sand and their properties

Course Outcome: After completing the course the student will be able to
1. Manipulate with the working of a metallurgical microscope
2. Interpret the strength properties of foundry sand
3. Evaluate the permeability of foundry sand
4. Understand procedures for preparing samples for metallurgical studies
5. Identify various types of steels based on their microstructure
6. Differentiate metal samples that are heat treated based on the microstructure

LIST OF EXPERIMENTS
1. Study and use of metallurgical microscope
2. Measurement of hardness
3. Determination of compression strength and tensile strength
4. Examination of microstructure under Optical microscope.
6. Electrical Conductivity measurement

Course Objectives: To impart knowledge on
1. Usage of computers and modeling software in design and manufacturing.
2. Visualization of objects in three dimensions and producing orthographic views, sectional views and auxiliary views of it.
3. Writing codes for CNC, VMC and turning centres to produce components.

Course Outcome: After completing the course the student will be able to
1. Model the components using the commands such as extrude, revolve, fillet, hole pattern.
2. Use the commands rib, chamfer, draft and 3D sketch to modify the parts
3. Create an assembly model of knuckle joint and screw jack and convert them into orthographic views.
4. Write CNC codes for linear, circular interpolation step turning ball turning and external threading.
5. Write CNC codes for creating holes on components using CNC drilling machine.
6. Write CNC program for creating square pockets using vertical milling centre.

LIST OF EXPERIMENTS
1. 3D Modelling with Extrude, Round (Fillet) and Mirror Commands
2. 3D Modelling With Revolve, Hole Pattern Commands
3. 3D Modelling With Rib, Chamfer, Draft and 3D sketching Commands
4. Modelling, Assembly and Drafting of Knuckle Joint
5. Modelling, Assembly and Drafting of Screw Jack
6. Advanced modelling commands-Sweep and Blend (Loft)
7. Study of CNC XL Mill Trainer and CNC XL Turn trainer
8. Profile cut using linear and circular interpolation
10. Square pocketing and Drilling in a VMC/CNC drilling machine
11. Step turning and external thread cutting in a CNC lathe
12. Ball tuning in a CNC turning Centre

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<tr>
<th>18ME3001</th>
<th>THERMODYNAMICS AND COMBUSTION</th>
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Course Objectives: To impart knowledge on
1. Combustion principles and chemical kinetics.
2. Combustion in SI and CI engines.

Course Outcomes: After completing the course the student will be able to
1. Analyse the closed and open systems by using laws of thermodynamics
2. Calculate the properties of gases and gas mixtures
3. Calculate change in entropy and enthalpy during the phase change of pure substances
4. Compute air requirements and adiabatic flame temperatures
5. Develop an understanding of the combustion process, engine emissions
6. Develop an understanding of statistical methods

MODULE I – REVIEW OF FIRST AND SECOND LAW OF THERMODYNAMICS
(8 Lecture Hours)
Energy balance analysis, application to closed and open systems. Second-law efficiency, concept of entropy, exergy analysis, availability analysis of simple cycles.

MODULE II – REAL GAS BEHAVIOUR AND MULTI-COMPONENT SYSTEMS
(8 Lecture Hours)
Equations of State Compressibility, fugacity coefficient, Real gas mixtures, Ideal solution of real gases, Gibbs phase rule.

MODULE III – THERMODYNAMIC PROPERTY RELATIONS
(8 Lecture Hours)
Thermodynamic Potentials, Maxwell relations, Generalized relations for changes in Entropy, Internal Energy and Enthalpy, C_p and C_v, Clausius Clayperon Equation, Joule- Thomson Coefficient.

MODULE IV – COMBUSTION PRINCIPLES
(8 Lecture Hours)
Thermodynamics concepts of combustion, First law and second law of thermodynamics applied to combustion process, Heat of combustion, Adiabatic flame temperature, Stoichiometry and excess air, Combustion calculations, Minimum air required for complete combustion of fuel.

MODULE V – CHEMICAL KINETICS
(7 Lecture Hours)
Chemical equilibrium and dissociation, Theories of combustion - homogeneous mixture, Heterogeneous mixture, Laminar and Turbulent flame propagation in engines, Second law analysis of reacting mixture, Availability analysis of reacting mixture

MODULE VI – STATISTICAL AND THIRD LAW OF THERMODYNAMICS
(6 Lecture Hours)
Statistical thermodynamics, statistical interpretations of first and second law and Entropy, Third law of thermodynamics, Nernst heat theorem.

Reference Books:
Course Objectives: To impart knowledge on
1. Continuity, momentum and energy equations of fluid flow.
2. Irrotational flows, flow past cylinders and Rankine body.
3. Concepts of boundary layer, Prandtl mixing length, turbulent theory, universal velocity profile.

Course Outcomes: After completing the course the student will be able to
1. Choose method to describe the fluid motion.
2. Solve fluid flow problems using conservation principles.
3. Analyze the forces acting on a fluid particle.
4. Distinguish between irrational and vortex flows.
5. Analyze the fluid flow over cylindrical and spherical bodies.
6. Recognize boundary layer formation in external and internal flows.

MODULE I – FLUID KINEMATICS (7 Lecture Hours)
Method of describing fluid motion– Lagrangian, Eulerian Method – Local and individual time rates of change, acceleration. - Eulerian and Lagrangian equation of continuity, Bernoulli’s equation from Euler’s equation – solved problems related to liquid motion, related to equation of continuity.

MODULE II – GOVERNING EQUATIONS OF FLUID MOTION (7 Lecture Hours)
Forces and stress acting on fluid particles, Differential momentum equation. Navier Stokes Equations of Motion for simple cases in rectangular, cylindrical and spherical coordinate, Energy Equation.

MODULE III – IDEAL FLOWS (7 Lecture Hours)
Irrotational motion in two dimensions, sources and sink Complex potential due to a source, due to a doublet, Images with respect to straight line, solved problem. Vortex motion-Vortex tube, Helmholtz’s vorticity theorem, velocity potential and stream function.

MODULE IV – FLOW OVER BODIES (7 Lecture Hours)
Flow over Circular cylinders, sphere, solution of Laplace equation, Flow past cylinder with and without circulation, flow past Rankine body. Liquid streaming past a fixed sphere and solved problems.

MODULE V – BOUNDARY LAYER THEORY (7 Lecture Hours)
Boundary layer principles, flat plate, conduits, curved solid bodies, universal velocity profile, and momentum eddy concept – simple applications. Modern trends in the application of CFD to Boundary layer flows.

MODULE VI – BASICS OF TURBULENCE (10 Lecture Hours)
Joukowshi transformation, Analytic function Conformal Transformation of infinite and semi – infinite strip, Prandtl mixing length turbulent theory, Von Karman integral equation to Boundary layer – with and without pressure gradient.

Reference Books:
2. Model heat transfer in complex internal flow systems and external flow configurations.
3. Design and analyze the performance of heat exchangers.
4. Model two-phase heat transfer problems in boiling and condensation.
5. Model mass transfer problems involving mass diffusion in gases.
6. Analyze radiative heat exchange between surfaces.

**MODULE I – CONDUCTION**


**MODULE II – CONVECTION**


**MODULE III – HEAT EXCHANGER**


**MODULE IV – BOILING AND CONDENSATION**


**MODULE V – RADIATION**


**MODULE VI – MASS TRANSFER**


**Reference books:**


**Course Objectives:** To impart knowledge on
1. Boiler manufacturing regulations/code.
2. The design of various equipment used in thermal power plants.
3. Steam washing and ash separation from flue gases.

**Course Outcomes:** After completing the course the student will be able to
1. Compare and contrast different types of boilers for power plant application.
2. Design boilers for power plant applications according to standards.
3. Recognize waste heat recovery options in power plants using accessories such as economizers, super heaters, re-heaters and air pre-heaters.
4. Design chimney and fans for the draught system in thermal power plants.
5. Design condensers and cooling towers for steam power plants.
6. Recognize significance of water and steam purification and ash cleaning mechanisms in thermal power plants.
MODULE I – BOILER SERVICE REQUIREMENTS, IBR ACT AND FURNACE DESIGN
(8 Lecture Hours)
Services requirements, Parameters to be considered in Boiler Design, IBR Code Furnace Design, Heat Transfer in Furnace, Heat balance, Types of refractory walls, Furnace, Water wall arrangements, Heat release rates, Furnace bottoms, Slag removal, Primary, secondary and tertiary air system, box assembly, Different types of furnaces for solids and liquids

MODULE II – WATER SIDE DESIGN (8 Lecture Hours)
Circulation-natural, Forced circulation ratio, Design of condensers, Economic selection of condensers, Types - Direct contact, Surface condensers, Vacuum efficiency, Air leakage into the condenser-air removal, Cooling tower Types and design for power plant application

MODULE III – PERFORMANCE OF BOILER (8 Lecture Hours)

MODULE IV – WATER AND STEAM PURIFICATION (7 Lecture Hours)
Chemical treatment, Mechanical carry over, Silica carry over gravity separation, Drum internals, Steam washing typical arrangements of boiler drum internal in H.P. boilers.

MODULE V – AIR-PREHEATERS AND DRAFT SYSTEM DESIGN (7 Lecture Hours)
Types of Air heater, Recuperative and regenerative air-preheaters, Design considerations, Forced, induced, balanced drafts, Pressure losses.

MODULE VI – FAN, CHIMNEY DESIGN AND ASH SEPARATION (7 Lecture Hours)
Power requirement for forced and induced draft fans, Chimney design - Diameter and height, Ash separation by electrostatic precipitators, Flue gas desulphurization systems.

Reference Books:

Course Objectives:
To impart knowledge on
1. Significance of refrigerants and their impact on the environment.
2. Working principle of various refrigeration cycles.

Course Outcomes:
After completing the course the student will be able to
1. Select the refrigerants.
2. Estimate the performance of a vapour compression cycle.
3. Compare different types of refrigeration cycles.
4. Identify the components of a refrigeration system.
5. Analyze the performance of different components in a refrigeration system.
6. Discuss the controls employed in refrigeration system.

MODULE I – REFRIGERANTS (6 Lecture Hours)
Classification of Refrigerants, Refrigerant properties, Oil Compatibility, Environmental Impact-Montreal / Kyoto protocols-Eco Friendly Refrigerants, alternatives to HCFCs, Secondary Refrigerants.

MODULE II – VAPOUR COMPRESSION REFRIGERATION CYCLE (9 Lecture Hours)
Development of Vapor Compression Refrigeration Cycle from Reverse Carnot Cycle- conditions for high COP-deviations from ideal vapor compression cycle, Multi pressure System, Cascade Systems-Analysis.
MODULE III – VAPOUR ABSORPTION AND AIR REFRIGERATION CYCLES (9 Lecture Hours)

MODULE IV – REFRIGERATION SYSTEM COMPONENTS (6 Lecture Hours)
Compressor- Types, performance, Characteristics, Types of Evaporators & Condensers and their functional aspects, Expansion Devices and their Behavior with fluctuating load, cycling controls, other components such as Accumulators, Receivers, Oil Separators, Strainers, Driers, Check Valves, Solenoid Valves Defrost Controllers.

MODULE V – SYSTEM BALANCING (9 Lecture Hours)
Balance points and system simulation - compressor, condenser, evaporator and expansion devices performance – Complete system performance; graphical and mathematical analysis – sensitivity analysis.

MODULE VI – ELECTRICAL DRIVES & CONTROLS (6 Lecture Hours)
Electric circuits in Refrigeration systems, Refrigerant control devices, Types of Motors, Starters, Relays, Thermostats and Microprocessor based control systems, Pressure controls and other controls, Acoustics and noise controls.

Reference Books:

18ME3006 COMPUTER AIDED DESIGN LABORATORY

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<td>2. Visualization of objects in three dimensions and producing orthographic views, sectional views and auxiliary views of it.</td>
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<td>3. Finite element analysis of beams, trusses, plates and frames.</td>
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<th>Course Outcome: After completing the course the student will be able to</th>
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<td>1. Model the components using the commands such as extrude, revolve, fillet, hole pattern.</td>
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<td>2. Use the commands rib, chamfer, draft and 3d sketch to modify the parts</td>
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<td>3. Create an assembly model of knuckle joint and screw jack and convert them into orthographic views.</td>
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<td>4. Conduct structural analysis of trusses, frames and beams.</td>
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<td>5. Conduct modal of structures</td>
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<tr>
<td>6. Conduct heat transfer analysis of solids and pipes</td>
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LIST OF EXPERIMENTS
1. 3D Modeling with Extrude, Round (Fillet) and Mirror Commands
2. 3D Modeling With Revolve, Hole Pattern Commands
3. 3D Modeling With Rib, Chamfer, Draft and 3D sketching Commands
4. Modeling, Assembly and Drafting of Knuckle Joint
5. Modeling, Assembly and Drafting of Screw Jack
6. Advanced modeling using variable sweep, helical sweep etc.
7. Structural analysis of Trusses
8. Structural analysis of Beams
9. Structural analysis of Frames
10. Plane stress/Plane strain analysis
11. Modal analysis of different structures
12. Steady state thermal analysis
Course Objectives: To impart knowledge on
1. Mechanical engineering problems using advanced analysis package like ansys.
2. Simulation software like matlab to construct and execute goal-driven system models.
3. Various simulation and analysis tools to different real-time applications.

Course Outcomes: After completing the course the student will be able to
1. Demonstrate the use of analysis software for various structural, thermal and flow-related problems.
2. Apply the suitable commands in solving the problems in analysis software.
3. Compare the various element types, material properties, and boundary conditions with real-life problems to get an optimal solution.
4. Interpret the various mechanisms and problems into a simple model to carry out simulation.
5. Examine the model with suitable commands and constraints.
6. Evaluate the working and performance of various mechanisms using the simulation software.

ANALYSIS MODULE USING ANSYS WORKBENCH
1. Force and stress analysis using link elements in trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions
3. Stress analysis of flat plate (with circular hole) and simple shells.
4. Stress analysis of axi-symmetric component
5. Thermal stress and heat transfer analysis of a 2D component and cylindrical shells
6. Flow through a duct, elbow
7. Conductive and convective heat transfer analysis of a 2D component
8. Modal analysis of a beam
9. Harmonic, transient and spectrum analysis of simple systems.

SIMULATION MODULE USING MATLAB 2018R
1. Vibration based simple problems- a. simulation of an accumulator, b. linear damping force
2. Simulation of cam and follower mechanism
3. Simple exercise to determine stiffness
4. Simulation of four bar mechanism

Reference Books:
1. Lab Manual

Course Objectives: To impart knowledge on
1. Boiling and condensation of vapors in surfaces.
2. The working of air conditioning system.
3. Heat transfer in two-phase system.

Course Outcomes: After completing the course the student will be able to
1. Appreciate the mechanism of condensation process.
2. Distinguish between types of condensation.
3. Employ lumped thermal capacitance method for temperature estimation under transient mode.
4. Evaluate the performance of air-conditioning system.
5. Recognize bubble formation in the nucleate boiling regime.
6. Recognize transition from nucleate boiling to film boiling.

LIST OF EXPERIMENTS
1. Drop-wise and film-wise condensation
2. Investigation of lumped thermal capacitance method of transient temperature analysis
3. Cop test on air conditioning test rig
4. Nucleate boiling
5. Critical heat flux apparatus
6. Estimation of heat transfer coefficient of heat pipes (12 exp)
Course Objectives: To impart knowledge on
1. Finite volume computational fluid dynamics codes working strategies.
2. Actual setting up of the problem and solution procedure.
3. Data extraction, post processing and comparison with experimental/theoretical data.

Course Outcomes: After completing the course the student will be able to
1. Recognize applications of computing tools in fluid dynamics.
2. Model and analyze various heat transfer and fluid flow problems.
3. Select appropriate mesh type and boundary conditions.
4. Apply suitable solvers for problem solution.
5. Extract post processing data and compare them with available data.
6. Infer the pictorial results after post-processing.

LIST OF EXPERIMENTS
1. One dimensional steady state diffusion
2. One dimensional steady state diffusion with volume source
3. One dimensional steady state diffusion with surface source
4. One dimensional unsteady heat conduction
5. Conjugate heat transfer
6. Periodic flow and heat transfer
7. Laminar flow
8. Turbulent flow
9. Flow through porous media
10. Flow around an aerofoil
11. Modelling radiation and natural convection.

Course Objectives: To impart knowledge on
1. Different types of conventional manufacturing processes.
2. The mechanism and capabilities of non-conventional manufacturing processes.

Course Outcomes: After completing the course the student will be able to
1. Evaluate and select suitable manufacturing processes for particular applications.
2. Recognize the need for unconventional manufacturing processes for various applications.
3. Apply the latest manufacturing process for micro-fabrication.
4. Develop new products by making use of new materials and processes.
5. Establish newer manufacturing methods to replace conventional fabrication methods.
6. Adapt the powder metallurgy technique to fabricate components for diverse applications.

MODULE I – CASTING AND MOULDING (7 Lecture hours)
Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

MODULE II – BULK FORMING (7 Lecture hours)
Plastic deformation and yield criteria; Fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing).

MODULE III – SHEET METAL FORMING (7 Lecture hours)
Sheet metal characteristics – shearing, bending and drawing operations, design considerations – Stretch forming operations; Formability of sheet metal; Hydro forming – Rubber pad forming – Metal spinning–Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming.
MODULE IV – NEWER MACHINING PROCESSES (8 Lecture hours)
Construction; working principle; steps; types; process parameters; derivations; problems, merits, demerits and applications of AJM – WJM - USM – CHM – ECM – EDM - Wire cut EDM - ECM – ECG - LBM – EBM ---expand.

MODULE V – MICRO-FABRICATION (8 Lecture hours)
Semiconductors; fabrication techniques; surface and bulk machining; LIGA Process; Solid free form fabrication; Wafer preparation techniques; PCB board hybrid and MCM technology; programmable devices and ASIC; electronic material and processing; stereo lithography SAW devices; Surface Mount Technology.

MODULE VI – ADVANCED JOINING / FASTENING PROCESSES (8 Lecture hours)
Physics of welding; joint preparation; design considerations in welding. Solid and liquid state joining processes; Thermit welding, submerged arc welding, Advanced welding techniques - Friction stir welding, friction stir processing, explosive welding; brazing and soldering; defects in welding and remedies.

Reference Books:

18ME3011 ADVANCED METAL CUTTING THEORY L T P C

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<th>Course Objectives</th>
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<tr>
<td>1.</td>
<td>Fundamentals of metal cutting theory and nomenclature of cutting tools.</td>
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<th>Course Outcomes</th>
<th>After completing the course the student will be able to</th>
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<tbody>
<tr>
<td>1.</td>
<td>Understand mechanism and theories of metal cutting.</td>
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<td>2.</td>
<td>Select the cutting tool based on the operation to be done.</td>
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<td>3.</td>
<td>Understand thermal aspects in machining.</td>
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<td>4.</td>
<td>Analyze tool materials and tool life.</td>
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<td>5.</td>
<td>Measure cutting forces during machining processes.</td>
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<td>6.</td>
<td>Diagnose tool wear, vibration and chatter.</td>
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MODULE I – METAL CUTTING FUNDAMENTALS (7 Lecture hours)

MODULE II – TOOL NOMENCLATURE OF CUTTING TOOLS (7 Lecture hours)
Nomenclature of single point tool - Systems of tool Nomenclature and Conversion of rake angles - Nomenclature of multi point tools like drills, milling cutters and broaches.

MODULE III – THERMAL ASPECTS OF MACHINING (7 Lecture hours)
Thermodynamics of chip formation - Heat distributions in machining-Effects of various parameters on temperature - Method of temperature measurement in machining - Hot machining - cutting fluids, Surface finish and integrity.

MODULE IV – TOOL MATERIALS AND TOOL LIFE (8 Lecture hours)
MODULE V – CUTTING FORCES AND ECONOMICS OF MACHINING (8 Lecture hours)
Forces in turning, drilling and milling - specific cutting pressure- measurement of cutting forces.
Concepts of machinability and machinability index - Economics of machining, Machining Time –
Estimation of machining time in different machining operations.

MODULE VI – TOOL WEAR MECHANISMS AND CHATTER IN MACHINING (8 Lecture hours)
Reasons for failure of cutting tools and forms of wear-mechanisms of wear - chatter in machining -
Factors effecting chatter in machining - types of chatters-Mechanism of chatter based on Force Vs
Speed graph.

Reference books:
1. B.L. Juneja and G.S. Sekhon - “Fundamentals of metal cutting and machine tools”, New Age
   International (p) Ltd., 2015.
   Calcutta 2016.
5. Stephenson, D. A., &Agapiou, J. S. Metal cutting theory and practice: CRC Taylor & Francis,
   2016.

18ME3012 DESIGN FOR MANUFACTURING AND ASSEMBLY

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<td>1. The real engineering design processes.</td>
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<td>2. In-depth practice in design, the use of a structured approach to design, an introductory knowledge of business practices.</td>
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<td>3. Critical thinking, creativity, and independent learning.</td>
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<th>Course outcome: After completing the course the student will be able to</th>
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<td>Design the components suitable for various manufacturing process such as welding, casting, machining.</td>
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<td>Identify and describe how the integrated design, manufacturing, process works.</td>
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<td>Describe how the details of example production plans affect the product and can be designed for the ease of manufacturing and assembly besides reducing the overall costs of the product.</td>
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<td>Update the knowledge of design process and methods.</td>
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<td>Know the importance of material selection, quality, statistics in design and its help in designing a new product.</td>
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<tr>
<td>Learn the process of design based on the scientific method, to combine creative thinking with engineering principles to turn ideas into robust reality.</td>
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MODULE I – INTRODUCTION (8 Lecture Hours)
General Design principles for manufacturing – strength and mechanical factors, mechanisms selection,
Functional datum, machining sequence, manufacturing datum, changing the datum. Examples.

MODULE II – FACTORS INFLUENCING FORM DESIGN (8 Lecture Hours)

MODULE III – COMPONENT DESIGN – MACHINING CONSIDERATION (8 Lecture Hours)
Design features to facilitate machining – drills – milling cutters – keyways – Doweling-procedures,

MODULE IV – COMPONENT DESIGN – CASTING AND WELDING CONSIDERATIONS (8 Lecture Hours)
Redesign of castings based on parting line considerations – minimizing core requirements, machined holes, Redesign of cast members to obviate cores. Redesign of weld members based on Weld joints-Material thickness-Specifying Welds-cost of welding-Weld distortion-Weld Strength-Finishing and Tolerancing considerations.

**MODULE V – REDESIGN FOR MANUFACTURE AND CASE STUDIES (8 Lecture Hour)**
Identification of uneconomical design – Modifying the design – group technology –Design for reliability and safety.

**MODULE VI – CASE STUDIES (8 Lecture Hour)**
Robust and quality design. Computer Application for Design for Manufacturing and Assembly.

**Reference Books:**

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<tr>
<th>18ME3013</th>
<th>ENGINEERING MATERIALS AND APPLICATIONS</th>
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**Course Objectives:** To impart the knowledge on
2. Fracture behavior of materials.
3. The principles of design, selection and processing of materials.

**Course Outcomes:** After completing the course the student will be able to
1. Apply the concepts of materials science for material selections towards new product development.
2. Analyze the elastic and plastic behavior of materials.
4. Evaluate fracture behavior of materials in engineering applications.
5. Appraise the utility of new age material for specific application.
6. Synthesize and develop the unique customized composites for special needs.

**MODULE I – ELASTIC AND PLASTIC BEHAVIOR (8 Lecture Hours)**

**MODULE II – FRACTURE BEHAVIOR (7 Lecture Hours)**

**MODULE III – MATERIAL SELECTION AND MODERN METALLIC MATERIALS (7 Lecture Hours)**

**MODULE IV – NEW AGE MATERIALS (8 Lecture Hours)**

**MODULE V – SPECIAL PURPOSE MATERIALS (7 Lecture Hours)**
MODULE VI – COMPOSITE MATERIALS  
(8 Lecture Hours)
Polymer Matrix Composites (PMC) -PMC processes - Hand layup processes – Spray up processes – 
Compression moulding –injection moulding - Resin transfer moulding – Pultrusion – Filament winding 
– Injection moulding. Metal Matrix Composites (MMC) - characteristics of MMC. Advantages of 
MMC, Processing of MMC – Powder metallurgy process - diffusion bonding – stir casting – squeeze 
casting.

Reference Books:
1. V. Raghavan, “Materials Science and Engineering – Prentice Hall of India (P) Ltd., New 
Hall, 2010.

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<tr>
<th>18ME3014 ADVANCED METROLOGY AND MEASUREMENT SYSTEMS</th>
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Course Objectives: To impart knowledge on
1. Science of measurement and measuring machines commonly used.
2. Limits, fits and tolerances, geometric dimensioning aspects
3. Methods of acceptance test for conventional machine tools.

Course Outcomes: After completing the course the student will be able to
1. Use different measuring instruments in industries.
2. Utilize Geometrical Dimensioning and Tolerancing symbols and apply them in inspection and 
testing process.
3. Apply the concepts of Laser metrology in quality control.
4. Examine the surface roughness of work pieces from various production processes.
5. Choose the modern manufacturing methods using advanced metrology systems.
6. Recommend calibration standards towards measuring instruments.

MODULE I – INTRODUCTION TO MECHANICAL MEASUREMENTS  (7 Lecture Hours)
Science of measurement: Mechanical measurement – types, measurement standards– terms used in 
rating instrument performance, Precision, accuracy and uncertainty in measurements.

MODULE II – GEAR MEASURING MACHINES  (7 Lecture Hours)
Study of Measuring Machines, gear tooth measurement- measurement of gear profile, Isometric 
Viewing of Surface Defects, Image Shearing Microscope for Vertical Dimensions.

MODULE III – ELECTRON AND LASER MICROSCOPY  (7 Lecture Hours)
Laser metrology and microscopy: Laser Metrology - Vision systems- Principles and applications, 

MODULE IV – CALIBRATION AND SURFACE ROUGHNESS MEASUREMENTS (7 Lecture Hours)
Acceptance tests for machine tools and surface finish measurements, calibration of machine tools. 
Three ball or four ball measurement, Measurement of surface roughness.

MODULE V – GEOMETRIC DIMENSIONING AND TOLERANCING(7 Lecture Hours)
Introduction. Indian Standard System of Limits and Fits (IS:919-2709) ; Designation of Holes ,Shafts 
and Fits. Meaning of GD and T, Various Geometric symbols used in GD and T, Datum feature, 
Material Conditions.

MODULE VI – METROLOGY FOR QUALITY  (8 Lecture Hours)
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 micro-scale machining. Inspection and workpiece quality.
Reference books:

<table>
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<th>18ME3015</th>
<th>ADVANCED COMPUTER AIDED MANUFACTURING LABORATORY</th>
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Course Objectives: To impart knowledge on
1. Usage of Manufacturing software in writing the codes for CNC, VMC and Turning centres to produce components
2. Concepts of CNC programming and simulation on CNC turning center and Machining center
3. Concepts of Robot programming and PLC programming

Course Outcomes: After completing the course the student will be able to
1. Machine complex profiles using CNC machines with the aid of auto generated CNC codes
2. Generate CNC program for turning and milling of component using Master CAM / Edge CAM softwares
3. Write CNC codes for linear, circular interpolation step turning ball turning and external threading.
4. Write CNC codes for creating holes on components using CNC drilling machine.
5. Write CNC program for creating square pockets using vertical milling centre.
6. Generate Robot programming and PLC programming

LIST OF EXPERIMENTS:
1. Study of different control systems and CNC codes
2. Programming and simulation for turning, taper turning, circular interpolation, thread Cutting and facing operation
3. Profile cut using linear and circular interpolation
4. Drilling in a CNC drilling machine.
5. Square pocketing and Drilling in a VMC/CNC drilling machine
6. Step turning and external thread cutting in a CNC lathe
7. Taper turning and internal thread cutting in a CNC lathe
8. Ball turning in a CNC turning Centre
9. Programming using canned cycles
10. Robot programming for Material handling applications (2 exp)
11. PLC ladder logic programming

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Course Objectives: To impart knowledge on
1. Fundamentals of fluid power and Mechatronics systems and primary actuating systems.
2. Programming skills in Programmable logic controllers.
3. Principles of pneumatics and hydraulics and apply them to real life problems.

Course Outcomes: After completing the course the student will be able to
1. Apply Boolean algebra for logic design of pneumatic circuits.
2. Apply Boolean algebra for logic design of hydrauliccircuits
3. Build logic circuits for industrial applications
4. Build cascade circuits for multiple cylinder applications.
5. Design automation circuits with PLC for industrial problems
6. Write Programme for robot movements

LIST OF EXPERIMENTS:
1. Standard Fluid Power Symbols
2. Pneumatic Basic Logic Circuit
3. Pneumatic Circuit for Material Handling System
4. Electro-Pneumatic Circuit Using Relay, Limit Switch and Solenoid Valves
5. Electro-Pneumatic Circuit for an Automation of Double Acting Cylinder by using Proximity Sensors and Cascade System of sequence A+B+C+A-B-C-.
7. PLC Controlled Pneumatic Logic Circuits
8. PLC Controlled Pneumatic Circuit for Material Handling System
9. Control of Fanuc robot
10. Robot programming for pick and place application
11. Assembly and disassembly of pic controller based mobile robot.

### Course Objectives:
To impart knowledge on

1. Mohr’s circle and energy methods to predict stress, strain and deflection.
2. Stress distribution in thin walled section subjected to torsion and find shear center in beams.
3. The behavior of thin walled cylinders under pressure and stress distribution in rotating disks.

### Course Outcomes:
After completing the course the student will be able to

1. Find principals stress and strains in solids of two dimensions and three dimensions.
2. Determine deflection and stress at critical points in a structure using various methods.
3. Analysis of stress distribution of thin walled sections subjected to torsion.
4. Determine shear center of thin walled beams.
5. Design thin walled cylinders under pressure and determine stress in a rotating disk.
6. Identify method to determine contact stress and deflection for various load conditions.

### MODULE I – THEORY OF ELASTICITY  
(8 Lecture Hours)
Analysis of stress, Analysis of strain, Elasticity problems in two dimension and three dimensions, Mohr’s circle for three dimensional stresses. Stress tensor, Air’s stress function in rectangular and polar coordinates.

### MODULE II – ENERGY METHODS  
(8 Lecture Hours)
Energy method for analysis of stress, strain and deflection. Theorem of virtual work, theorem of least work, Castigliona’s theorem, Rayleigh Ritz method, Galerkin’s method and Elastic behavior of anisotropic materials like fiber reinforced composites.

### MODULE III – THEORY OF TORSION  
(8 Lecture Hours)
Torsion of prismatic bars of solid section and thin walled section. Analogies for torsion, membrane analogy, fluid flow analogy and electrical analogy. Torsion of conical shaft, bar of variable diameter, thin walled members of open cross section in which some sections are prevented from warping, Torsion of noncircular shaft

### MODULE IV – UNSYMMETRICAL BENDING AND SHEAR CENTRE  
(7 Lecture Hours)
Concept of shear center in symmetrical and unsymmetrical bending, stress and deflections in beams subjected to unsymmetrical bending, shear center for thin wall beam cross section, open section with one axis of symmetry, general open section, and closed section.

### MODULE V – PRESSURIZED CYLINDERS AND ROTATING DISKS  
(7 Lecture Hours)
Governing equations, stress in thick walled cylinder under internal and external pressure, shrink fit compound cylinders, stresses in rotating flat solid disk, flat disk with central hole, disk with variable thickness, disk of uniform strength, Plastic action in thick walled cylinders and rotating disc.

### MODULE VI – CONTACT STRESSES  
(7 Lecture Hours)
Geometry of contact surfaces, method of computing contact stresses and deflection of bodies in point contact, stress for two bodies in line contact with load normal to contact area and load normal and tangent to contact area. Introduction to analysis of low speed impact.

### Reference Books:

**Course Objectives:** To impart knowledge on
2. Various types of elements used in FEA.
3. Implementation of galerkin’s formulation into the finite element method for the solution of ordinary and partial differential equations.

**Course Outcomes:** After completing the course the student will be able to
1. Acquire the fundamental theory of finite element analysis and develop element characteristic equation, global stiffness equation.
2. Derive element matrix equation using different methods by applying basic laws in mechanics and integration by parts.
3. Solve problems under dynamic conditions by applying various techniques.
4. Attain knowledge in error norms, convergence rates and refinement.
5. Use professional-level finite element software to solve engineering problems in structural mechanics, fluid mechanics and heat transfer.
6. Solve the real world engineering problems using FEA.

**MODULE I – INTRODUCTION**
Basic concepts- General applicability of the method to structural analysis, heat transfer and fluid flow problems- general approach of finite element method with case studies - classical analysis techniques-finite element packages - Solution of equilibrium problems- solution of Eigen value problem - Solution of propagation problems.

**MODULE II – GENERAL PROCEDURE**
Discretization of Domain- basic element shapes- interpolation polynomials natural coordinates-formulation of element characteristic matrices and vectors-direct approach -variational approach and weighted residual approach-Continuity conditions.

**MODULE III – FINITE ELEMENTS**
Formulation of one dimensional, two dimensional, three dimensional elements - isoparametric elements- curve sided elements-higher order elements-Lagrangian element-serendipity element-Shape functions and stiffness matrix- Error norms and Convergence rates – h-refinement with adaptivity – adaptive refinement.

**MODULE IV – FIELD PROBLEMS**

**MODULE V – TORSION OF NON-CIRCULAR SECTION**

**MODULE VI – DYNAMIC ANALYSIS**
Reference Books:

18ME3019 ADVANCED VIBRATIONS AND ACOUSTICS

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Course Objective: To impart knowledge on
1. Fundamentals of vibrations and its practical applications.
2. Analyzing the vibration behavior of mechanical systems subjected to excitation.

Course Outcomes: After completing the course the student will be able to
1. Classify the systems of vibration and formulate equations of motion for vibratory systems.
2. Solve vibration problems with multi-degrees of freedom.
3. Suggest methods to control vibration and to perform vibration tests.
4. Categorize with international standards in acoustics and noise engineering.
5. Present the theoretical, experimental principles of mechanical vibrations to gain practical understanding in the field of vibration.
6. Understand unwanted vibration, noise in machines and proficient with instrumentation used in noise, vibration control tests.

MODULE I – VIBRATION OF SINGLE DEGREE OF FREEDOM SYSTEM (7 Lecture Hours)

MODULE II – VIBRATION OF TWO AND MULTI DEGREE FREEDOM SYSTEMS (8 Lecture Hours)
Equations of motion for Two Degree of freedom systems- –Influence coefficients- mode of vibration-principle modes-principle of orthogonal generalized coordinates– semi definite systems-Multi degree of freedom system-continuous system- Vibration equation, Natural frequency and mode shape for beams, rod.

MODULE III – NUMERICAL AND COMPUTER METHODS IN VIBRATIONS, (7 Lecture Hours)

MODULE IV – VIBRATION CONTROL (7 Lecture Hours)
Vibration isolation and transmissibility- Vibration Isolation methods- Dynamic Vibration absorber-Torsional and Pendulum Type Absorber-Active vibration control.

MODULE V – ENGINEERING ACOUSTICS (8 Lecture Hours)
Basic physical acoustics- acoustic levels and spectra- decibels, sound power, Sound pressure, power and intensity - Character of noise – Addition of two noise sources -Noise source identification. Noise radiation from vibrating bodies sound- properties of the various sources that create noise - Noise in machines and machine elements.

MODULE VI – VIBRATION MEASUREMENT AND ACOUSTIC STANDARDS (8 Lecture Hours)
Reference Books:

18ME3020 COMPUTER AIDED DESIGN

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Course Objectives: To impart knowledge on
1. Various computer aided design tools for industrial applications.
2. Graphical entities of CAD / CAM and computer numerical programming.
3. Application of computers in manufacturing sectors.

Course Outcomes: After completing the course the student will be able to
1. Demonstrate the basic structure and components of cad.
2. Outline the process of representing graphical entities in a cad environment.
3. Construct the geometric model using different techniques to represent a product.
4. Illustrate various techniques and devices involved in cad hardware.
5. Analyze the models for design solutions using fem.
6. Discuss the various computer aided tools implemented in various industrial applications.

MODULE I – INTRODUCTION (7 Lecture Hours)
Introduction to CAD, Scope and applications in mechanical engineering, Need for CAD system, use of computer, Computer fundamentals, Computer aided design process, CAD configuration, CAD tools, advantages and limitations in CAD, CAD Standards – IGES, GKS and PDES, CAD/ CAM integration.

MODULE II – COMPUTER GRAPHICS (8 Lecture Hours)

MODULE III – GEOMETRIC MODELLING (8 Lecture Hours)

MODULE IV – CAD HARDWARE (8 Lecture Hours)
Introduction to hardware specific to CAD, Product cycle, CRT, Random scan technique, raster scan technique, CAD specific i/o devices, DVST, Raster display, Display systems, sequential scanning and interlaced scan.

MODULE V – FINITE ELEMENT METHOD (7 Lecture Hours)
Introduction to FEM, Principle of minimum potential energy, steps involved in FEM, discretization, types of nodes and elements, elemental stiffness matrix, elemental strain displacement matrix, types of force, elemental force matrix, assembly, shape function, introduction to 2 dimensional FEM.

MODULE VI – OPTIMIZATION AND NEW TECHNIQUES OF CAD (7 Lecture Hours)
Reference Books:

18ME3021 VIBRATION LABORATORY

Course Objectives: To impart knowledge on
1. Fundamentals of digital data acquisition, signal processing, data reduction and display
2. Sensors, signal conditioning and associated instrumentation for vibration
3. Vibration measurement techniques

Course Outcomes: After completing the course the student will be able to
1. Study the effect of dynamics on vibration.
2. Recognize the instrumentation used in vibration control tests.
3. Understand the working principle of vibration measuring instruments
4. Adapt and evaluate the way to measure vibration
5. Gain knowledge of fundamental information about vibration phenomenon and find remedy of the vibration problems encountered in machineries
6. Understand the behavior of vibration in simple mechanical systems

LIST OF EXPERIMENTS
1. Longitudinal Vibration for single degree of freedom system
2. Torsional vibration for single degree of freedom system
3. Forced vibration for spring mass system
4. Multiple degree of freedom system
5. Transmissibility ratio in vibration table
6. Study of frequency and amplitude in vibration table
7. Vibration measurement using accelerometer for rotating machinery
8. Frequency measurement using Impact hammer
9. Real Time PC based vibration measurement
10. Measurement of Acoustic Emission signals
11. Generation of vibration signal by vibration controller
12. Study on the effect of material on load and deflection using tensile test

18ME3022 MULTIBODY DYNAMICS LABORATORY (ADAMS)

Course Objectives: To impart knowledge on
1. Various linkage mechanisms
2. Simulation software like ADAMS
3. Kinematics and dynamics of mechanisms using software like ADAMS.

Course Outcomes: After completing the course the student will be able to
1. Illustrate the movements involved in various links and joints using software like ADAMS
2. Understand the various constraints and degree of freedom in the simple mechanism
3. Simulations of the mechanics involved in real life applications
4. Describe the mechanisms and motions of simple mechanical system
5. Find the DOF in various links and joints
6. Understand the working of different mechanism by relating it to simple computer simulation models using ADAMS software

LIST OF EXPERIMENTS
1. Simple motion analysis of one degree of freedom pendulum
2. Simulation of a slider crank mechanism
3. Simulation of a simple belt (open belt drive)
4. Simulation of a simple gear drive.
5. Velocity and Acceleration analysis
6. Angular velocity of a simple four bar mechanism
7. Position analysis of two degree of freedom link system
8. Vibration analysis of a spring mass system
9. Spring damper analysis
10. Quick return mechanism - simulation
11. Simulation of Hartnel governor
12. Simulation of IC engine crank multibody.

Reference Books:
1. Lab Manual

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<th>18ME3023</th>
<th>NUCLEAR POWER ENGINEERING</th>
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Course Objectives: To impart knowledge on
1. The fundamental terms and concepts of nuclear power engineering.
2. The neutron life cycle, heat flow, radiation, fluidized bed reactor.
3. The safety principles and methods utilized in designing, constructing and operating a safe nuclear power plant.

Course Outcomes: After completing the course the student will be able to
1. Explain fundamental physics that applies to a broad range of nuclear technologies.
2. Understand the coolant channel orificing, hot spot factors.
3. Acquire knowledge on reactor hydraulics, different bed reactors.
4. Determine thermal reaction equation, temperature, pressure coefficient.
5. estimate safety calculations in support of the preparation of an abbreviated safety analysis
6. Demonstrate an understanding of social, professional, and ethical issues related to the safe and wise development of nuclear science and engineering.

MODULE I – REVIEW OF NUCLEAR PHYSICS

MODULE II – HEAT GENERATION IN REACTOR

MODULE III – REACTOR COOLING

MODULE IV – TYPES OF REACTOR

MODULE V – FUSION ENERGY CONVERSION

Module VI – SAFETY OF NUCLEAR PLANTS
Nuclear plant safety – safety systems-changes and consequences of an accident-criteria for safety.

Reference books:

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**Course Objectives:** To impart knowledge on
1. Energy conservation.
2. Energy auditing.
3. Energy management.

**Course Outcomes:** After completing the course the student will be able to
1. Discuss the present status of national energy scenario.
2. Compare the different forms of energy.
3. Apply various energy auditing methods.
4. Analyze the energy conservation areas in thermal systems.
5. Estimate the energy conservation areas in electrical systems.
6. Choose the different financial management methods.

**MODULE I – ENERGY SCENARIO (6 Lecture Hours)**

**MODULE II – BASICS OF ENERGY AND VARIOUS FORMS (6 Lecture Hours)**
Various forms of energy – grades of energy. Electrical energy basics – Electricity tariff – Basics of thermal energy

**MODULE III – ENERGY AUDIT (6 Lecture Hours)**
Definition and Objectives of energy audit – Need for energy audit – Types of energy auditing – Instruments used for energy auditing

**MODULE IV – ENERGY CONSERVATION IN THERMAL SYSTEMS (9 Lecture Hours)**

**MODULE V – ENERGY CONSERVATION IN ELECTRICAL SYSTEMS (9 Lecture Hours)**

**MODULE VI – ENERGY MANAGEMENT (9 Lecture Hours)**
Energy management principles, need for organization and goal setting - Life cycle costing and other methods - Factors affecting economics - Introduction to financial management - Simple payback period - Net present value method – Internal rate of return method.

**Reference books:**
Course Objectives: To impart knowledge on
1. Solar energy and techniques to utilize it efficiently and cost effectively.
2. Conversion of sunlight to heat for either direct usage or further conversion to other energy carriers.
3. Design a solar thermal system for a desired application.

Course Outcomes: After completing the course the student will be able to
1. Understand the available solar energy and the utilization processes.
2. Compare the different types of solar collectors.
3. Evaluate the performance of solar collectors.
4. Analyze the performance of solar air heaters.
5. Explain the energy storage system.
6. Apply the solar energy technology for various applications.

MODULE I – INTRODUCTION

MODULE II – FLAT PLATE COLLECTORS
Energy balances equation and collectors efficiency – collector performance – collector improvements, effect of incident angle, dust and shading – thermal analysis of flat plate collector and useful heat gained by the fluid - collector design – heat transfer factors.

MODULE III – CONCENTRATION COLLECTORS

MODULE IV – SOLAR AIR HEATERS
Introduction – Performance analysis of a conventional air heater – Other types of air heaters – Testing procedures.

MODULE V – SOLAR ENERGY STORAGE
Stratified storage – well mixed storage – comparison – Hot water system – practical consideration – solar ponds – principle of operation and description of Non-convective solar pond – extraction of thermal energy application of solar ponds.

MODULE VI – APPLICATIONS OF SOLAR ENERGY
Solar electric power generation, photo voltaic cells. Solar furnace, Solar Chimney, heaters – power generation system. Tower concept – solar refrigeration system, thermoelectric refrigeration system.

Reference Books:
2. Compare different types of air-conditioning systems.
3. Evaluate the space cooling load.
4. Design the duct.
5. Choose the fan for desired application
6. Design the water and refrigerant piping

MODULE I – PSYCHROMETRY AND AIR CONDITIONING PROCESSES (9 Lecture Hours)
Moist Air properties, use of Psychrometric Chart, Various Psychrometric processes, Air Washer, Adiabatic Saturation. Summer and winter Air conditioning. Enthalpy potential and its insights.

MODULE II – TYPES OF AIR CONDITIONING SYSTEMS (6 Lecture Hours)
Thermal distribution systems – Single, multi zone systems, terminal reheat systems, Dual duct systems, variable air volume systems, water systems and unitary type systems.

MODULE III – COOLING LOAD ESTIMATION (9 Lecture Hours)

MODULE IV – DUCT DESIGN (6 Lecture Hours)
Flow through Ducts, Static and Dynamic Losses, Diffusers, Duct Design–Equal Friction Method.

MODULE V – FAN (6 Lecture Hours)
Fan and its types, Fan characteristics and laws. Fan Arrangement Variable Air Volume systems, Air Handling Units and Fan Coil units – Control of temperature, humidity, air flow and quality.

MODULE VI – WATER PIPING AND REFRIGERANT PIPING DESIGN (9 Lecture Hours)

Reference Books:
2. ASHRAE . Fundamentals and equipment , 4 volumes-ASHRAE Inc. 2005
MODULE III – AIRCRAFT PROPULSION (7 Lecture Hours)
Gas turbine cycles for aircraft propulsion -simple turbojet cycle-the turbofan engine-turbo prop engine-the turbo shaft engine-thrust augmentation- auxiliary power units.

MODULE IV – COMPRESSORS (8 Lecture Hours)
Centrifugal compressors-principle of operation-the diffuser-compressor characteristics and improvement, axial flow compressors- basic operation-degree of reaction- Blade materials, manufacturing techniques, blade fixing, blade design-axial flow compressor characteristics and improvement- mixed flow compressor, parameters affecting performance.

MODULE V – COMBUSTION SYSTEMS (6 Lecture Hours)
Types of combustion systems- various fuels and fuel systems, the combustion process-factors affecting combustor design-combustion chamber performance-gas turbine emissions.

MODULE VI – AXIAL AND RADIAL FLOW TURBINES (8 Lecture Hours)
Elementary theory of axial flow turbine-vortex theory-choice of blade profile, pitch and chord, estimation of stage performance, overall turbine performance- Problems of high temperature operation, blade cooling, and practical air cooled blades, the radial flow turbine

Reference Books:

18ME3028 ADVANCED INSTRUMENTATION IN THERMAL ENGINEERING

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Course Objectives: To impart knowledge on
1. The working of measuring instruments and errors associated with them.
2. Error analysis and uncertainty of measurements.
3. The measurement and data acquisition applicable to a thermal systems.

Course Outcomes: After completing the course the student will be able to
1. Identify experimental data and predict correlation.
2. Interpret uncertainties in various measurements.
3. Apply measurement techniques of intensive and extensive properties.
4. Analyze specific functional characteristics of thermal instruments.
5. Estimate the control system parameters using analog and digital controllers.
6. Formulate concepts to reduce errors in measurements.

MODULE I – MEASUREMENT CHARACTERISTICS (8 Lecture Hours)
Introduction to measurements, errors in measurements, statistical analysis of data, regression analysis, correlation, estimation of uncertainty and presentation of data.

MODULE II – MEASUREMENTS IN THERMAL SYSTEMS (7 Lecture Hours)
Basic Electrical measurements, Transducers and its types, Measurement of temperature, pressure, velocity, flow - simple and advanced techniques.

MODULE III – MEASUREMENT OF THERMO-PHYSICAL PROPERTIES (8 Lecture Hours)
Thermal conductivity, viscosity, surface tension, specific heat capacity, radiation properties of surfaces.

MODULE IV – MEASUREMENT OF FUEL PROPERTIES (8 Lecture Hours)
Flame ionization detector, non-dispersive infrared analyzer, smoke meters, and gas chromatography

MODULE V – DATA LOGGERS (8 Lecture Hours)
Data logging and acquisition, sensors for error reduction, elements of computer interfacing, timers and counters.
MODULE VI – DESIGN OF EXPERIMENTS  
(8 Lecture Hours)
Modeling of thermal equipment. Examples applied to heat transfer problems and energy systems.

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Course Objectives: To impart knowledge on
1. Types of biomass resources and their properties.
2. Biomass conversion processes and application of conversion products.

Course Outcomes: After completing the course the student will be able to
1. Select suitable biomass for conversion, based on its properties.
2. Analyze the performance of engines using biodiesel.
3. Design a community biogas plant.
4. Select conditions for biomass pyrolysis & develop a small size biomass gasifier.
5. Demonstrate techniques used for liquefaction of biomass.
6. Explain the economics of production processes of biofuels.

MODULE I – BIOMASS AS ENERGY SOURCE  
(8 Lecture Hours)
Biomass energy usage in different countries – Advantages and disadvantages in use of biomass as energy source- Sources of biomass available for energy use- physical properties of biomass- proximate analysis- ultimate analysis- heating value analysis- Empirical relations for estimating heating values- Application of biomass conversion products.

MODULE II – BIODIESEL PRODUCTION  
(8 Lecture Hours)
Vegetable oil and animal fat characteristics- fatty acid composition-oil extraction processes-oil refining processes-Transesterification- ASTM characterization- Engine performance and exhaust emissions.

MODULE III – BIOGAS PRODUCTION  
(8 Lecture Hours)
Biomass parameters important in anaerobic digestion- Acid and methane forming microbes-advantages and disadvantages of anaerobic digestion processes- design of biogas digester- biogas utilization.

MODULE IV – PYROLYSIS AND GASIFICATION  
(10 Lecture Hours)
Pyrolysis processes based on heating rate- effect of temperature on product yields- applications of products from fast pyrolysis-bio oil characterization processes- bio oil upgrade processes- advantages and disadvantages of pyrolysis process. Chemistry of biomass gasification- various types of gasifiers-applications of biomass gasifiers- empirical chemical formula of biomass- air requirement for gasification- equivalence ratio calculations in a gasifier- syngas requirement in internal combustion engines.

MODULE V – BIOMASS LIQUEFACTION  
(7 Lecture Hours)
Bioethanol production - household and pilot scale ethanol production systems- Methanol production from synthesis gas- Fischer Tropsch processes- direct liquefaction processes- Advantages and disadvantages of biomass liquefaction processes.

MODULE VI – BIOFUELS COMBUSTION AND ECONOMICS  
(7 Lecture Hours)
Applications of biomass combustion systems- amount of CO₂ produced for every metric ton of biomass combusted- biomass combustion efficiency- Economics of production processes for major biofuels-measuring sustainability of biofuels.

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<th>DESIGN AND ANALYSIS OF HEAT EXCHANGERS</th>
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**Course objectives:** To impart knowledge on
2. Design of Shell and tube, compact heat exchangers.

**Course Outcomes:** After completing the course the student will be able to
1. Identify the constructional aspects of various types of heat exchangers.
2. Predict the effectiveness of heat exchangers NTU method.
3. Calculate the design parameters of shell-and-tube heat exchanger.
4. Analyze compact heat exchanger.
5. Evaluate the performance of condensers.
6. Formulate concepts of single and multi-effect evaporators.

**MODULE I – VARIOUS TYPES OF HEAT EXCHANGER** (8 Lecture Hours)

**MODULE II – BASIC DESIGN METHODS OF HEAT EXCHANGERS** (7 Lecture Hours)
Arrangement of flow path in heat exchangers; basic equations in design; Overall heat transfer coefficient; LMTD and NTU methods for heat exchanger analysis, Heat exchanger design calculation, Variable overall heat transfer coefficient, Heat exchanger design methodology.

**MODULE III – SHELL AND TUBE HEAT EXCHANGERS** (8 Lecture Hours)
Basic components-shell types, tube bundle types, tubes and tube passes, tube layout in baffle type heat exchanger, allocation of stream; basic design procedure of a heat exchanger- unit size, performance rating.

**MODULE IV – DESIGN OF DOUBLE PIPE HEAT EXCHANGERS** (7 Lecture Hours)
Thermal and hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop.

**MODULE V – COMPACT HEAT EXCHANGE** (8 Lecture Hours)
Plate-fin heat exchanger, tube-fin heat exchangers, Heat transfer, pressure drop in finned-tube and plate-fin heat exchanger.

**MODULE VI – CONDENSERS AND EVAPORATORS** (7 Lecture Hours)
Shell-and-tube condensers-horizontal shell-side condensers, vertical tube-side condensers, horizontal in-tube condensers, steam turbine exhaust condensers; Plate condensers; Air-cooled condensers; Direct contact condensers; Thermal design of shell-and-tube condensers, Single and multi-effect evaporators.

**Reference Books:**
Course Objectives: To impart knowledge of
1. Two phase flow and circulation in boiler.
2. Heat transfer with change of phase in condensation and boiling.
3. Fluidized beds and gas-liquid fluidization.

Course Outcomes: After completing the course the student will be able to
1. Understand vertical, horizontal and inclined two phase flow.
2. Determine effective pressure head in boiler tubes.
3. Choose various types of fluidized beds.
4. Evaluate heat transfer during condensation.
5. Analyze heat transfer with change of phase in boiling.

MODULE I – TWO PHASE FLOW (8 Lecture Hours)
Simultaneous flow of liquids and gases, horizontal two phase flow, lock hart and Martenelli procedure
flow factor method, vertical two phase flow, two phase flow through inclined pipes.

MODULE II – CIRCULATION IN BOILER (7 Lecture Hours) Natural
and forced circulation, effective pressure head in boiler tubes, variation of major parameters of drum
during transient conditions, the hydrodynamics stability of vapor – liquid system.

MODULE III – FLUIDIZED BEDS (8 Lecture Hours) Simultaneous
flow of fluids and solids, dynamics of particles submerged in fluids, flow through packed bed.
Fluidization, calculation of pressure drop in fixed bed, determination of minimum fluidization velocity,
Expanded bed, dilute phase, moving solids fluidization, Elutriation in fluidized Bed, Semi fluidization,
applications, Pulsating column, oscillating fluidized beds.

MODULE IV – CONDENSATION (7 Lecture Hours) Film wise
condensation of pure vapors, Drop wise condensation in plated surfaces, condensation in presence of
non-condensable gas.

MODULE V – BOILING (8 Lecture Hours) Pool
boiling, Boiling in forced flow inside tubing.

MODULE VI – GAS-LIQUID FLUIDIZATION (7 Lecture Hours) Gas liquid
particle process, Gas liquid particle operation, Gas liquid fluidization. Flow of Gas - Bubble formation,
bubble growth gas hold up, Gas mixing liquid holdup, liquid mixing, flow of liquid mixing, Gas liquid
mass transfer.

Reference books:
   1997.
   1997.

Course Objectives: To impart knowledge on
1. Governing equations in fluid dynamics.
2. Solution methodologies of discretized equations.
3. Turbulence and combustion models.

Course Outcome: After completing the course the student will be able to
1. Develop governing equations for fluid flow and heat transfer.
2. Demonstrate the physical behaviors of flow.
3. Perform cfd analysis.
4. Impose boundary conditions while solving CFD problems.
5. Applying turbulence and combustion models in problem solving.
6. Develop various types of grids for solving CFD problems.

MODULE I – GOVERNING EQUATIONS AND BOUNDARY CONDITIONS (8 Lecture Hours)

MODULE II – DIFFUSION (8 Lecture Hours)
Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems

MODULE III – CONVECTION AND DIFFUSION (8 Lecture Hours)
Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional convection and diffusion.

MODULE IV – SOLUTION METHODOLOGIES (7 Lecture Hours)
Solution methodologies: Representation of the pressure - Gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure - Correction equation, SIMPLE algorithm and its variants.

MODULE V – GRID GENERATION (7 Lecture Hours)

MODULE VI – TURBULENCE AND COMBUSTION (7 Lecture Hours)

Reference Book

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<thead>
<tr>
<th>18ME3033 ADVANCED IC ENGINES</th>
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Course objectives: To impart knowledge on
1. Performance of SI and CI engines.
2. Understand recent trends in engine technology.
3. Engine exhausts emission control and alternate fuels.

Course Outcomes: After completing the course the student will be able to
1. Classify different types of internal combustion engines.
3. Identify recent technology trends in engine.
4. Study about friction reduction and light weighting technologies.
5. Predict concentrations of primary exhaust pollutants.
6. Analyze the performance and emissions of alternate fuels.
MODULE I – SPARK IGNITION ENGINES (8 Lecture Hours)
Mixture requirements of air-fuel ratio, Fuel injection system, Monopoint, Multipoint & Direct injection -Stages of combustion, Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers, New technologies employed in 3 way catalytic convertor, stoichiometric and lean combustion.

MODULE II – COMPRESSION IGNITION ENGINES (7 Lecture Hours)
Diesel Fuel Injection Systems, Stages of combustion, Knocking, Factors affecting knock, Direct and Indirect injection systems, Combustion chambers, Fuel Spray behavior, Spray structure and spray penetration, Air motion, Introduction to Turbo charging, Advanced trends in Diesel oxidation catalyst (DOC), and Diesel particulate filter (DPF).

MODULE III – POLLUTANT FORMATION AND CONTROL (8 Lecture Hours)

MODULE IV – NON CONVENTIONAL I.C. ENGINES (7 Lecture Hours)

MODULE V – ALTERNATIVE FUELS (8 Lecture Hours)

MODULE VI – AUTOMOTIVE FUEL INJECTION SYSTEM (7 Lecture Hours)

Reference Books:

Course Objectives: To impart knowledge on
1. Various types of turbine, pump and compressor.
2. Performance analysis of turbines, pumps and compressors.
3. Application of turbo machines.

Course Outcomes: After completing the course the student will be able to
1. Classify types of turbine, pump, and compressors.
2. Demonstrate knowledge of turbines, pumps and compressors.
3. Compare the performance of turbo machines.
4. Select turbo machines for specific applications.
5. Analyze flow patterns in turbo machines.
6. Design micro and small turbo machines.

MODULE I – CLASSIFICATION OF TURBO MACHINERY (7 Lecture Hours)
Introduction, definition of turbo machine, parts of turbo machines, comparison with positive displacement machines, classification, dimensionless parameters and their significance, effect of Reynolds’s number, unit and specific quantities, model studies, application of first and second law’s of thermodynamics to turbo machines, efficiencies of turbo machines, problems
MODULE II – THERMODYNAMICS OF FLUID FLOW (7 Lecture Hours)
Static and Stagnation states- Incompressible fluids and perfect gases, overall isentropic efficiency, stage efficiency and polytropic efficiency for compression and expansion processes. Reheat factor for expansion process.

MODULE III – ENERGY EXCHANGE IN TURBO MACHINES (7 Lecture Hours) Euler’s turbine equation, alternate form of Euler’s turbine equation, velocity triangles for different values of degree of reaction, components of energy transfer, degree of Reaction, utilization factor, relation between degree of reaction and utilization factor, problems.

MODULE IV – GENERAL ANALYSIS OF TURBO MACHINES (8 Lecture Hours) Radial flow compressors and pumps, expression for degree of reaction, velocity triangles, effect of blade discharge angle on energy transfer, degree of reaction, and performance, theoretical head capacity relationship, general analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, problems.

MODULE V – STEAM TURBINES (8 Lecture Hours)
Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, need and methods of compounding, multi-stage impulse turbine, expression for maximum utilization factor, Reaction turbine, Parsons turbine, condition for maximum utilization factor, reaction staging problems.

MODULE VI – HYDRAULIC TURBINES (8 Lecture Hours)
Classification, Different efficiencies, Pelton turbine, velocity triangles, design parameters, maximum efficiency, Francis turbine -velocity triangles, design parameters, runner shapes for different blade speeds. Draft tubes- Types and functions. Kaplan and Propeller turbines -velocity triangles, design parameters, problems.

Reference Books:

18ME3035  |  DESIGN OF SOLAR AND WIND SYSTEMS  |  L  |  T  |  P  |  C  
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Course Objectives: To impart knowledge on
1. Fundamental principles of thermodynamics and heat transfer for performance analysis of solar energy collectors.
2. Small scale wind mills.
3. Various alternative energy sources for power generation.

Course Outcomes: After completing the course the student will be able to
1. Identify renewable energy sources for power generation.
2. Obtain solar radiation data.
3. Analyze the performance of solar energy collectors.
4. Select wind power generators for specific applications.
5. Recognize various types of fuel cells and solar pv systems.
6. Recognize different sources of alternate energy and evaluate performance of thermoelectric power generators.

MODULE I – INTRODUCTION TO ENERGY SOURCES (7 Lecture Hours)
Energy consumption as a measure of prosperity-world energy futures- energy sources and their availability-conventional energy sources- new energy technologies-renewable energy sources-prospects of renewable energy sources.

MODULE II – SOLAR RADIATION AND ITS MEASUREMENT (7 Lecture Hours)
MODULE III – SOLAR ENERGY COLLECTORS AND STORAGE (8 Lecture Hours)
Flat plate collectors- energy balance equation and collector efficiency- concentrating collectors-performance analysis of solar collectors- selective absorber coatings- solar air heaters- solar energy storage systems- thermal energy storage- solar pond.

MODULE IV – WIND ENERGY (8 Lecture Hours)

MODULE V – SOLAR PHOTO-VOLTAICS, MHD AND FUEL CELLS (7 Lecture Hours)
Photovoltaic cells- solar cell modules, applications, advantages and disadvantages of photovoltaic solar energy conversion-principle of MHD power generation, MHD systems, advantages, materials for MHD generators- principle of operation of a fuel cell, types, advantages and disadvantages, applications, batteries.

MODULE VI – OTHER ALTERNATE ENERGY SOURCES (8 Lecture Hours)
Thermionic generation- analysis of thermionic generator- thermoelectric power generator, performance analysis, thermoelectric materials- energy from biomass- biomass conversion technologies, biogas generation, classification of biogas plants- hydrogen energy, hydrogen production, storage, transportation and utilization- geothermal- geothermal sources, geothermal power plants, advantages and disadvantages, applications.

Reference Books:
4. N.K. Bansal “Non-Conventional Energy Sources” Vikas publishing, 2014

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<th>18ME3036</th>
<th>QUALITY CONCEPTS IN DESIGN</th>
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Course Objectives: To impart knowledge on
1. Basic concepts in total quality management
2. Statistical process control
3. Reliability computation and reliability improvement

Course Outcomes: After completing the course the student will be able to
1. Apply the basic tools of quality in product development
2. Analyze the basic tools of quality in improving or redesigning the production process
3. Adopt/adept TQM and SPC tools in product/process industries
4. Conduct experiments and to analyze the significance of proceeds parameters
5. Compute reliability of parallel, series and mixed configurations
6. Improve the reliability of the systems by redundancy

MODULE I – BASIC CONCEPTS (6 Lecture Hours)
Basic concepts in quality engineering and management, TQM, Cost of quality, quality engineering, concept of quality auditing, customer satisfaction.

MODULE II – QUALITY LEVEL (7 Lecture Hours)

MODULE III – STATISTICAL PROCESS CONTROL (9 Lecture Hours)
DMAIC process for process and design improvement, Acceptance Sampling, Statistical Process Control (SPC), Process Capability, Gage Reproducibility and Repeatability, Quality Function Deployment.

MODULE IV – FAILURE ANALYSIS (7 Lecture Hours)
Failure mode effect analysis, Fault-tree analysis APQP, Embodiment checklist- Advanced methods: systems modeling, mechanical embodiment principles.
MODULE V – DESIGN OF EXPERIMENTS
(8 Lecture Hours)
Procedure for DOE, Fractional, Full and Orthogonal Experiments, Regression model building, Taguchi methods for robust design.

MODULE VI – RELIABILITY
(8 Lecture Hours)
Definition, Survival and Failure rates-Series and parallel and mixed systems-Mean time between failure, Mean time to failure,-Availability models-redundancy

Reference Books:

18ME3037
MANUFACTURING SYSTEM AND SIMULATION
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Course Objectives:
To impart knowledge on
1. Various modeling techniques.
2. Random number generation.

Course Outcomes:
After completing the course the student will be able to
1. Create model of the real manufacturing system.
2. Generate random numbers for simulation experiments.
4. Analyse material handling problem and to give solutions.
5. Optimize the performance of a discrete system.
6. Verify and validate the simulation model.

MODULE I – BASICS OF SIMULATION
(8 Lecture Hours)
Simulation-Introduction, advantages and limitations, areas of application, systems and system environment, components of a system, discrete and continuous system, models of a system, Types of models, Discrete event system simulation, steps in simulation study.

MODULE II – INFORMATION SYSTEMS
(8 Lecture Hours)
Fundamentals of information technology, information networking, parts oriented production information systems, and computerized production scheduling, online production control systems. Computer based production management systems, principles and effectiveness of CIM, factory automation, FMS.

Module III – SIMULATION OF INVENTORY AND MAINTENANCE PROBLEMS
(8 Lecture Hours)
Random number generations Random numbers generation- methods and techniques - Montecarlo simulation to solve inventory problem and maintenance problem. Queuing models: Review of terminology and concepts, characteristics of queuing systems, Queuing notations, Transient and steady state behavior-long run measures of performance of queuing systems.

MODULE IV – DISCRETE EVENT SIMULATION
(7 Lecture Hours)
Concepts in discrete event simulation: Event scheduling/Time advance algorithm-manual simulation using event scheduling-list processing Programming for discrete event systems in GPSS.

MODULE V – MANUFACTURING SIMULATION
(7 Lecture Hours)
Simulation of manufacturing & material handling system, manufacturing models - Types and uses, material handling –Goal and performance measures-Issues in Manufacturing &Material handling simulation-case studies-Introduction to softwares-SIMFACTORY,AIM,ARENA and TAYLOR II.

MODULE VI – VERIFICATION AND VALIDATION
(7 Lecture Hours)
Simulation experiments, Verification and validation of simulation models. –Face validity-Validation of model assumptions, validation of input-output transformation-input-output validation.
Reference books:

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<th>18ME3038</th>
<th>FLEXIBLE MANUFACTURING SYSTEM</th>
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Course Objectives: To impart knowledge on
1. Demonstrates basics and components of FMS to learners
2. Discover the use of computers in FMS
3. Formulate the scheduling techniques of FMS

Course Outcomes: After completing the course the student will be able to
1. Understand the basic concepts and components of FMS
2. Identify Automated material handling systems used in FMS
3. Infer FMS control using computers
4. Formulate the modeling of FMS.
5. Analyse the database for manufacturing systems
6. Compose the scheduling of FMS

MODULE I – INTRODUCTION TO FMS (8 Lecture Hours)
Definition of an FMS - Need for FMS - types and configuration - types of flexibilities and performance measures - Economic justification of FMS - Development and implementation of FMS - planning phases – integration - system configuration - FMS layouts - simulation.

MODULE II – AUTOMATED MATERIAL HANDLING AND STORAGE (8 Lecture Hours)

MODULE III – COMPUTER CONTROL OF FMS (8 Lecture Hours)
Planning - scheduling and computer control of FMS - Hierarchy of computer control - supervisory computer. DNC system- communication between DNC computer and machine control unit - features of DNC systems.

MODULE IV – COMPUTER SOFTWARE AND SIMULATION (7 Lecture Hours)

MODULE V – DATA BASE OF FMS (7 Lecture Hours)

Module VI – SCHEDULING OF FMS (7 Lecture Hours)
Scheduling of operations on a single machine- two machine flow shop scheduling - two machine job shop scheduling, - three machine flow shop scheduling- scheduling ‘n’ operations on ‘n’ machines, knowledge based scheduling - scheduling rules - tool management of FMS - material handling system schedule.

Text Books:

Reference Books:

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<th>18ME3039</th>
<th>COMPUTER INTEGRATED MANUFACTURING SYSTEMS</th>
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Course Objectives: To impart knowledge on
1. The use of computers in the area of manufacturing.
2. New technology in the area of manufacturing.
3. Artificial intelligence and expert systems in manufacturing systems.

Course Outcomes: After completing the course the student will be able to
1. Employ computers in the area of manufacturing to reduce manual processing.
2. Understand group technology
3. Apply computer aided process planning
4. Examine Material Requirement Planning (MRP) and Enterprise Resource Planning (ERP)
5. Apply computer aided quality control and Flexible manufacturing systems
6. Recommend Artificial intelligence and Expert systems

MODULE I – INTRODUCTION (8 Lecture Hours)
Objectives of a manufacturing system-identifying business opportunities and problems classification production - systems-linking manufacturing strategy and systems-analysis of manufacturing operations.

MODULE II – GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING (7 Lecture Hours)

MODULE III – COMPUTER AIDED PLANNING AND CONTROL (7 Lecture Hours)
Production planning and control-cost planning and control-inventory management-Material requirements planning - (ERP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology automated data collection system.

MODULE IV – PRODUCTION MONITORING (7 Lecture Hours)
Types of production monitoring systems-structure model of manufacturing process-process control & strategies direct digital control-supervisory computer control-computer in QC - contact inspection methods non-contact inspection method - computer-aided testing - integration of CAQ with CAD/CAM.

MODULE V – INTEGRATED MANUFACTURING SYSTEM (8 Lecture Hours)
Definition - application - features - types of manufacturing systems-machine tools-materials handling system computer control system - DNC systems manufacturing cell.

MODULE VI – FLEXIBLE MANUFACTURING SYSTEMS (8 Lecture Hours)
Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS – variable mission manufacturing system. Human labor in the manufacturing system-computer integrated manufacturing system benefits. Rapid prototyping - Artificial Intelligence and Expert system in CIM.

Reference Books:
Course Objectives: To impart knowledge on
1. How computers can be used in mechanical engineering design.
2. Basics of CAD modeling (surface and solid) and Visual realism.
3. The techniques for assembly of parts, tolerance analysis, mass property calculation, solid modeling techniques and rapid prototyping.

Course Outcomes: After completing the course the student will be able to
1. Summarize the applications of computers Mechanical Engineering Design.
2. Categorize and use various surface and curve techniques for 3d modelling
4. Develop complex parts based on Visual realism techniques
5. Create part assemblies; apply tolerance analysis and mass property calculations.
6. Analyze simple truss and beam structures using FEA and Construct using rapid prototyping techniques.

MODULE I – INTRODUCTION TO CAD FUNDAMENTALS (8 Lecture Hours)
Introduction to CAD- Design Process-Product cycle - Sequential and concurrent engineering- Graphics displays - Output primitives (points, lines, curves etc.), 2-D & 3-D transformation (Translation, scaling, rotators) windowing - view ports - clipping transformation.

MODULE II – CURVES AND SURFACES MODELLING (9 Lecture Hours)

MODULE III – NURBS AND SOLID MODELING (8 Lecture Hours)

MODULE IV – VISUAL REALISM (7 Lecture Hours)
Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software’s and their principles creation of prismatic and lofted parts using these packages.

MODULE V – PART ASSEMBLY AND PRODUCT DATA EXCHANGE (7 Lecture Hours)

MODULE VI – FINITE ELEMENT ANALYSIS (6 Lecture Hours)
Introduction to Finite element analysis/method – computer aided analysis of simple truss and beam – Computer aided mechanism simulation, Rapid prototyping- application of computers in RP.

Reference Books:
Course Objectives: To impart knowledge on
1. Laws and governing equations for hydraulics and pneumatics with ISO symbolic representations.
2. Working principles of hydraulic and pneumatic drives and develop circuits for engineering applications.
3. Trouble shooting the hydraulic and pneumatic systems.

Course Outcomes: After completing the course the student will be able to
1. Interpret the standard symbols and laws used in FPC Systems.
2. Infer the working principles of pumps and motors.
3. Identify the suitable elements of fluid power systems for a particular application.
4. Examine hydraulic circuits for an industrial application.
5. Assess the optimal components of pneumatic system.

MODULE I – FLUID POWER ELEMENTS (8 Lecture Hours)
Industrial Prime Movers, basic laws, applications, types of fluid power systems, fluid types and properties. Comparison of power systems, Fluid power symbols, fluid reservoir, Cylinders, Mechanics of cylinder loading, Pressure accumulators-types, DCV,FCV, relief valve, hydraulic servo systems, Cartridge valves, Hydraulic fuses, Temperature and pressure switches, Shock Absorbers, electromechanical devices like relays and solenoids.

MODULE II – HYDRAULIC PUMPS AND MOTORS (8 Lecture Hours)
Types – design and construction, gear pumps, vane pumps, piston pumps and pump performance, numerical problems, Hydraulic Motors – Types, theoretical torque, power and flow rate, performance and numerical problems.

MODULE III – DESIGN OF HYDRAULIC CIRCUITS (9 Lecture Hours)
Reciprocation, quick return, Speed control circuits, sequencing, synchronizing circuits, clamping and accumulator circuits, press circuits and hydro-pneumatic circuit.

MODULE IV – DESIGN OF PNEUMATIC CIRCUITS (8 Lecture Hours)
Basic elements - Compressor, Cylinders, DCV,FCV, other special valves, Boolean algebra, truth tables, reciprocation, quick return circuit, cascade circuits/ sequencing circuits like A+B+ A- B-, electro-pneumatic circuits.

MODULE V – INDUSTRIAL APPLICATIONS (8 Lecture Hours)
MPL control of Fluid power circuits, fluidic elements and fluidic sensors, Basic concepts of programmable logical control, Fail-safe Circuits, Intensifier circuits, Box-sorting System, Electrical Control of Regenerative Circuit, Hydro-pneumatic circuit.

MODULE VI – FAULT FINDING AND MAINTENANCE (4 Lecture Hours)

Reference books:
Course Objectives: To impart knowledge on
1. Concepts, principles and applications of TQM.
2. Tools and techniques of TQM.
3. Control charts and process capability.

Course Outcomes: After completing the course the student will be able to
1. Apply the tools and techniques of TQM in manufacturing and service sectors.
2. Assess the barriers of TQM implementation.
3. Formulate and implement quality circles in their workplace.
4. Apply six sigma concepts in manufacturing and service sectors.
5. Apply TPM principles in manufacturing sectors.
6. Improve the processes by using control charts.

MODULE 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.

MODULE 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.

MODULE III
Tools of Quality :The seven traditional tools of quality; New management tools; Six sigma - concepts, Methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

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

MODULE V
CONTROL CHARTS: Control for process capability: variable control charts- Attribute control charts- Process capability-Process capability index-Application of control

MODULE VI
Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, Documentation, Quality auditing, QS 9000, ISO 14001 - concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Reference Books:
Course Outcomes: After completing the course the student will be able to
1. Develop intelligent automated system and manufacturing data base system.
2. Implement the concepts of a productive system in automation.
3. Apply the knowledge of automated flow lines for industrial and other applications.
4. Design and analysis of material handling systems for automated assembly lines.
5. Select proper sensor and actuator for a given application.

MODULE I – PRODUCTION AND AUTOMATION STRATEGIES (8 Lecture Hours)
Plant Layout, production concepts and mathematical models, Automatic loading Systems-Automated flow lines, Methods of work flow - transport transfer mechanisms, buffer storage, Control functions, Automation for machining operations.

MODULE II – DESIGN AND FABRICATION CONSIDERATIONS (8 Lecture Hours)
Analysis of transfer lines without storage -partial automation automated flow lines with storage buffers implementing of automatic flow lines-Line balancing problems, Considerations in assemble line design-Manual assembly lines - line balancing problem.

MODULE III – FLEXIBLE MANUAL ASSEMBLY LINES (8 Lecture Hours)

MODULE IV – OVERVIEW OF MECHATRONICS PRODUCTS (7 Lecture Hours)

MODULE V – FUNDAMENTAL CONCEPTS OF ADAPTIVE AND FUZZY CONTROL (7 Lecture Hours)
Fuzzy logic compensatory control of transformation and deformation non-Z linearities- Introduction to Microprocessor and programmable logic controllers and identification of system, System design Classification. Motion control aspects in Design.

MODULE VI – MANUFACTURING DATABASE (7 Lecture Hours)

References Books

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<tr>
<th>18ME3044</th>
<th>CONTROL OF CNC MACHINE TOOLS</th>
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Course Objectives: To impart knowledge on
1. CNC programming, hydraulic system
2. CNC interpolation, DDA integrator
3. CNC control loops and architecture

Course Outcomes: After completing the course the student will be able to
1. Design control systems for CNC machine tool
2. Understand the principles of motors and hydraulic system
3. Compare the interpolation methods in CNC control system
4. Recommend PID controllers, servo controller, Numerical control Kernel types
5. Select the components of CNC architecture
6. Propose the PLC programming Languages

**MODULE I – INTRODUCTION TO CNC SYSTEMS AND PROGRAMMING (8 Lecture Hours)**
Introduction to CNC systems, Coordinate systems of CNC machines, Economics. CNC programming- Interpolation, CNC programming - feed, tool and spindle functions (G-codes).

**MODULE II – CNC DRIVES AND CONTROLLERS (8 Lecture Hours)**
CNC drives Hydraulic systems, servo and stepping motors, response analysis, Feedback devices and counter.

**MODULE III – CNC HARDWARE INTERPOLATORS (8 Lecture Hours)**
CNC Interpolation – Hardware interpolators- DDA integrator, linear, circular, complete interpolators,

**MODULE IV – CNC SOFTWARE INTERPOLATORS (7 Lecture Hours)**
Software interpolators, Tustin method, NURBS and polynomial interpolators, Acceleration and deceleration control techniques.

**MODULE V - CNC CONTROL LOOPS (7 Lecture Hours)**
CNC control loops, PID control, servo controller, gain tuning, feed forward control, Mathematical analysis of control loops.

**MODULE VI - CNC ARCHITECTURE (7 Lecture Hours)**
CNC Architecture - Numerical control kernel- types, PLC, programming, languages, Human-Machine Interface functions, structure, Introduction to Open CNC architecture.

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<th>18ME3045</th>
<th>ENGINEERING PRODUCT DESIGN AND DEVELOPMENT STRATEGIES</th>
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**Course Objectives:**
To impart knowledge on
1. Modeling, simulation, material selection and GD & T.
2. Important practices followed during designing and developing a product in industries.
3. Product life cycle right from its conceptual stage to its development stage.

**Course Outcomes:**
After completing the course the student will be able to
1. Apply the appropriate design process and modelling techniques to design components.
2. Categorize the models used in product design and use appropriately for product analysis.
3. Choose the right material selection process and calculate the economics of materials.
5. Use GD & T principles for better product manufacturing.
6. Apply the principles of reliability, safety, robust design and design optimization.

**MODULE I – NATURE AND SCOPE OF PRODUCT ENGINEERING (8 Lecture Hours)**
MODULE II – MODELING AND SIMULATION (8 Lecture Hours)
The role of Models in Engineering Design-Mathematical modeling, Similitude and scale modeling, Simulation, Finite-Difference method, Geometric modeling on the computer, Finite Element Analysis-Introduction to simulation modeling-Simulation programming software-Monte Carlo Simulation

MODULE III – MATERIAL SELECTION AND MATERIALS IN DESIGN (8 Lecture Hours)

MODULE IV – DESIGN FOR SUSTAINABILITY AND ENVIRONMENT (7 Lecture Hours)
The Environmental Movement- Sustainability -Challenges of Sustainability for Business- End-Of-Life Product Transformations -Role of Material Selection in Design for Environment-Tools to Aid Design for the Environment and Sustainability- Influence of Space, Size, Weight, etc., on Form design, Aesthetics- Human factors Design-Industrial Ergonomic considerations.

MODULE V – GEOMETRIC DIMENSIONING AND TOLERANCING (7 Lecture Hours)

MODULE VI – RELIABILITY, SAFETY, ROBUST DESIGN AND OPTIMIZATION (7 Lecture Hours)

Reference Books:

## Course Outcomes:
1. Select appropriate materials for tool, jigs and fixtures.
2. Understand the requirements and challenges in the development of cutting tools.
3. Design Jigs and fixtures for conventional machines.
4. Develop Jigs and fixtures for CNC machines.

## Course Objectives:
1. Tool design and advanced cutting tool materials.
2. Design of cutting tools, forming tools and jigs.
3. Press tool design and fixtures for CNC machines.

### MODULE I – INTRODUCTION TO TOOL DESIGN (7 Lecture Hours)
MODULE II – DESIGN OF CUTTING TOOLS (9 Lecture Hours)

MODULE III – DESIGN OF JIGS (8 Lecture Hours)

MODULE IV – DESIGN OF FIXTURES AND PRESS TOOLS (7 Lecture Hours)

MODULE V – TOOL DESIGN FOR CNC MACHINE TOOL (8 Lecture Hours)

MODULE VI – TOOL MATERIALS (7 Lecture Hours)

Reference books:

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<tr>
<th>18ME3047</th>
<th>INDUSTRIAL ROBOTICS</th>
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Course Objectives: To impart knowledge on
1. Robot configurations.
2. Sensors and transducers.
3. Actuating systems and Robot programming skills.

Course Outcomes: After completing the course the student will be able to
1. Infer the robot history and configurations.
2. Assess various components of a robot and choose the control system.
3. Compute the kinematic equations and select an actuator for robot configurations.
4. Identify the suitable sensor for a particular robot application.
5. Write a robot Program for an industrial application.
6. Identify the robot application for a unique operation.

MODULE I – AUTOMATION AND ROBOTICS CONCEPTS (7 Lecture Hours)
Basic Concepts such as Definition, three laws, DOF, Misunderstood devices etc., Elements of Robotic Systems i.e. Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc. Automation - Concept, Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.
MODULE II – ROBOT GRIPPERS AND SENSORS  (7 Lecture Hours)
Types of Grippers, Design aspect for gripper, Force analysis for various basic gripper system. Sensors for Robots:- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.

MODULE III – CONTROL SYSTEMS AND DRIVES  (9 Lecture Hours)

MODULE IV – KINEMATICS AND DYNAMICS  (6 Lecture Hours)
Transformation matrices and their arithmetic, link and joint description, Denavit–Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods. Velocities and Static forces in manipulators:- Jacobians, singularities, static forces, Jacobian in force domain. Dynamics:- Introduction to Dynamics , Trajectory generations.

MODULE V – MACHINE VISION AND PROGRAMMING LANGUAGES (7 Lecture Hours)
Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques, Noise reduction methods, Edge detection, Segmentation. Robot Programming:- Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types such as RAIL and VAL II etc, Features of type and development of languages for recent robot systems.

MODULE VI – PLANT AUTOMATION AND ARTIFICIAL INTELLIGENCE (9 Lecture Hours)

Reference Books:

<table>
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<tr>
<th>Course Objectives: To impart knowledge on</th>
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<tr>
<td>1. Applications and design of mechanical system elements.</td>
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<td>2. Applying the design concept in product design and development.</td>
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<td>3. Using standard data’s for design of machine components.</td>
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<tr>
<th>Course Outcomes: After completing the course the student will be able to</th>
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<tbody>
<tr>
<td>1. Understand the design principles of mechanical systems.</td>
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<td>2. Design the machine elements and systems.</td>
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<td>3. Design the material handling equipment.</td>
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<td>4. Learn about construction, working principle and design of the conveyor systems.</td>
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<tr>
<td>5. Select appropriate machine elements for mechanical systems.</td>
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<tr>
<td>6. Design and develop new products which can be used in mechanical systems.</td>
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</tbody>
</table>
MODULE I – MATERIAL HANDLING EQUIPMENTS (7 Lecture Hours)
Types, Selection and applications, Method for determining stresses-Terminology and ligament efficiency-application.

MODULE II – STRESSES IN PRESSURE VESSELS (8 Lecture Hours)
Stresses in a circular ring, cylinder-Membrane stress analysis of vessels shell components-Cylinder shells, to spherical heads, conical heads-Thermal stresses, Dis-continuity stresses in pressure vessels.

MODULE III– DESIGN OF PRESSURE VESSELS (8 Lecture Hours)
Design of tall cylinder self-supporting process columns-Supports for short vertical vessels Stress concentration at a variable thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of reinforcement.

MODULE IV – DESIGN OF AUTOMOTIVE TRANSMISSION SYSTEM (7 Lecture Hours)

MODULE V – DESIGN OF HOISTING ELEMENTS (8 Lecture Hours)
Welded and roller chains-Hemp and wire ropes. –Design of ropes, pulleys, pulley system, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks crane grabs-lifting magnets-Grabbing Attachments.

MODULE VI – CONVEYORS (7 Lecture Hours)
Types-description-Design and applications of belt conveyors, apron conveyors and escalators, pneumatic conveyors, screw conveyors and vibratory conveyors.

Reference Books:
contact. Deformation-Strain Defined-Equations of Compatibility-State of Strain at a Point-
Measurement of Strain: Strain Rosettes.

**MODULE II – PROBLEMS IN ELASTICITY**  
(7 Lecture Hours)

**MODULE III – FAILURE CRITERIA**  
(8 Lecture Hours)

**MODULE IV – TORSION OF PRISMATIC BARS**  
(8 Lecture Hours)
Introduction-Elementary Theory of Torsion of -Stresses on Inclined Planes-General Solution of the Torsion Problem-Prandtl’s Stress Function-Prandtl’s Membrane Analogy-Torsion of Narrow Rectangular Cross Section-Torsion of Multiply Connected Thin Walled Sections-Fluid Flow Analogy and Stress Concentration-Torsion of Restrained Thin-Walled Members of Open Cross Section.

**MODULE V – APPLICATIONS OF ENERGY METHODS**  
(7 Lecture Hours)

**MODULE VI – UNSYMMETRICAL BENDING AND SHEAR CENTRE**  
(7 Lecture Hours)
Concept of shear center in symmetrical and unsymmetrical bending, stress and deflections in beams subjected to unsymmetrical bending, shear center for thin wall beam cross section, open section with one axis of symmetry, general open section, and closed section.

**Reference Books:**

<table>
<thead>
<tr>
<th>18ME3050</th>
<th>ENGINEERING FRACTURE MECHANICS</th>
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**Course Objectives:** To impart knowledge on
1. Stress and strain field around a crack in a body for different fracture modes.
2. Factors governing crack growth, crack arrest and fatigue.
3. The applications of fracture mechanics.

**Course Outcomes:** After completing the course the student will be able to
1. Estimate stress and strain field around a crack.
2. Understand plastic material behavior around the crack tip.
3. Estimate the fracture toughness value of a material for various fracture modes.
4. Design of components that contain crack under static and fatigue load condition.
5. Provide solution to prevent crack growth and fatigue failures.
MODULE I – ELEMENTS OF SOLID MECHANICS (8 Lecture Hours)
The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation – limit analysis – Airy’s function – field equation for stress intensity factor

MODULE II – STATIONARY CRACK UNDER STATIC LOADING (8 Lecture Hours)

MODULE III – ENERGY BALANCE AND CRACK GROWTH (8 Lecture Hours)

MODULE IV – FATIGUE CRACK GROWTH (7 Lecture Hours)

MODULE V – TESTING METHODS FOR DETERMINING CRACK GROWTH (7 Lecture Hours)
Test methods for determining critical energy, release rate, critical stress intensity factor, J-Integral.

MODULE VI – APPLICATIONS OF FRACTURE MECHANICS (7 Lecture Hours)
Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields - numerical methods

Reference Books:

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<th>18ME3051</th>
<th>ADVANCED MECHANISM DESIGN</th>
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Course Objectives: To impart knowledge on
1. The fundamentals of a mechanism and machines.
2. Kinematics of a mechanism.
3. Forces in the joints and links of a mechanism and a robot.

Course Outcomes: After completing the course the student will be able to
1. Identify the type and find degree of freedom of a given mechanism.
2. Conduct kinematic analysis of a mechanism.
3. Apply the path curvature theories in the analysis of a mechanism.
4. Synthesis of a mechanism for a given application.
5. Investigate forces in the joints and links of a mechanism.
6. Employ the capabilities of a robot in design.

MODULE I – INTRODUCTION (8 Lecture Hours)

MODULE II – PATH CURVATURE THEORY (8 Lecture Hours)
Fixed and moving centroids, inflection points and inflection circle. Euler Savary equation, Bobilier’s construction - Cubic of stationary curvature.

MODULE III – SYNTHESIS OF MECHANISMS (8 Lecture Hours)
Type synthesis- Number synthesis- Associated Linkage concept. Dimensional synthesis –function generation, path generation, motion generation, Graphical methods. Cognate linkage- coupler curve

**MODULE IV – DYNAMICS OF MECHANISMS** (7 Lecture Hours)
Static force analysis with friction – inertia force analysis- combined static and inertia force analysis, shaking force, kinetostatic analysis. Introduction to force and moment balancing of linkages.

**MODULE V – COUPLER CURVES** (7 Lecture Hours)
Equation of coupler curve, Robert-Chebychev theorem, double points and symmetry.

**MODULE VI – SPATIAL MECHANISM AND ROBOTICS** (7 Lecture Hours)

**Reference Books:**

**18ME3052 TRIBOLOGY IN DESIGN**

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**Course Objectives:** To impart knowledge on
1. Application of basic theories of friction, wear and lubrication.
2. Frictional behavior of commonly encountered sliding interfaces.
3. Various testing methods for tribological properties.

**Course Outcomes:** After completing the course the student will be able to
1. Apply concepts of friction mechanisms and analyze performance of design components based on relative motion.
2. Identify wear mechanism on macro-scale in metals.
3. Recombined lubrications based on the type of lubrication.
4. Outline the methods to improve surface engineering.
5. Generate performance reports of the lubrications using tribo testing methods.
6. Understand the fundamentals of tribology and associated parameters.

**MODULE I – FRICITION** (8 Lecture Hours)

**MODULE II – WEAR** (8 Lecture Hours)

**MODULE III – LUBRICANTS, FILM LUBRICATION THEORY AND LUBRICATION TYPES** (8 Lecture Hours)
MODULE IV – SURFACE ENGINEERING AND MATERIALS FOR BEARINGS (8 Lecture Hours)

MODULE V – DYNAMIC TRIBOLOGY AND TESTING METHODS (7 Lecture Hours)
Dynamic testing machines and test methods, dry sand–rubber wheel test.

MODULE VI – TRIBOLOGY TESTING METHODS (7 Lecture Hours)
Wet sand rubber wheel test, slurry abrasivity test, solid particle erosion test, pin–on–disk wear test, rolling wear test, drum wear test, drill wear test. Lubricants, testing methods - Four ball tribo test.

Reference books:

<table>
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<tr>
<th>18ME3053</th>
<th>ROTOR DYNAMICS</th>
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Course Objectives: To impart knowledge on
1. Rotor dynamics phenomena with the help of simple rotor models
2. Behavior of fluid film lubrication and rotor bearing system in rotor system
3. Performance of bearings under dynamic conditions

Course Outcomes: After completing the course the student will be able to
1. Apply the principles of rotor dynamics in design and analysis of mechanical components
2. Analyze the bearing behavior under dynamic conditions
3. Acquire knowledge in rotor balancing.
4. Measure vibration and conduct dynamic analysis in rotating machine elements
5. Model a rotating machine element theoretically
6. Study the effect of vibration in rotating machinery

MODULE 1 – INTRODUCTION (8 Lecture Hours)

MODULE II – INSTABILITY IN ROTATING MACHINES (8 Lecture Hours)
Oil whip and Oil whirl - stability analysis using linearized stiffness and damping coefficients - Instability due to stream whirl and seals - Theory of Balancing of Rotors - Rigid rotor classification - Balancing criteria - Balancing of rigid rotors -Balancing of flexible rotors - Balance criteria for flexible rotors

MODULE III – ROTOR MODELS (8 Lecture Hours)
Single DOF undamped rotor model for both free and forced vibration - single DOF damped rotor model - attenuation of vibration - Rankine rotor model - Jeffcott rotor model - simple rotor systems with Gyroscopic effects - synchronous motion, asynchronous rotational motion - Asynchronous General Motion - Gyroscopic Effects by the Dynamics Approach

MODULE IV – BEARING IN ROTORS (7 Lecture Hours)
Rolling element bearings - Hydrodynamic oil lubricated journal bearing - types of hydrodynamic bearing - Reynolds equation and its basic assumptions - Basic concepts and assumptions of fluid - film bearing models - Short and long hydrodynamic radial bearings - Dynamic characteristics of fluid - film bearings - Dynamic seals and its classifications.
MODULE V – ROTOR VIBRATION AND CRITICAL SPEEDS  (7 Lecture Hours)
Rotor vibration and Rotor critical speeds - support stiffness on critical speeds - Stiffness and damping coefficients of journal bearings - computation and measurements of journal bearing coefficients - Mechanics of Hydrodynamic Instability

MODULE VI – SIGNAL PROCESSING AND CONDITION MONITORING IN ROTOR DYNAMICS  (7 Lecture Hours)
Vibration generating mechanism - Condition monitoring - Noise spectrum - Signal processing in rotating machineries - Measurements in rotating machineries - Real time analysis & Knowledge based (data base) - Expert systems - Display of vibration measurement instruments - Signature Analysis of Common Rotor Faults - Signature Analysis of Common Rotor Faults.

Reference Books:

18ME3054  OPTIMIZATION TECHNIQUES  L  T  P  C
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Course Objectives: To impart knowledge on
1. The need and origin of the optimization methods.
2. The various applications of optimization methods used in engineering.
3. Optimization of various components

Course Outcomes: After completing the course the student will be able to
1. Outline the importance of optimization of industrial process management.
2. Apply basic concepts of mathematics to formulate an optimization problem
3. Analyze and appreciate variety of performance measures for various optimization problems
4. Select engineering minima/maxima problems into optimization framework
5. Develop an efficient computational procedures to solve optimization problems.
6. Developing skill for formulating and solving the engineering optimization problems

MODULE I – INTRODUCTION TO OPERATION RESEARCH  (8 Lecture Hours)
Operation Research approach, scientific methods, introduction to models and modeling techniques, general methods for Operation Research models, methodology and advantages of Operation Research, history of Operation Research.

MODULE II – LINEAR PROGRAMMING  (8 Lecture Hours)
Introduction to Linear Programming and formulation of Linear Programming problems, Graphical solution method, alternative or multiple optimal solutions, Unbounded solutions, Infeasible solutions, Maximization – Simplex Algorithm, Minimization – Simplex Algorithm using Big-M method, Two phase method, Duality in linear programming, Integer linear programming.

MODULE III – TRANSPORTATION & ASSIGNMENT PROBLEM  (7 Lecture Hours)
Introduction to Transportation problems, various methods of Transportation problem, Variations in Transportation problem, introduction to Assignment problems, variations in Assignment problems.

MODULE IV – NETWORK ANALYSIS  (7 Lecture Hours)
Network definition and Network diagram, probability in PERT analysis, project time cost trade off, introduction to resource smoothing and allocation.

MODULE V – SEQUENCING  (7 Lecture Hours)
Introduction, processing N jobs through two machines, processing N jobs through three machines, processing N jobs through m machines. Introduction to inventory control, deterministic inventory model, EOQ model with quantity discount.
MODULE VI – QUEUING MODELS  
(8 Lecture Hours)
Concepts relating to queuing systems, basic elements of queuing model, role of Poison & exponential distribution, concepts of birth and death process. Replacement of items, subject to deterioration of items subject to random failure group vs. individual replacement policies. Introduction & steps of simulation method, distribution functions and random number generation.

Reference Books:

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<tr>
<th>18ME3055</th>
<th>CONDITION BASED MONITORING</th>
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**Course Objectives:** To impart knowledge on
1. Health monitoring and condition monitoring of structures and machines.
2. Basics of signal processing and various types of signals.

**Course Outcomes:** After completing the course the student will be able to
1. Explain the aim and the basics of CM
2. Appreciate and understand the basic idea behind vibration-based structural health
3. Monitor the vibration-based condition monitoring, and to know the general stages of CM.
4. Apply some basic techniques for analysis of random and periodic signals
5. Identify the basic instrumentation used for machinery and structural vibration-based monitoring
6. Aware of some basic faults in rotating machinery, their manifestation and methods for detection and recognition.

**MODULE I – HEALTH MONITORING**  
(8 Lecture Hours)
The basic idea of health monitoring and condition monitoring of structures and machines. Some basic techniques.

**MODULE II – SIGNAL PROCESSING**  
(8 Lecture Hours)
Basics of signal processing: Study of periodic and random signals, probability distribution, statistical properties, auto and cross correlation and power spectral density functions of commonly found systems, spectral analysis

**MODULE III – FOURIER TRANSFORM**  
(8 Lecture Hours)
Fourier transform: the basic idea of Fourier transform, interpretation and application to real signals. Response of linear systems to stationary random signals: FRFs, resonant frequencies, modes of vibration.

**Module IV – VIBRATION-BASED MONITORING**  
(7 Lecture Hours)
Introduction to vibration-based monitoring, Machinery condition monitoring by vibration analysis: Use and selection of measurements, analysis procedures and instruments.

**MODULE V – APPLICATIONS OF CONDITION MONITORING**  
(7 Lecture Hours)
Typical applications of condition monitoring using vibration analysis to rotating machines.

**MODULE VI – SPECIAL TYPES OF HEALTH MONITORING TECHNIQUES**  
(7 Lecture Hours)
Special types of health monitoring techniques, acoustic emission, oil debris and temperature analysis, Applications.

**Reference Books**

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<tr>
<th>18ME3056</th>
<th>MULTI-BODY DYNAMICS</th>
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Course Objectives: To impart knowledge on
1. Equation of motion for the bodies
2. Differential equations for multi-body dynamics
3. Intellectual skill to incorporate in the project and presentation

Course Outcomes: After completing the course the student will be able to
1. Derive equations of motion for interconnected bodies in multi-body systems with three dimensional motion.
2. Implement and analyze methods of formulating equations of motion for interconnected bodies.
3. Write programs to solve constrained differential equations for analyzing multi-body systems.
4. Simulate and analyze all types of static and dynamic behaviors of the multi-body systems including the kineto-static analysis.
5. Lead team projects in academic research or the industry that require modeling and simulation of multi-body systems.
6. Demonstrate an improved technical writing and presentation skills.

MODULE I – INTRODUCTION (8 Lecture Hours)
The method of constraints for planar kinematic analysis. Revolute, prismatic, gear and cam pairs are considered together with other 2 degrees-of-freedom types of constraints.

MODULE II – BASIC PRINCIPLES FOR ANALYSIS OF MULTIBODY SYSTEMS (8 Lecture Hours)

MODULE III – DYNAMICS OF PLANAR SYSTEMS (8 Lecture Hours)

MODULE IV – KINEMATICS OF RIGID BODIES IN SPACE (7 Lecture Hours)
Reference frames for the location of a body in space. Euler angles and Euler parameters. Formula of Rodrigues. Screw motion in space. Velocity, acceleration and angular velocity. Relationship between the angular velocity vector and the time derivatives of Euler parameters.

MODULE V – KINEMATIC ANALYSIS OF SPATIAL SYSTEM (7 Lecture Hours)
Basic kinematic constraints. Joint definition frames. The constraints required for the description in space of common kinematic pairs (revolute, prismatic, cylindrical, and spherical). Equations of motion of constrained spatial systems.

MODULE VI – COMPUTATION OF FORCES (7 Lecture Hours)
Computation of spatial generalized forces for external forces and for actuator-spring-damper element. Computation of reaction forces from Lagrange’s multipliers.

Reference Books:

<table>
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<tr>
<th>18ME3057</th>
<th>RESEARCH METHODOLOGY AND IPR</th>
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**Course Objectives:** To impart knowledge on
1. Principles of academic and scientific research
2. Literature Review and Research ethics
3. Principles and practices of IPR

**Course Outcomes:** After completing the course the student will be able to
1. Understand research problem formulation.
2. Review the relevant literature
3. Analyze research related information
4. Follow research ethics
5. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
6. Understand that when IPR would take such important place in growth of individuals & nation,

**MODULE I – INTRODUCTION** *(7 Lecture Hours)*

**MODULE II – LITERATURE REVIEW** *(7 Lecture Hours)*
Effective literature studies approaches, analysis Plagiarism, Research ethics and Research principles

**MODULE III – TECHNICAL WRITING** *(7 Lecture Hours)*
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and Assessment by a review committee

**MODULE IV – IPR** *(8 Lecture Hours)*

**MODULE V – PATENTS** *(8 Lecture Hours)*

**MODULE VI – NEW DEVELOPMENTS IN IPR** *(8 Lecture Hours)*
Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

**Reference Books:**
1. Stuart Melville and Wayne Goddard,“Research methodology: an introduction for science& engineering students”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”

<table>
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<tr>
<th>18ME3058</th>
<th>BUSINESS ANALYTICS</th>
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**Course objectives:** To impart knowledge on
1. Understand the role of business analytics and analyze data using statistical techniques.
2. Formulate and solve business problems using decision-making tools.
3. Manage business process using analytical and management tools.
**Course Outcomes:** After completing the course the student will be able to

1. Understand the concept of business analytics.
3. Apply technical skills in predictive and prescriptive modeling.
4. Understand the forecasting techniques, Monte Carlo simulation and risk analysis.
5. Analyze and solve business problems using decision-making tools.

**MODULE I – BUSINESS ANALYTICS** (8 Lecture Hours)

**MODULE II – TRENDINESS AND REGRESSION ANALYSIS** (7 Lecture Hours)

**MODULE III – VARIOUS TECHNIQUES IN BUSINESS ANALYTICS** (7 Lecture Hours)
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

**MODULE IV – FORECASTING TECHNIQUES, MONTE CARLO SIMULATION AND RISK ANALYSIS** (8 Lecture Hours)

**MODULE V – DECISION ANALYSIS** (8 Lecture Hours)
Formulating Decision Problems, Decision Strategies with the Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

**MODULE VI – RECENT TRENDS** (8 Lecture Hours)
Recent trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

**Reference Books:**

**Course Objectives:** To impart knowledge on

1. Recognition, investigation, analysis, and control of hazards.
2. Management’s role in safety and assess the importance
3. Multiple hazards associated with welding

**Course Outcomes:** After completing the course the student will be able to

1. Apply the basic concepts and scope of engineering safety.
2. Implement the standards of professional conduct that are published by professional safety organizations and certification bodies.
3. Illustrate the importance of safety of employees while working with machineries
4. Express Safety in terms of Risk and to recognize unacceptable/inappropriate levels of Risk
5. Identify hazards arising from runaway reactions, explosions and fires
6. Suggest the various methods to prevent the hazards working with machineries

MODULE I – SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES (7 Lecture Hours)

MODULE II – PRINCIPLES OF MACHINE GUARDING: GUARDING DURING MAINTENANCE (8 Lecture Hours)
Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards – point of operation protective devices.

MODULE III – SAFETY IN WELDING AND GAS CUTTING (8 Lecture Hours)
Gas welding and oxygen cutting, resistances welding, arc welding and cutting, personal protective equipment, training, safety precautions during welding.

MODULE IV – SAFETY IN COLD FORMING AND HOT WORKING OF METALS (7 Lecture Hours)
Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism.

MODULE V – SAFETY IN FINISHING (7 Lecture Hours)
Heat treatment operations, electro plating, paint shops, sand and shot blasting industries.

MODULE VI - INSPECTION AND TESTING (8 Lecture Hours)
Safety in inspection and testing, dynamic balancing, hydro testing. Applicable standards in Industrial safety management.

Reference books:

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<tr>
<th>18ME3060</th>
<th>OPERATIONS RESEARCH</th>
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Course Objectives: To impart knowledge on
1. Linear Programming techniques.
2. Job sequencing problems, Transportation and assignment problems.
3. Inventory models, PERT/CPM and Queuing theory.

Course Outcomes: After completing the course the student will be able to
1. Correlate this subject knowledge with the engineering problems.
2. Construct flexible appropriate mathematical model to represent physical problem
3. Schedule their engineering projects by using network analysis
4. Analyze the transportation problem and optimize the resources and output
5. Apply their knowledge in solving their engineering queuing problems.
6. Develop their skills in decision making analysis by allocation of resources

MODULE I – LINEAR PROGRAMMING PROBLEM (9 Lecture Hours)
Formulation of LPP – Graphical Method – Simplex Method –Artificial variable technique and two phase simplex method. Duality – Dual and simplex method – Dual Simplex Method – Sequencing: Job sequencing – n jobs through two machines and three machines
MODULE II – TRANSPORTATION PROBLEM  
(9 Lecture Hours)
Transportation Model, finding initial basic feasible solutions using least cost method, Vogell’s approximation method and North-West corner method, moving towards optimality through MODI method, Resolving degeneracy in transportation.

MODULE III – ASSIGNMENT PROBLEM  
(8 Lecture Hours)
Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossibility Assignment.

MODULE IV – NETWORK ANALYSIS  
(9 Lecture Hours)

MODULE V – INVENTORY MODELS  
(9 Lecture Hours)
Economic order quantity models-purchase models with and without shortage, production models with and without shortage-ABC analysis-Two Bin system.

MODULE VI – QUEUING MODELS  
(9 Lecture Hours)
Structure of queuing models-Attributes and components of queuing models-application of queuing models-Kendall’s Notation -Single service channel with finite and infinite queue size - Single service channel with finite and infinite population size

Reference books:

<table>
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<tr>
<th>18ME3061</th>
<th>COST MANAGEMENT OF ENGINEERING PROJECTS</th>
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Course Objectives: To impart knowledge on
1. The concept of cost management process and projects
2. Project cost and materials.
3. Budgetary Control and quantitative techniques for cost management.

Course Outcomes: After completing the course the student will be able to
1. Identify various costs.
2. Understand the elements of engineering project.
3. Analyze and control project cost.
4. Understand various cost management techniques.
5. Analyze and control Budget.
6. Apply quantitative techniques for cost management.

MODULE I – INTRODUCTION TO STRATEGIC COST MANAGEMENT PROCESS  
(8 Lecture Hours)
Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

MODULE II – ENGINEERING PROJECT  
(7 Lecture Hours)
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts, Types and contents. Project execution, Bar charts and Network diagram, Project commissioning.
MODULE III – PROJECT COST CONTROL

MODULE IV – Cost Management Techniques

MODULE V – Budgetary Control
Budgetary Control, Flexible Budgets, Performance budgets, Zero-based budgets, Measurement of Divisional profitability pricing decisions including transfer pricing.

MODULE VI – Quantitative Techniques for Cost Management

Text Books:

Reference Books:

18ME3062 COMPOSITE MATERIALS

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Objectives: To impart knowledge on
1. Composite materials and their applications.
2. Fabrication, analysis, and design of composite materials and structures.
3. Prediction of the mechanical response of multi layered materials and structures.

Course Outcomes: After completing the course the student will be able to
1. Predict elastic properties of composites and
2. Predict mechanical properties of fiber reinforced composite materials.
3. Design a composite laminate for a given load condition.
4. Describe fundamental fabrication processes for polymer matrix composites.
5. Analyze the stresses using laminated plate theories.
6. Compare and contrast different processes of manufacture of polymer composites.

MODULE I – INTRODUCTION COMPOSITES
Definition – need- General Characteristics, applications, Fibers- Glass, Carbon, Ceramic and Aramid fibers. Matrices- polymer, Graphite, Ceramic and Metal Matrices- Characteristics of fibers and matrices. Smart Materials- type and Characteristics

MODULE II – MECHANICS AND PERFORMANCE
Characteristics of fiber-reinforced lamina-laminates-interlaminar stresses – Static Mechanical properties- Fatigue and Impact properties- Environmental Effects - Fracture behaviour and Damage Tolerance.

MODULE III – POLYMER MATRIX COMPOSITES

MODULE IV – METAL MATRIX COMPOSITES

Mechanical Engineering

**MODULE V – ANALYSIS**  
(8 Lecture Hours)

**MODULE VI – DESIGN AND TESTING**  
(7 Lecture Hours)
Characterization of composite products – laminate design consideration- bolted and bonded joints design examples- non-destructive testing- failure mode Predictions.

**Reference Books:**

**18ME3063 WASTE TO ENERGY**

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**Course Objectives:** To impart knowledge on
1. List the various biomass energy sources and their conversion processes.
2. Develop a small scale gasifier and biogas plant.
3. Determine the power generation from biomass waste.

**Course Outcomes:** After completing the course the student will be able to
1. Explain the working principle of biomass conversion processes.
2. Estimate the liquid fuel production from pyrolysis process.
3. Analyze the composition of synthesis gas using gas chromatography.
4. Design a community type biogas plant.
5. Design and develop a biogas stove.
6. Determine the amount of power generation from I C engines using alcohol fuels.

**MODULE I – INTRODUCTION TO ENERGY FROM WASTE**  
(7 Lecture Hours)
Classification of waste as fuel – agro based, forest residue, industrial waste – municipal solid waste – conversion devices – incinerators, gasifiers, and digesters- biomass resources and their classification, biomass energy programme in India, Urban waste to energy conversion.

**MODULE II – BIOMASS PYROLYSIS**  
(7 Lecture Hours)
Pyrolysis – slow pyrolysis, flash pyrolysis and fast pyrolysis – Manufacture of charcoal – methods - yields and application – manufacture of pyrolytic oils and gases, properties of pyrolysis oil and composition of pyrolysis gases- application.

**MODULE III – BIOMASS GASIFICATION**  
(8 Lecture Hours)

**MODULE IV – BIOMASS COMBUSTION**  
(8 Lecture Hours)
Biomass stoves – improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, fluidized bed combustors, design, construction and operation - biomass combustors-operation, fuel, efficiency and maintenance.

**MODULE V – BIOGAS**  
(8 Lecture Hours)
Properties of biogas - biogas plant technology and status - bio energy system - design and constructional features - biomass conversion processes - thermo chemical conversion processes - direct combustion -
biomass gasification - pyrolysis and liquefaction - biochemical conversion processes - anaerobic digestion- types of biogas Plants – applications- maintenance problem.

**MODULE VI – ALCOHOL PRODUCTION FROM BIOMASS**

(7 Lecture Hours)
Ethanol production from wood by acid hydrolysis- ethanol from sugar cane-fermentation systems-methanol production- properties of liquid fuel- bio diesel production- performance of alcohol in I.C engines.

Reference Books:

18ME3064 DISASTER MANAGEMENT

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**Course objectives:**
To impart knowledge on
1. Critical understanding of key concepts in disaster risk reduction and humanitarian response
2. Disaster risk reduction and humanitarian response policy and practice from multiple perspectives
3. Understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations

**Course Outcomes:**
After completing the course the student will be able to
1. Understand Definitions and Terminologies used in Disaster Management
2. Apply Disaster Concepts to Management
3. Analyzing Relationship between Development and Disasters
4. Classify Categories of Disasters and
5. Understand the Challenges posed by Disasters
6. Enumerate the responsibilities to society

**MODULE I – INTRODUCTION**
(7 Lecture Hours)
Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

**MODULE II – REPERCUSSIONS OF DISASTERS AND HAZARDS**
(8 Lecture Hours)

**MODULE III – DISASTER PRONE AREAS IN INDIA**
(7 Lecture Hours)
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

**MODULE IV – DISASTER PREPAREDNESS AND MANAGEMENT**
(8 Lecture Hours)
Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

**MODULE V – RISK ASSESSMENT**
(8 Lecture Hours)

**MODULE VI – DISASTER MITIGATION**
(7 Lecture Hours)
Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.
Reference Books:

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Course objectives: To impart knowledge on
1. Basic information about Indian constitution.
2. Identification of individual role and ethical responsibility towards society.
3. Human rights and its implications

Course Outcomes: After completing the course the student will be able to
1. Have general knowledge and legal literacy and thereby to take up competitive examinations
2. Understand state and central policies, fundamental duties
3. Understand Electoral Process, special provisions
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies
5. Understand Engineering ethics and responsibilities of Engineers.
6. Have an awareness about basic human rights in India

MODULE I – INTRODUCTION (6 Lecture Hours)
Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations

MODULE II – DUTIES OF PRIME MINISTER, PRESIDENT AND SUPREME COURT (6 Lecture Hours)

MODULE III – DUTIES OF GOVERNOR, CHIEF MINISTER HIGH COURT AND ELECTION COMMISSION (6 Lecture Hours)
State Executives – Governor Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th & 91st Amendments.

MODULE IV – PROVISIONS FOR SC/ST, WOMEN, CHILDREN AND BACKWARD CLASSES (7 Lecture Hours)

MODULE V – ETHICS AND RESPONSIBILITY OF ENGINEERS (6 Lecture Hours)
Scope & Aims of Engineering Ethics, Responsibility of Engineers, Impediments to Responsibility, Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering

MODULE VI – POWERS AND FUNCTIONS OF MUNICIPALITIES, PANCHAYATS AND SOCIETIES (6 Lecture Hours)
Powers and functions of Municipalities, Panchayats and Co-operative Societies

Reference Books:
Course Objectives: To impart knowledge on
1. Understanding the meaning, philosophies and theories of education.
2. Identify critical evidence gaps to guide the development.
3. Summarize existing evidence on the review topic to inform programme design and policy making undertaken by agencies and researchers.

Course Outcomes: After completing the course the student will be able to
1. Demonstrate knowledge of major theories and values of education in relation to class room management and social life.
2. Analyze the implications of thoughts and theories of education on teaching, learning processes, curriculum, class room management and social changes.
3. Outline how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
4. Demonstrate skills in curriculum management and implementation
5. Evaluate how philosophy, thoughts and theories of education affect learning processes.
6. Explain what pedagogical practices are being used by teachers in formal and informal classrooms in developing countries

MODULE I – INTRODUCTION AND METHODOLOGY  (7 Lecture Hours)
Aims and rationale- policy background- conceptual framework and terminology- meaning of education-theories of learning, curriculum and teacher education- conceptual framework- research questions-overview of methodology and searching.

MODLUE II – THEMATIC OVERVIEW  (7 Lecture Hours)
Pedagogical practices- used by teachers in formal and informal classrooms in developing countries-curriculum and teacher education- critical pedagogy and standards- pedagogy and models of teacher knowledge.

MODULE III – EFFECTIVENESS OF PEDAGOGICAL PRACTICES(8 Lecture Hours)
Methodology for the in depth stage, quality assessment of included studies, teacher education - curriculum and guidance materials - best support effective pedagogy- theory of change- strength and nature of the body of evidence for effective pedagogical practices.- pedagogic theory and pedagogical approaches.- teachers attitudes and beliefs and pedagogic strategies.

MODULE IV – PROFESSIONAL DEVELOPMENT  (8 Lecture Hours)
Alignment with classroom practices and follow-up support- peer support - support from the head teacher and the community- curriculum and assessment- barriers to learning- limited resources and large class sizes.

MODULE V – RESEARCH GAPS AND FUTURE DIRECTIONS  (8 Lecture Hours)
Research design - contexts - pedagogy - teacher education- dissemination and research impact- great teachers- examples- parents as primary educators- education and technology- future visions- moral education.

MODULE VI – PEDAGOGY APPROACHES  (7 Lecture Hours)
Educational philosophy and theory- pedagogy approaches- equality and diversity- learning principles to guide pedagogy- constructivist pedagogy- critical pedagogy-pedagogic theory- pedagogic strategies-teaching generation next

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<td>Design of Thermal Power Equipment</td>
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17ME1001 BASIC MECHANICAL ENGINEERING

Credits: 3:0:0

Course Objectives:
To impart knowledge
- To provide knowledge about IC Engines, External Combustion Engines, Boilers.
- To understand about power plants, metal forming, metal joining, machining process
- To learn the application of CAD, CAM, MEMS and CIM.

Course Outcomes:
Ability to
- Describe the working principle of Engines and Turbines.
- Classify Boilers and identify different types of engines.
- Distinguish conventional and non-conventional power plants.
- Examine various types of engineering materials.
- Select different types of metal forming and joining processes.
- Analyze metal machining processes.


Text Books:

**Reference Books:**

**17ME1002 ENGINEERING DRAWING**

**Credits:** 0:0:2

**Course Objectives:**
To impart knowledge on:
- Visualization of objects and projection.
- Dimensioning, conventions and standards related to working drawings.
- Application of various line types, arcs and methods to draw using AutoCAD.

**Course Outcomes:**
Ability to
- Visualize the objects from their drawings.
- Illustrate graphically the details of engineering components using conventions and standards.
- Apply the theory of projection to represent the front and top views of points, lines and solids.
- Construct drawings using various line types, arcs, and circles using CAD software.
- Prepare drawings using modify, draw, layers and properties tool bars to draw orthographic views.
- Develop 2D models using modify, draw and properties tool bars to draw isometric views.

**List of experiments**
1. Geometrical constructions
   i) Introduction and use of drawing instruments & Lettering practice.
   ii) Construction of polygons using
      a. Semicircle and Bi-section of given side method
      b. Inscribing polygon in a circle method
      c. Special Method for Hexagon
   iii) Dimensioning practice of lines, circles, arcs using aligned and chain dimensioning systems.
2. First and third angle projections. Conversion of pictorial views into orthographic views (in first angle projection) of simple machine elements like V-block and bearing block.
3. Projection of points in different quadrants.
4. Projection of lines in first quadrant
   a. Parallel to both planes.
   b. Inclined to one plane and parallel to other.
   c. Parallel to one plane and perpendicular to other plane.
5. Projection of solids
6. Projections of prism, pyramid, cylinder and cone - axis parallel to one plane and perpendicular to the other plane. Parallel to both planes.
7. Isometric projection, Isometric views of basic solids - prism, pyramid, cylinder and cone.

**Computer aided drafting:**
8. Snap, Grid, Limits, OSNAP, line types and weights, text, pdf file creation and plotting.
9. Modifying Commands: Erase, trim, array, lengthen, break, mirror, offset, move, copy etc.
10. Methods of Drawing lines, arcs and circles and applications.
11. Dimensioning, hatching methods to show different materials, title block and layers.
12. Isometric view of primitive solids and combination of primitive solids.

**Text books:**

**Reference books:**

**17ME1003 WORKSHOP PRACTICE**

Credits: 0:0:2

**Course Objectives:**
To impart knowledge on
- Fitting joints, carpentry joints and plumbing practices.
- Wiring of tube lights and lights used in stair case
- Assembly of PC and installation of operating system in PC

**Course Outcomes:**
Ability to
- Apply the practical skills in assembly work.
- Assemble mechanical devices and equipment by applying fitting practices
- Apply carpentry and fitting joints, to fabricate useful products
- Design and develop electronic and electrical circuits towards real time works and their project work.
- Identify and install the appropriate Operating System (OS) to the computes.
- Devise suitable procedural protocol to troubleshoot the functioning of the computer

**List of Experiments:**
1. Making of rectangular planning in carpentry
2. Making of middle lap joint in carpentry
3. Making of Square filing in Fitting
4. Making of V joint in Fitting
5. Assembly of pipes, valves and other fittings in Plumbing
6. Drilling holes & welding of Mild Steel plates
7. Assembly practice of Mono block pump
8. Assembly and dismantling of personal computer
10. Design suitable electrical circuits for different applications
11. Measure the performance of various electrical devices

**Text books:**
2. S. Suyambazhagan, Engineering practices, Prentice Hall India, 2012

**Reference books:**

**17ME2001 ENGINEERING MECHANICS**

Credits: 3:0:0

**Course Objectives:**
To impart knowledge on
- Forces acting on particle and rigid bodies.
- Free body diagrams for solving problems with structural members.
- Geometrical properties of surfaces and solids
- Concepts of kinematics, kinetics of particle and rigid bodies

**Course Outcomes:**
Ability to
- Resolve the components of force and understand equilibrium of bodies
- Formulate free body diagram and calculate the forces in space.
- Determine the limiting conditions of friction
• Analyze the rectilinear and curvilinear motion using Newton’s second law
• Apply the work energy method to determine motion of particle
• Apply impulse momentum principle to determine motion of rigid bodies.


Unit II - STATICS OF RIGID BODIES: Centre of gravity and Centroid of composite plane figure – Moment of inertia – Parallel axis and Perpendicular axis theorem – Moment of inertia of composite planes – Mass moment of inertia of simple solid and composite bodies.


Text Books:

Reference Books

Credits: 3: 0: 0

Course Objectives:
To impart knowledge on
• To impart knowledge of the properties and applications of various engineering materials.
• To expose testing methods and procedures to find the mechanical properties of engineering materials
• To acquire knowledge on construction of phase diagrams and also the importance of iron-iron carbide phase diagram and different heat treatment

Course Outcomes:
Ability to
• Identify crystal structures of common engineering materials.
• Understand the principle of various microscopes.
• Identify the various behavior of materials and defects.
• Analyze failures and predict service behavior of materials for various applications
• Interpret and determine the right compositions of metals.
• Select the heat treatment process based on the metals.


Unit II - MECHANICAL BEHAVIOR: Defects in crystals -point defects line defect edge and screw dislocations – propagation of dislocation - Frank Read source – surface imperfections - diffusion - mechanisms of diffusion - Fick’s Laws of diffusion – plastic, deformation- slip and twinning - recovery re-crystallization and grain growth.- strengthening mechanisms strain hardening precipitation hardening.


Unit V - HEAT TREATMENT OF STEEL & NON FERROUS ALLOYS: Annealing normalizing - spheroidising- hardening, tempering – Hardenability, Case hardening of steels- carburizing- nitriding, induction hardening- flame hardening, Age hardening of Aluminium alloys

Text Books:

Reference Books

17ME2003 METROLOGY AND MEASUREMENT SYSTEMS

Credits: 3:0:0

Course objectives:
To impart knowledge on
• To acquaint the concepts of Measurements.
• To impart knowledge on various Metrological equipment available to measure the dimension of the components.
• To identify procedures for the measurement of the dimension of the components.

Course Outcomes:
Ability to
• Differentiate accuracy, precision, and some additional terminology.
• Employ measuring instruments for linear and angle measurement.
• Use effective methods of measuring straightness, flatness, screw threads and gear teeth
• Recommend suitable techniques to measure temperature and flow
• Demonstrate the use of advanced measurement techniques.
• Demonstrate handling of various metrological equipment to measure the dimension of the components.

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Unit I : GENERAL CONCEPTS OF MEASUREMENT: Definition-Standards of measurement-Errors in measurement-Accuracy, precision, sensitivity and readability - calibration of instruments, simple problems to find least count, selection and care of instruments.

Unit II - LINEAR AND ANGULAR MEASUREMENTS: Length standard-Line and end standard - Slip gauges, micrometers, Verniers, dial gauges comparators: various types-principle and applications, angular measuring instruments-bevel protractor, levels, sine bar and sine center, simple problems for finding taper angle using sine bar and sine center, angle Dekkor - autocollimator.

Unit III - FORM MEASUREMENT: Straightness, flatness, surface texture-various measuring instruments-run out and concentricity, Tool maker’s microscope. Various elements of threads - 2 wire and 3 wire methods, simple problems in screw threads for calculating effective diameter -gear elements - Parkinson gear tester. Measurement of gear pitch, Gear rolling test, Gear tooth Vernier Caliper

Unit IV - MEASUREMENT OF FLOW AND TEMPERATURE: Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer

Unit V - ADVANCES IN METROLOGY: Coordinate measuring machine- Constructional features, types, applications, Introduction to Interferometer, optical and LASER interferometers-applications.

Text books:

Reference books:

17ME2004 ENGINEERING THERMODYNAMICS
(Use of standard thermodynamic tables, Mollier diagram and Psychrometric chart are permitted.)

Credits: 3:0:0

Course Objectives:
To impart Knowledge on
- The basic principles of thermodynamics via real-world engineering examples, to show students how thermodynamics is applied in engineering practice.
- The First Law of Thermodynamics (principle of conservation of energy) and its application to a wide variety of systems.
- The implications of the second law of thermodynamics and limitations placed by the second law on the performance of thermodynamic systems.

Course Outcomes:
Ability to
- Understand the basic concepts in thermodynamics and its application in different fields.
- Apply the first law of thermodynamics for closed and open systems to solve simple engineering problems
- Evaluate the feasibility of a thermodynamic cycle using the second law of thermodynamics for typical engineering problems.
- Determine steam quality using steam tables and Mollier chart.
- Apply the gas laws to solve problems related to ideal gases and mixtures.
- Apply psychrometric chart to perform moist air process calculations.

Unit I - BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS: Concept of continuum, microscopic and macroscopic approach, thermodynamic systems – closed, open, isolated, control volume. Thermodynamic properties and equilibrium state of a system, state diagram, path and process, quasi-static process, work, modes of work, zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities C_v and C_p, enthalpy, steady flow process with reference to various thermal equipment.
**Unit II - SECOND LAW OF THERMODYNAMICS:** Kelvin’s and Clausius statements of second law. Reversibility and irreversibility. Carnot cycle, reversed Carnot cycle, efficiency, COP, Carnot theorem. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy, absolute entropy, availability.

**Unit III - PROPERTIES OF PURE SUBSTANCES:** Thermodynamic properties of pure substances in solid liquid and vapour phases, phase rule P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes - simple problem.

**Unit IV - GAS MIXTURES:** Properties of ideal and real gases, equation of state, Avagadro’s law, Dalton’s law of partial pressure, Gay Lussac’s law, Graham’s law of diffusion, kinetic theory of gases, Vander Wall’s equation of states, compressibility, compressibility chart.


**Text Books:**

**Reference Books:**

**17ME2005 MECHANICS OF SOLIDS**

**Credits:** 3:1:0

**Prerequisites:** Engineering Mechanics [17ME2001]

**Course Objectives:**
To impart knowledge on
- Material behaviour under various stress and strain conditions.
- Bending moment and shear force of determinate beams
- Stresses under torsion and bending loads
- Concepts of deflection and theories of failure

**Course Outcomes:**
Ability to
- Demonstrate the concept of stress and strain in solids
- Establish the relation between material properties.
- Analyze the structure for shear force and bending moment for design
- Analyze the behavior of structures subjected to bending and torsion conditions
- Interpret failure of mechanical components using theories of failure.
- Determine the deflection of beams and stability of columns

**Unit I - SIMPLE STRESS AND STRAIN:** Stresses and strain due to axial force – Hooke’s law, factor of safety, stepped bars – Uniformly varying sections – Stresses in composite bars due to axial force and temperature – Strain energy due to axial force, stresses due to sudden loads and impact – Lateral strain: Poisson’s ratio – Change in volume – Shear stress – Shear strain – Relationship between elastic constants, Cauchy stress tensor – Hoop and longitudinal stress in thin cylindrical and spherical shells subjected to internal pressure – Changes in dimensions and volume.

**Unit II - SHEAR FORCE AND BENDING MOMENT:** Relationship between loading – Shear force and bending moment – Shear force and bending moment diagrams for cantilever, simply supported and overhanging beams subjected to concentrated loads and uniformly distributed loads only – Maximum bending moment and point of contra flexure.

**Unit III - BENDING STRESSES:** Theory of simple bending and assumptions – Simple bending equation - Calculation of normal stresses due to flexure application. Leaf Springs – Strain Energy Due to Bending - Moment Torsion: Theory of torsion and assumptions – Torsion equation – Stresses and Deformation in Solid Circular and
Hollow Shafts – Stepped Shafts – Composite Shaft – Stress due to combined bending and Torsion – Strain energy due to Torsion - Deformations and Stresses in Helical Springs.

**Unit IV - PRINCIPAL STRESSES and Theories of Elastic Failure:** State of stress at a point, normal and tangential stresses on inclined planes – Principal stresses and their planes – Plane of maximum shear - Mohr’s circle of stresses. Theories Of Elastic Failure: Maximum principal stress theory – Maximum shear stress theory – Maximum principal strain theory – Strain energy theory – Mohr’s theory. Application of theories of failure

**Unit V - DEFLECTION OF BEAMS:** Deflection in statically determinate beams – Macaulay’s method for prismatic members – Area moment method for stepped beams with concentrated loads. Maxwell’s reciprocal and Castigliano’s Theorems. Long columns: Buckling of long columns due to axial load – Euler’s and Rankine’s formulae for columns of different end conditions.

**Text Books:**

**Reference Books:**

17ME2006 MANUFACTURING PROCESSES

**Credits: 3:0:0**

**Course Objectives:**
To impart knowledge on
- The principle, procedure and applications of Casting
- The working principle and applications of Bulk forming and Sheet Metal
- Welding and Powder metallurgy processes

**Course Outcomes:**
Ability to
- Identify casting process to produce complex parts
- Suggest primary manufacturing process for the mass production of components
- Develop products with superior Mechanical properties using Bulk forming processes
- Perform various sheet metal operations on metal sheets
- Join multiple parts to form working assemblies using welding
- Provide exceptional properties using powder metallurgy


**Unit III - SHEET FORMING PROCESSES:** punching and blanking – stripping force – punching force calculations – Clearance and shear on punch and die – Drawing – calculation of blank diameter - number of draws – Bending – allowances – bending force – stretch forming, spinning, embossing, coining – Types of sheet metal dies.


Text books:

Reference books:

17ME2007 METROLOGY LABORATORY

Credits: 0:0:1

Course Objectives:
To impart knowledge on
- Working principles of linear and angular measuring instruments.
- The measurement of linear and angular dimensions of work piece specimens using measuring instruments
- The methods of form measurements

Course Outcomes:
Ability to
- Carry out- measurements using linear measuring instruments.
- Demonstrate measurements using angular measuring instruments.
- Calibrate linear and angular measuring instruments.
- Construct process control charts for quality control
- Inspect screw threads for different forms of errors.
- Suggest suitable measuring instruments for various engineering applications.

List of experiments:
1. Calibration of vernier height gauge using slip gauges and to draw the calibration graph.
3. Measurement of taper angle using sine bar and sine centre along with slip gauges.
4. Measurement of circularity of the given shaft by using bench centre method and V block method and to draw the polar graph.
5. Calibration of micrometer and vernier caliper by using slip gauges and to draw the calibration graph.
6. Establishing the control charts (X, R chart) for the given sample workpieces.
7. Measurement of major diameter, minor diameter, pitch and thread angle measurement of the screw thread by using profile projector.
8. Measurement of major diameter, minor diameter, pitch and thread angle measurements of a small screw thread using Tool maker’s microscope.

17ME2008 METALLURGY LABORATORY

Credits: 0:0:1

Course Objectives:
- Gain practical experience with the microstructure and performance of materials.
- Demonstrate to use optical microscope for analysis of materials.
- Impart knowledge to obtain properties of foundry sand

Course Outcomes:
Ability to
- Demonstrate the working principle of optical microscope
- Prepare samples for metallurgical studies following appropriate metallographic procedure and extract metallographic images.
• Determine the strength of foundry sand
• Analyse various phases of Iron Carbon alloy
• Select heat treated alloys for various applications.
• Identify the microstructures of different types of steels, aluminum and copper.

List of Experiments:
1. Study of Metallurgical microscope and Micro hardness Tester, UTM and Pin On Disc Wear tester
2. Determination of strength and permeability of foundry sand
3. Identification of Cast Iron specimen (a) Grey Cast Iron (b) Spheroidal Graphite Iron (c) Malleable Cast Iron
4. Identification of Low-, medium-, and High-Carbon steels
5. Identification of Heat Treated steels: (a) Annealed (b) Normalised (c) Hardened (d) Tempered steels and Case Hardened Steel
6. Identification of brasses and bronzes and aluminum
7. Heat treatment practice-Hardening and tempering
8. Sieve Analysis

17ME2009 FOUNDRY, SMITHY, WELDING AND SHEET METAL LABORATORY

Credits: 0:0:2

Course Objectives:
To impart knowledge on
• Hand tools used in the foundry, welding, smithy and sheet metal laboratories
• Process planning and procedures to develop models in foundry and smithy laboratories
• Sequence of operations adopted in welding and sheet metal laboratories to fabricate various Joints and models

Course Outcomes:
Ability to
• Use appropriate hand tools in the foundry, welding, smithy and sheet metal laboratories
• Apply standard operating procedures to develop models in foundry and smithy laboratories.
• Appraise the use of various equipments such as open furnace and closed furnaces in forging and casting.
• Design and fabricate the various objects in sheet metal using hand tools.
• Assess the capabilities and limitations of these production processes towards manufacturing
• Translate the acquired knowledge and skill to other real time engineering projects.

Exercises:
1. Preparation of green sand mould for a single piece pattern
2. Preparation of green sand mould for split pattern
3. Preparation of green sand mould for split pattern with additional core preparation
4. Making of butt joint by arc welding process
5. Making of lap joint by arc welding process
6. Making of T joint by arc welding process
7. Conversion of round rod into square rod by smithy forging operation
8. Preparation of L bend from square rod by smithy forging operation
9. Preparation of J bends from square rod by smithy forging operation.
10. Making of Rectangular tray by sheet metal operation
11. Making of Hopper by sheet metal operation

17ME2010 MACHINING PROCESSES

Credits: 3:0:0
Prerequisite: Manufacturing Processes [17ME2006]

Course Objectives:
To impart knowledge on
• The principles and applications of Metal cutting Theory
Course Outcomes:
Ability to
- select the machining processes suitable for machining a component
- generate the process sequences for machining in machine tools to reduce the lead time
- analyse and choose the optimized machining parameters
- select cutting tools for the identified machining sequences
- justify the abrasive machining process based on the surface finish requirements
- implement the non-conventional machining processes for machining hard materials.


Unit IV - ABRASIVE PROCESSES: Grinding wheel – designation and selection, types of grinding machines – Cylindrical grinding, surface grinding, centerless grinding, honing, lapping, super finishing, polishing and buffing.

Unit V - NON-CONVENTIONAL MACHINING PROCESSES: Need for Unconventional processes - Electrical discharge machining (EDM) – Dielectric fluid – electrode – wire EDM – Electrochemical Machining (ECM) – Electrochemical Grinding (ECG), Ultrasonic Machining (USM) – Abrasive Jet Machining (AJM) – Laser Beam Machining (LBM) – Plasma Arc Machining (PAM).

Text books:

Reference books:

17ME2011 THERMAL ENGINEERING I

Credits: 3:0:0
Prerequisite: Engineering Thermodynamics [17ME2004]

Course Objectives:
To impart knowledge on
- Steam generators and nozzles, Steam turbines.
- Steam turbines and vapour power cycles.
- Air compressors and refrigeration systems.

Course Outcomes:
Ability to
- Estimate the performance of a steam generator
- Analyze the flow through steam nozzles
- Determine the efficiency of the impulse and reaction turbine using velocity triangles
- Describe vapour power cycles
• Calculate the efficiency of a reciprocating air compressor
• Evaluate Coefficient of performance of Refrigeration systems


Unit II - STEAM NOZZLES: Steam nozzles, flow through nozzles - general relation for adiabatic flow - effect of friction - critical pressure ratio, super saturated flow.

Unit III - STEAM TURBINES: Steam turbines, advantages of turbines, Impulse and reaction turbine, Compounding-Pressure compounding, velocity compounding, pressure velocity compounding - velocity diagrams for simple and multi stage turbines. Vapour power cycles: Simple Rankine Cycle, Reheat Rankine cycle, Regenerative Rankine cycle.

Unit IV - AIR COMPRESSOR: Classification and working principle, work of compression with and without clearance. Volumetric, Isothermal and Isentropic efficiency of reciprocating air compressors, multistage compressor and inter-cooling, work of multistage compressor.

Unit V - REFRIGERATION CYCLES: Vapour compression refrigeration cycle, Super heating, sub-cooling and performance calculations. Working principle of vapour absorption system, Ammonia-water, lithium bromide-water systems (Description only), Comparison between vapour compression and absorption systems.

Text Books:

Reference Books:

17ME2012 KINEMATICS OF MACHINERY

Credits: 3:1:0

Course Objectives:
• To understand the basic components and layout of linkages in the assembly of a system / machine.
• To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
• To understand the function gears and cams in mechanisms and machines.

Course Outcomes:
Ability to
• Find the relation between input and output of simple mechanisms.
• Apply mobility criterion to determine degrees of freedom of a mechanism.
• Determine position, velocity and acceleration of a link in a linkage.
• Employ gears and gear trains in machine design.
• Estimate the effects of friction on motion transmission and machine components.
• Design a cam profile for the given motion characteristics of a follower.


Unit V - FRICTION IN MACHINE ELEMENTS: Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction in brakes– Band and Block brakes.

Text books:

Reference books:

17ME2013 FLUID MECHANICS AND MACHINERY

Credits: 3:1:0
Pre-requisite: Engineering Mechanics [17ME2001]

Course Objectives:
To impart knowledge on
- Conservation of mass, momentum and energy in fluid flows.
- Internal flows and dimensional analysis
- To understand working of pumps and turbines.

Course Outcomes:
Ability to
- Recognize the important fluid properties.
- Determine forces acting on immersed bodies.
- Solve fluid flow problems using Conservation principles.
- Determine rate of flow and calculate flow losses through pipes.
- Analyze the relationship between different physical quantities of fluid flow.
- Evaluate the performance of pumps and turbines.


Unit II - EQUATIONS OF FLUID FLOW: Types of flow, Velocity and acceleration, Stream line – streak line – path line, velocity potential and Stream function. Differential Equations of continuity and momentum, Free and forced vortex flow, Euler’s equation, Bernoulli’s equation – Venturi meter – Orifice meter – Pitot tube.

Unit III - FLOW THROUGH CIRCULAR CONDUITS: Laminar flow through circular conduits –Boundary layer concepts – elementary turbulent flow, Loss of energy in pipes – Major and Minor energy losses – Hydraulic gradient line and Total energy line – Pipes in series and parallel, Dimensional analysis – Application of dimensionless parameters – Model analysis.


Text Books:

Reference Books:

17ME2014 MACHINING LABORATORY

Credits: 0:0:2
Co/Pre-requisite: Machining Processes [17ME2010]

Course Objectives:
To impart knowledge on
- Types of machine tools
- Metal cutting operations.
- Selection of tools for machining operations.

Course Outcomes:
Ability to
- Demonstrate skills to machine cylindrical components using Lathe
- Demonstrate skills to machine V-block, rectangular block and key way using shaping/milling/slotting machine.
- Demonstrate skills to cut spur gear using gear hobbing machine.
- Select appropriate cutting tools
- Interpret component drawings
- Compare the dimensions of the components using measuring instruments.

List of Experiments:
1. Step turning
2. Taper turning
3. Knurling and countersinking
4. Drilling and boring
5. External thread cutting
6. Tapping
7. Machining rectangular block using shaper
8. Machining V- block using shaper
9. Machining rectangular block using milling machine
10. Key way cutting
11. Cylindrical grinding
12. Spur gear cutting.
17ME2015 FLUID MECHANICS AND STRENGTH OF MATERIALS LABORATORY

Credits: 0:0:2

Course Objectives:
To impart knowledge on
- The calibration of Flow measurement devices and calculation of losses due to friction and pipe fittings
- The working of different types of Pumps and Turbines.
- The mechanical properties of materials and apply the theory of mechanics of solids for testing of beams and springs.

Course Outcomes:
Ability to
- Conduct flow measurements in pipes.
- Evaluate performance of pumps and turbines.
- Determine the head losses for internal flows.
- Prepare specimens according to standards.
- Determine mechanical properties of materials through tests.
- Analyze the deflections in beams and springs.

List of Experiments:
1. Determination of Darcy’s Friction Factor.
2. Calibration of Venturi Meter.
3. Calibration of orifice Meter.
4. Determination of Minor Losses in pipes
5. Performance of single stage Centrifugal Pump.
7. Tension test on mild steel
8. Test on springs (open coiled springs)
9. Static bending test on wood
10. Deflection tests on cantilever beams
11. Charpy Impact tests
12. a) Double shear test on mild steel
    b) Rockwell Hardness test

17ME2016 MACHINE DRAWING

Credits 0:0:2

Course Objectives:
To impart knowledge on:
- Visualize and represent any matter/object with the help of drawings.
- Working drawings.
- Orthographic drawing of different machine parts.
- Developing assembly drawings.

Course Outcomes:
Ability to
- Understand drafting fundamentals and standards.
- Interpret drawings and extract required information.
- Prepare part drawings of threaded fasteners, keys and rivets.
- Create sectional views of machine components.
- Develop assembly drawings from part drawings.
- Analyze tolerances for the design of engineering components.

List of experiments
1. Conventional Representations of machine parts and symbols
2. Representation of limits, Fits and Tolerances
3. Basics of Geometric Dimensioning and Tolerancing
4. Representation of screw threads and threaded fasteners

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5. Sectional views of machine components
6. Illustration of different types of keys and rivets
7. Assembly drawing of cotter Joints with sleeve
8. Assembly drawing of knuckle Joint
9. Assembly drawing of flanged Coupling [Protected Type]
10. Assembly drawing of universal Coupling
11. Assembly drawing of Plummer Block
12. Assembly drawing of machine Vice/screw Jack

Text books:

Reference books:
3. Revised IS codes; 10711, 10713, 10714, 9609, 1165, 10712, 10716, 10717, 11663, 11668, 10968, 11669, 8043, 8000.

17ME2017 COMPUTER AIDED DESIGN AND MANUFACTURING

Credits: 3:0:0

Course Objectives:
- To impart knowledge on the various computer aided design tools for industrial applications
- To provide an overview on the graphical entities of CAD/CAM and computer numerical programming
- To make the students understand the application of computers in manufacturing sectors

Course Outcomes:
Ability to
- Outline the process of representing graphical entities in a CAD environment
- Construct the geometric model using different techniques to represent a product
- Interpret the geometric function of various elements of a CNC machine tool
- Program and operate the CNC Machines by identifying proper cutting tools
- Analyse the models for design solutions using FEM.
- Discuss the various computer aided tools implemented in various industrial applications

Unit I - Introduction to CAD/CAM:

Unit II - Geometric Modeling:

Unit III - CNC Machine Tools:

Unit IV - CNC Programming:

Unit V - Finite Element Analysis: Basic concepts – General applicability of the method to structural analysis, heat transfer and fluid flow problems – Boundary Value Problems and Initial Value Problems – General Procedure of FEA – Element Types and its Characteristics – Boundary conditions – Convergence and Continuous criteria.

Text books:

References Books:

17ME2018 THERMAL ENGINEERING II
(Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant, property tables are permitted.)

Credits: 3:0:0
Prerequisite: Engineering Thermodynamics [17ME2004]
Course Objectives:
To impart knowledge on
- Internal combustion engines, gas power cycles and air conditioning.
- Isentropic flow, Fanno flow and Rayleigh flow
- Gas turbines and jet propulsion

Course Outcomes:
Ability to
- Evaluate the performance of internal combustion engine
- Estimate the efficiency of gas power cycles
- Determine cooling loads in air–conditioning systems
- Explain isentropic flow through variable area
- Describe Fanno flow and Rayleigh flow
- Analyze gas turbines cycles and compare the operational aspects of jet engines.


Unit II - GAS POWER CYCLES: Otto cycle, Diesel cycle, Dual cycle, Brayton cycle, calculation of mean effective pressure and air standard efficiency.


Unit IV - GAS DYNAMICS: Isentropic flow – Isentropic flow through variable area, Mach number variation, area ratio as a function of Mach number, impulse function, flow through nozzles and diffusers. Fanno flow and Rayleigh flow.


Text Books:

Reference Books:

17ME2019 DYNAMICS OF MACHINERY

Credits: 3:1:0

Course Objectives:
To impart knowledge on
- Turning moment diagrams employed in flywheel and forces involved in reciprocating engines.
- Balancing procedures for rotating and reciprocating engines.
- Fundamentals of free and forced vibrations.

Course Outcomes:
Ability to
- Demonstrate an understanding of turning moment diagrams in various applications.
- Demonstrate skills to design flywheel for an IC engine and punching press with the consideration of geometrical and economical constraints.
- Perform static and dynamic balancing of high speed rotary and reciprocating machines.
- Analyze free vibrations of machines, engines and structures.
- Analyze forced vibrations of machines, engines and structures.
- Calculate gyroscopic couple on various vehicles and apply concept of governors.


Unit II - BALANCING: Static and Dynamic balancing of rotating masses – Balancing of reciprocating masses – Balancing of locomotives – Partial balancing of reciprocating masses – Multi cylinder Inline and radial engines.


Unit IV - TRANSVERSE AND TORSIONAL VIBRATION SYSTEMS: Transverse vibrations of shafts and beams – Rayleigh’s and Dunkerley’s method – Whirling of shafts. Torsional vibrations – Single rotor, two rotors and three rotors systems – Free vibration of geared systems.


Text books:

Reference books:

17ME2020 DESIGN OF MACHINE ELEMENTS
(Use of approved data books are permitted)

Credits: 3:1:0
Prerequisites: Mechanics of Solids [17ME2005]

Course Objectives:
To impart knowledge on
- Design principles and basic design procedures.
- Using design data for the design of mechanical elements.

Course Outcomes:
Ability to
- Understand the standard design procedure for Design of machine elements.
- Analyse stresses acting on components and determine the size based on theories of failure.
- Design machine components for a given load condition using design data hand books.
- Decide specifications as per standards given in design data and select standard components to improve interchangeability.
- Design and develop nonstandard machine components.
- Prepare a detail design layout and drawing of machine components.

Unit I - STRESSES IN MACHINE MEMBERS: Introduction to the design process, Factors influencing machine design, selection of materials based on physical and mechanical properties. Direct, bending, torsional and combined stress equations, Impact and shock loading. Criteria of failure, stress concentration factor, size factor and surface finish factor – Factor of safety, Theories of failures – simple problems.

Unit II - VARIABLE AND CYCLIC LOADS AND SPRINGS: Variable and cyclic loads – fatigue strength and fatigue limit – SN curve, combined cyclic stress, Soderberg and Goodman equations – Design of helical, leaf, disc and torsional springs under constant loads and varying loads.


Unit IV - JOINTS: Design of bolted, riveted and welded joints – pressure vessels and structures, Threaded fasteners, Cotter joints, Knuckle joints and pipe joints.

Unit V - DESIGN OF ENGINE COMPONENTS: Design of piston, connecting rod, crankshaft, and flywheel.

Text books:

Reference books:

Hand book:
Course Objectives:
To impart knowledge on
- Handling the 3D modelling softwares.
- Modelling products of industrial system.
- Analysis of structural and thermal engineering

Course Outcomes:
Ability to
- Recognize the applications of software in 3D modelling/analysis of Mechanical Engineering components
- Construct the 3D model using various commands like extrude, mirror, revolve etc
- Model 3D mechanical components like knuckle joint, plummer block using appropriate modelling/ assembing commands
- Build the 3-D model/ Assembly model and to create bill of materials.
- Identify the domain of the problem and select element, boundary condition, solvers for 2D problems
- Analyse the models for design solutions using software

List of Exercises:
Introduction to 3–D modeling software
1. 3D modeling using Extrude, Round, Mirror commands
2. 3D modeling using Revolve, Hole, shell, and pattern commands
3. Assembly of Knuckle Joint or Universal Joint/Plummer block or flange coupling/ Lathe Tailstock
4. Advanced modeling commands Sweep and Blend.
5. Drafting/Generation of bill of materials

Introduction to Simulation software
6. Force and Stress analysis of 2D Truss
7. Stress and deflection analysis in beams with different support conditions.
8. Analysis of Bicycle Frame
9. Static Analysis of Bracket or Corner Bracket
10. 2D Heat Conduction within a Solid
11. Thermal Analysis of 2D Chimney
12. Thermal Analysis of 3D Fin
13. Vibration analysis of spring–mass systems

Course Objectives:
To impart knowledge on
- The performance characteristics of various thermal systems and internal combustion engines
- The design calculations of different thermal equipment
- The boiler operation and conduct a performance test on a steam turbine

Course Outcomes:
Ability to
- Evaluate the performance of refrigeration, heat pump and air–conditioning cycles
- Conduct a variety of experiments in internal combustion engines
- Estimate emission contents in the exhaust gases through emission test
- Analyze the efficiency and performance of two stage reciprocating air compressor
- Calculate & compare the performance parameters of air blower
- Determine the principle of various parameters in the performance of steam turbine

List of Experiments
1. Measurement of coefficient of performance in a vapour compression refrigeration cycle
2. Measurement of coefficient of performance in a heat pump apparatus
3. Determination of coefficient of performance in air-conditioning cycle
4. Measurement of performance parameters on air blower
5. Measurement of performance parameters on two stage reciprocating air compressor
6. Performance test and study on the steam turbine apparatus
7. Performance test on variable compression ratio, 4 stroke petrol engine
8. Performance test on four–stroke twin cylinder vertical Diesel engine
9. Heat balance test on four stroke single cylinder Diesel engine
10. Performance test on four stroke single cylinder Diesel engine
11. Heat balance test on four–stroke twin cylinder vertical Diesel engine
12. Retardation test on four stroke single cylinder vertical Diesel engine

17ME2023 DYNAMICS LABORATORY

Credits: 0:0:2

Course objectives:
To impart knowledge on
- Principle and operations of vibration based systems
- Measuring devices used for dynamic testing
- Forces in various equipment based on theoretical and experimental methods

Course outcomes:
Ability to
- Demonstrate the effect of unbalances resulting from rotary motions
- Study the effect of dynamics on vibrations in single and multi–degree of freedom system
- Understand the principle and mechanism used in governor /gyroscope
- Evaluate cutting forces using dynamometer
- Classify the systems of vibration and evaluate natural frequency using experimental & experimental methods
- Demonstrate the effect of forces in Differential Gear/ Centrifugal clutch/ four bar mechanism under dynamic conditions

List of experiments:
1. Longitudinal vibration for single degree of freedom
2. Torsional Vibration for single rotor system
3. Forced vibration in equivalent spring mass system
4. Whirling of shaft
5. Jump speed analysis of cam and follower
6. Transmissibility ratio in vibration table
7. Universal Governor apparatus
8. Dynamic balancing of single rotor system
9. Turn table apparatus
10. Forces in Lathe tool dynamometer/ Centrifugal clutch
11. Gyroscopic couple
12. Four bar mechanism–wiper setup

17ME2024 HEAT AND MASS TRANSFER

Prerequisite: Engineering Thermodynamics [17ME2004]
Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Conduction, convection and radiation.
- Analytical and computational tools to investigate heat and mass transport phenomena.
- Designing heat transfer equipment with increased efficiency.
Course Outcomes:
Ability to
- Interpret conduction, convection and radiation heat transfer.
- Formulate and solve one and two dimensional conduction heat transfer problems.
- Determine values of the convection heat transfer coefficient by applying empirical correlations.
- Analyze and design heat exchangers.
- Apply mass transfer correlations to process-based problems.
- Evaluate radiation heat transfer between black, gray surfaces and the surroundings.


Unit II - CONVECTION: Concept of hydrodynamic and thermal boundary layers. Significance of non-dimensional numbers in convection. Dimensional analysis in free and forced convection. Forced Convection over a flat plate, flow through pipes. Free Convection from vertical, horizontal and inclined surfaces. Fins with different boundary conditions.

Unit III - HEAT EXCHANGERS: Types of heat exchangers, overall heat transfer coefficients, LMTD and NTU methods, fouling factor, problems in heat exchangers, effectiveness.

Unit IV - RADIATION: Nature of thermal radiation, black body concepts, gray body, radiation shape factor, relation between shape factors, radiation heat transfer between two surfaces. Electrical analogy, Re-radiating surface, radiation shields.

Unit V - MASS TRANSFER: Fick’s law of diffusion, equimolal counter diffusion, Convective mass transfer coefficient, non-dimensional number in mass transfer, evaporation process in the atmosphere.

Text Books:

Reference Books:

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Linear Programming techniques.
- Job sequencing problems, Transportation and assignment problems.
- Inventory models, PERT/CPM and Queuing theory.

Course Outcomes:
Ability to
- Correlate this subject knowledge with the engineering problems.
- Construct flexible appropriate mathematical model to represent physical problem
- Schedule their engineering projects by using network analysis
- Analyze the transportation problem and optimize the resources and output
- Apply their knowledge in solving their engineering queuing problems.
- Develop their skills in decision making analysis by allocation of resources
Unit I - LINEAR PROGRAMMING PROBLEM: Formulation of LPP – Graphical Method – Simplex Method – Artificial variable technique and two phase simplex method. Duality – Dual and simplex method – Dual Simplex Method – Sequencing: Job sequencing – n jobs through two machines and three machines

Unit II - TRANSPORTATION PROBLEM: Transportation Model, finding initial basic feasible solutions using least cost method, Vogells’s approximation method and North–West corner method, moving towards optimality through MODI method, Resolving degeneracy in transportation

Unit III - ASSIGNMENT PROBLEM: Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

Unit IV - NETWORK ANALYSIS: Network diagram – probability of achieving completion date – crash time – cost analysis – PERT & CPM

Unit V - INVENTORY AND QUEUING MODELS: Economic order quantity models – techniques in inventory management – ABC analysis. Queuing problems with single server with finite and infinite population size, queuing problems with single server with finite and infinite queue size,

Text Books:

Reference books:

17ME2026 FLUID POWER CONTROL ENGINEERING

Credits: 3:0:0

Course Objectives:
To impart knowledge on
• The fundamental principles of fluid power systems
• The design and operation of hydraulic and pneumatic machines, components and systems
• Application in industrial automation

Course Outcomes:
Ability to
• Interpret the standard symbols and laws used in FPC Systems
• Infer the working principles of pumps and motors
• Identify the suitable elements of a fluid power systems for a particular application.
• Examine hydraulic circuits for an industrial application.
• Assess the optimal components of pneumatic system
• Build a logic circuit for an industrial problems.


Unit II - ELEMENTS OF HYDRAULIC SYSTEMS: Fluid reservoir, Cylinders – construction, Mechanics of cylinder loading, Types, Selection, Pressure accumulators – types, directional control valves, restrictors, check valve, flow control valves relief valve, hydraulic servo systems, Cartridge valves, Hydraulic fuses, Temperature and pressure switches, Shock Absorbers, electromechanical devices like relays and solenoids.

Unit III - OIL–HYDRAULIC CIRCUITS: Reciprocation, quick return, Speed control circuits, sequencing, synchronizing circuits, clamping and accumulator circuits, press circuits and hydro –pneumatic circuit.

Unit IV - PNEUMATIC SYSTEMS AND CIRCUITS: Compressor – types, Air servicing Unit, Cylinders – construction, Types, Section, directional control valves, check valve, flow control valves, other special valves,
Boolean algebra, truth tables, reciprocation, quick return circuit, cascade circuits / sequencing circuits like $A^*B^* A^* B$, electro–pneumatic circuits,

**Unit V - TYPICAL INDUSTRIAL APPLICATIONS:** MPL control of Fluid power circuits, fluidic elements and fluidic sensors, Basic concepts of programmable logical control, Fail–safe Circuits, Intensifier circuits, Box–sorting System, Electrical Control of Regenerative Circuit, Hydro–pneumatic circuit. Fault finding and maintenance, Hydraulic and Pneumatic power packs.

**Text Books:**

**Reference books:**

**17ME2027 DESIGN OF MECHANICAL TRANSMISSION SYSTEMS**
(Use of approved data books are permitted)

**Prerequisite:** Design of Machine Elements [14ME2020]

**Credits:** 3:0:0

**Course Objectives:**
To impart knowledge on
- Machine elements by specifying their type, geometry, material etc., and to integrate these elements to build a mechanical system.
- Usage of design data book to design standard machine elements like bearings, gears and other elements.
- Different mechanical transmission components and mechanisms.

**Course Outcomes:**
Ability to
- Select suitable principles and design flexible elements like Belt, rope, chain drives and bearings.
- Determine the dimensions and design the different types of gears using standard procedure.
- Estimate the layout and design gear boxes based on load and speed requirements.
- Design various types of cams, clutches and brakes for a given application.
- Analyze mechanical systems for machine elements from standard data books and catalogues for a required application.
- Know the applications of the various mechanical systems, materials used to make them and methods used.

**Unit I - DESIGN OF FLEXIBLE ELEMENTS AND BEARINGS:** Design of Flat belts and V belts, Design of Journal bearings – Sliding contact and Rolling contact.

**Unit II - CHAIN AND ROPE DRIVES, SPUR GEARS AND HELICAL GEARS:** Design and selection of Transmission chains and hoisting wire ropes, Design of gears – Spur gear, helical gear and Herring–bone gears, Skew gears.

**Unit III - BEVEL AND WORM GEARS:** Design of bevel gears – Straight and Spiral bevel types, Design of worm gears, Design of a Ratchet and pawl mechanism, Design of Geneva mechanism.

**Unit IV - GEAR BOXES:** Geometric progression, Standard step ratio, Ray diagram, Kinematics layout – Design of multi speed gear box for machine tool applications, Speed reducer unit and Stepped pulley.

**Unit V - CAMS, CLUTCHES AND BRAKES:** Design of cams – Contact stress and Torque calculation, Design of Power Screws, Design of plate clutches – Axial clutches and Cone clutches, Design of Internal and External shoe brakes.
Text books:

Reference books:

Hand book

17ME2028 HEAT TRANSFER LABORATORY
(Use of standard Heat and Mass Transfer data book is permitted)

Co/Prerequisite: Heat and Mass Transfer [17ME2024]
Credits: 0:0:2

Course Objectives:
To impart knowledge on
- The heat transfer characteristics of various heat transfer apparatus
- The design calculations of different modes of heat transfer
- Conducting the heat transfer experiments and practically learn how to find heat transfer coefficients

Course Outcomes:
Ability to
- Calculate and compare the thermal conductivity of different materials.
- Predict the convective heat transfer coefficient by free convection.
- Analyze the performance of forced convective heat transfer coefficient through pin–fin.
- Evaluate the performance of radiation through black and gray bodies.
- Analyze the performance parameters of parallel flow heat exchanger.
- Analyze the performance parameters of counter flow heat exchanger.

List of Experiments
1. Measurement of thermal conductivity through a composite wall.
3. Determination of thermal conductivity in a guarded plate.
4. Measurement of heat transfer coefficient in a vertical cylindrical rod by free convection.
5. Measurement of heat transfer coefficient in a flat plate by natural convection.
9. Determination of emissivity of the given test surface.
10. Determination of Stefan–Boltzmann constant in radiation heat transfer.
17ME2029 CAM LABORATORY

Credits: 0:0:2
Prerequisite: Machining Laboratory [17ME2014]

Course Objectives:
To impart knowledge on
- NC programming for CNC turning and milling operation and execution.
- Selection of tools for a machining operation.
- Simulation and verification of machining processes.

Course outcomes:
Ability to
- Know features and applications of CNC turning and machining centers.
- Understand the CNC control in modern manufacturing system.
- Prepare CNC Programming for different mechanical parts using G codes and M codes
- Implement the communication procedure for transmitting the CNC part program from an external computer to the control of the CNC machine tool.
- Generate automated tool paths for a given engineering component.
- Operate a modern industrial CNC machine tool for actual machining of simple and complex mechanical parts.

List of Experiments:
1. Step turning in CNC
2. Taper turning in CNC
3. Taper turning and thread cutting using multiple cutting cycles in CNC
4. Ball Turning in CNC
5. External thread cutting in a CNC Turning center
6. Drilling in a CNC drilling machine
7. Face milling and step milling in Machining center
8. Profile cut using linear and circular interpolation
9. Circular pocketing and slotting in CNC
10. Rectangular pocketing and slotting in CNC
11. Mirror using Subprogram and drilling using drilling cycles
12. Spiral cutting in a CNC 4–axis Trainer Mill
13. Integrating CAM with CNC Machines (demonstration only)

17ME2030 FLUID POWER CONTROL AND MECHATRONICS LABORATORY

Credits: 0:0:2

Course Objectives:
To impart knowledge on
- Application of fluid power symbols
- Designing a suitable hydraulic or pneumatic circuit
- Automating an Industrial application.

Course Outcomes:
Ability to
- Recognise the standard symbols used in fluid power circuits.
- Illustrate the working principles of valves
- Assess the suitable component for a particular application.
- Construct the hydraulic circuits for an industrial application.
- Build a pneumatic circuit and apply them to real life problems.
- Design and develop a plc controlled pneumatic circuit for industrial application.

List of Experiments:
1. Study of standard fluid power symbols
2. Development of basic pneumatic logic Circuits
3. Design of pneumatic speed control circuits
4. Application of time delay valve and pressure Sequence Valves in a pneumatic circuit.
5. Design of pneumatic circuit for material handling system
6. Design of electro-pneumatic circuit by using relay, limit switch and solenoids.
7. Design of Electro-pneumatic circuit for cascade system of sequence A+B+C+A–B–C–
8. Construct hydraulic speed control circuits
9. Create electro–hydraulic circuit for continuous reciprocation of DAC using limit switches
11. Design and develop PLC controlled pneumatic logic circuits
12. Simulation of PLC controlled pneumatic circuit for material handling unit

17ME2031 FINITE ELEMENT ANALYSIS

Credits: 3:0:0

Course Objective:
- To impart the knowledge to the students on the use of FEM to various Engineering Problems.
- To introduce the concepts of Mathematical Modeling of Engineering Problems
- To know the principles involved in discretization and finite element approach.

Course Outcomes:
Ability to
- recognise the use of FEM in various engineering problems and application
- outline the different formulation of field problems and governing equations for different models and problems
- Interpret the steps to find stiffness matrix and shape function for structural and thermal problems using suitable approaches.
- Demonstrate and categorise the 2D continuum and their various applications.
- Illustrate the axi-symmetric continuum and find stress, temperature and velocity head based on the application.
- Analyse the various isoparametric 2D continuum elements in 1-D, 2-D and 3-D.


Unit II - ONE DIMENSIONAL PROBLEMS: Finite Element Modeling- FEM analysis of one dimensional problems- Coordinates and Shape functions- Derivation of Shape functions- discretization of domain, element equations and assembly, derivation of stiffness matrices and load vectors- Solution of problems from solid mechanics and heat transfer

Unit III - TWO DIMENSIONAL CONTINUUM: Second order equation involving a scalar variable function – Triangular and quadrilateral elements- Shape functions and element matrices and force vectors- Application to Field Problems - Thermal problems

Unit IV - AXI-SYMMETRIC CONTINUUM: Equations of elasticity- Plane stress, plane strain and axisymmetric problems- Element stiffness matrix- body forces- Temperature effects- Stress calculation- head and fluid flow problems, time dependent problems- Application to Cylinder under internal and external pressure.

Unit V - ISOPARAMETRIC ELEMENTS FOR 2-D CONTINUUM: Isoparametric formulation- Shape functions for isoparametric elements-, Lagrangean and serendipity elements- element stiffness matrix- formulation of element equations- Stress calculations- Numerical integration

Text Books:

Reference Books

17ME2032 PRINCIPLES OF MECHANICAL VIBRATIONS

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Formulating mathematical model for vibration problems
- Analyzing the vibration behavior of mechanical systems subjected to loading
- Reduction of vibration and the equipments used for collecting response data.

Course Outcomes:
Ability to
- Classify the systems of vibration and formulate equations of motion for vibratory systems.
- Solve vibration problems with multiple degrees of freedom.
- Suggest methods to regulate vibration
- Perform vibration tests and acquire data from vibration measuring instruments.
- Present the theoretical and the experimental principles of mechanical vibrations to gain practical understanding in the field of vibration
- Recognize unwanted noise in machines and proficient with instrumentation used in noise control tests


Unit II - VIBRATION OF TWO AND MULTI DEGREE FREEDOM SYSTEMS: Equations of motion for Two Degree of freedom systems – generalized coordinates – dynamic vibration absorber – semi definite systems – Multi degree of freedom system

Unit III - NUMERICAL METHODS TO SOLVE VIBRATION PROBLEMS: Numerical methods in vibration problems to calculate natural frequencies – Matrix iteration technique – Stodola’s method, Holzer’s method.

Unit IV - ENGINEERING ACOUSTICS: Basic physical acoustics – acoustic levels and spectra – decibels, sound power, Sound pressure, power and intensity – Character of noise – Addition of two noise sources – Noise source identification. Noise radiation from vibrating bodies sound – properties of the various sources that create noise – Noise in machines and machine elements.


Text books:

Reference books:
17ME2033 PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

Credits: 3:0:0

Course Objectives:
To impart the knowledge on:
- The important practices followed during designing and developing a product in industry.
- The entire product life cycle right from its conceptual stage to its development stage.
- The concepts like modelling, simulation, material selection and GD&T, aesthetics.

Course Outcome:
Ability to
- Recognize the importance of product design and apply the design process in developing a product.
- Categorize various models in engineering design and select appropriate modeling and simulation techniques for analyzing a product.
- Choose the right material selection method and calculate the economics of a material for a new product.
- Distinguish between the functional and production design and use the right manufacturing method by considering the influence of size, shape and weight of the product.
- Use the Geometrical Dimensioning and Tolerancing rules and systems to select the desired fabrication method to produce the error free product.
- Design and Developing a product in industries by applying the aesthetic and ergonomic considerations

Unit I - NATURE AND SCOPE OF PRODUCT ENGINEERING: Importance of product design, Design Constraints, Safety and reliability considerations, The Design process – A simplified approach, Consideration of a Good Design, Detail description of Design process (Morphology of Design), Technological Innovation and the design process; Product and Process cycle.


Unit IV - FUNCTIONAL AND PRODUCTION DESIGN: Form design – Influence of basic design, Mechanical loading and material on Form design – Form design of Grey castings, Aluminum castings, Forging and Manufacture by machining methods. Influence of Space, Size, Weight, etc., on Form design, Aesthetic and Ergonomic considerations.

Unit V - DIMENSIONING AND TOLERANCING: Dimensioning systems, Dimensioning Rules, Geometric Tolerancing, Datum features, Functional production and Inspection datum, Tolerancing types, Tolerance analysis.

Text books:

Reference books:

17ME2034 COMPOSITE MATERIALS

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Composite materials and their applications.
- Fabrication, analysis, and design of composite materials and structures.
- Prediction of the mechanical response of multi layered materials and structures.
Course Outcomes:
- Predict elastic properties of composites.
- Predict mechanical properties of fiber reinforced composite materials.
- Design a composite laminate for a given load condition.
- Describe fundamental fabrication processes for polymer matrix composites.
- Make stress analyses using laminated plate theories.
- Compare and contrast different processes of manufacture of polymer composites.


Unit III - LAMINATED PLATES: Governing differential equation for a general laminate, angle ply and cross ply laminates. Failure criteria for composites.

Unit IV - SANDWICH CONSTRUCTIONS: Basic design concepts of sandwich construction – Materials used for sandwich construction – Failure modes of sandwich panels.


Text books:

Reference books:

17ME2035 DESIGN FOR MANUFACTURING

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- The design principles, the needs of product functionality, product design, and production planning and Product Assembly.
- Product quality by incorporate the reliability, safety functions and robustness of the product.
- Principles of the form design and GD&T for quality manufacturing

Course Outcomes:
Ability to
- Identify and apply the principles of DFM for an integrated design and manufacturing process.
- Select and suggest the materials and interrelations with the manufacturing processes to reduce the overall costs of the product.
- Distinguish between the manufacturing datum and functional datum and apply the principles during the designing and manufacturing.
- Design the components suitable for various manufacturing process such as machining, extrusion, thermo setting and electrical discharge machining.
- Categorize various design features required for better manufacturing output.
- Differentiate between economical and uneconomical design and modify using the principles of DFM, GD&T and Group technology

Unit II - MATERIALS SELECTION: Selection of Materials for design Developments in Material technology – criteria for material selection – Material selection interrelationship with process selection process selection charts – Ashby charts.


Text Books:

Reference Books:

17ME2036 TRIBOLOGY

Credits 3:0:0

Prerequisite: Design of Machine Elements [17ME2020]

Course Objectives:
To impart knowledge on
- Application of basic theories of friction, wear and lubrication.
- The frictional behavior of commonly encountered sliding interfaces.
- Various testing methods for tribological properties.

Course Outcomes:
Ability to
- Apply concepts of friction mechanisms and analyze performance of design components based on relative motion.
- Identify wear mechanisms on macro–scale in metals.
- Recombined lubrications based on the type of lubrication.
- Outline the methods to improve surface engineering
- Generate performance reports of the lubrications using tribo testing methods.
- Understand the fundamentals of tribology and associated parameters.


Unit III - LUBRICANTS, FILM LUBRICATION THEORY AND LUBRICATION TYPES: Types and properties of – Hydrodynamic Lubrication – Elasto–hydrodynamic lubrication – Boundary Lubrication – Solid

**Unit IV - SURFACE ENGINEERING AND MATERIALS FOR BEARINGS:** Topography of Engineering surfaces – Contact between surfaces – Sources of sliding Surface modifications – Thermo chemical processes – Surface coatings – Plating and anodizing – Fusion Processes – Vapour Phase processes – Materials for marginally lubricated and dry bearings.

**Unit V - MECHANICAL DYNAMIC TRIBOLOGY AND TESTING METHODS:** Mechanical dynamic testing machines and test methods, dry sand–rubber wheel test, wet sand rubber wheel test, slurry abrasivity test, solid particle erosion test, pin–on–disk wear test, rolling wear test, drum wear test, drill wear test. Lubricants – Testing methods.

**Text books:**

**Reference books:**

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**17ME2037 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS**

**Credits: 3:0:0**

**Course Objectives:**
To impart knowledge on
- The principles of designing jigs, fixtures and press tools.
- The use of standard parts in design.
- Be proficient in the development of jigs and fixtures.

**Course Outcomes:**
Ability to
- Understand the principles of location, clamping and mechanical actuation.
- Develop jigs and fixtures for different operations.
- Adopt standard procedure for the design of Jigs, fixtures
- Analyze tolerances and specify appropriate tolerances for the design of jigs, fixtures and dies.
- Design and develop bending, forming and drawing dies.
- Apply recent developments in tool design.

**Unit I - LOCATING AND CLAMPING PRINCIPLES:** Objectives of tool design – Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

**Unit II - JIGS AND FIXTURES:** Design and development of jigs and fixtures for given component – Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems – Quick change fixtures.


**Unit IV - BENDING FORMING AND DRAWING DIES:** Difference between bending, forming and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts –

**Unit V - ADVANCED PRESS TOOLS:** Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design – computer aided sheet metal forming. Tools for high velocity forming, explosive forming and pressure die casting.

**Text books:**

**Reference books:**

**17ME2038 INDUSTRIAL ENGINEERING AND MANGEMENT**

**Pre requisite:** Machining processes [17ME2010]

**Credits 3:0:0**

**Course objectives:**
To impart knowledge on
- Work study for the improvement of productivity.
- Planning and management of materials and operations in floor level and plan.
- Modern Industrial engineering approaches.

**Course outcomes:**
Ability to
- Apply work study techniques to improve working condition and productivity.
- Design an industrial system to optimize various factors of production.
- Analyze the past data for production planning and control.
- Identify suitable plant layout to minimize material handling and to improve productivity.
- Control quality of production using statistical process control and reliability tools.
- Appraise the impact of modern industrial engineering approaches in a global, economic, environmental, and social context.

**Unit I - WORK STUDY AND PRODUCTIVITY:** Introduction to industrial engineering – objectives and functional areas of Industrial engineering Method Study (Motion Study): Definition, objectives, micro motion study, therbligs, operation chart, flow process chart, man machine chart, SIMO chart. Time Study (Work measurement): uses of time study, procedure, standard time, performance rating, allowances, Methods of time study, Number of cycles to be timed. Productivity–Importance, Measurement of productivity, productivity indices, productivity improvement, Productivity bargaining

**Unit II - PRODUCTION PLANNING AND CONTROL:** Types of production – job, batch, mass and continuous production – Introduction to PPC, planning, Routing, scheduling, master schedule and subsidiary schedule, dispatching–functions, Follow up, control boards, idle machine time

**Unit III - PLANT LAYOUT:** Product layout, process layout, cellular manufacturing system, factors influencing layout. Factors governing flow pattern, travel chart, line balancing, work station design, tools and techniques for plant layout, advantages of scientific layout


**Text books:**
Reference books:

17ME2039 RAPID PROTOTYPING AND TOOLING

Prerequisite: Machining Processes [17ME2010]
Credits: 3:0:0

Course Objectives:
To impart knowledge on
- methods, areas of usage, possibilities and limitations as well as environmental effects of the Rapid Prototyping
- the characteristics of the different materials those are used in Rapid Prototyping
- Rapid tooling and reverse engineering.

Course Outcomes:
Ability to
- Recognize and use techniques for processing of CAD models for RP
- Outline the importance of RP Technology in product development cycle
- Know the principles and use RP Technology
- Select appropriate tooling for RP process
- Apply RP for reverse engineering
- Implement RP techniques & Manufacturing to solve real time industrial problems


Text Books:
Reference books:

17ME2040 METAL CUTTING THEORY AND PRACTICE
Prerequisites: Machining Processes [17ME2010]
Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Types of cutting tools and their nomenclature.
- Measuring cutting force and cutting temperature.
- The mechanisms of tool wear and chatter.

Course Outcomes:
Ability to
- Understand the theories of metal cutting mechanics
- Distinguish the types of tool and their nomenclature
- Measure the cutting force and apply for design of tools
- Determine the cutting temperature and suggest coolants
- Identify the mechanisms of tool materials wear and design optimum parameters
- Design tools and machines considering chatter

Unit I - INTRODUCTION:

Unit II - TOOL NOMENCLATURE AND CUTTING FORCES:
Nomenclature of single point tool – Systems of tool Nomenclature and Conversion of rake angles – Nomenclature of multi point tools like drills, milling cutters and broaches. Forces in turning, drilling and milling – specific cutting pressure – measurement of cutting forces.

Unit III - THERMAL ASPECTS OF MACHINING:

Unit IV - TOOL MATERIALS, TOOL LIFE AND TOOL WEAR:

Unit V - WEAR MECHANISMS AND CHATTER IN MACHINING:

Text books:

Reference books:
17ME2041 WELDING TECHNOLOGY

Pre-requisite: Manufacturing Processes [17ME2006]
Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Gas and arc welding processes, resistance welding processes, solid state welding processes
- Thermit welding, atomic hydrogen welding, electron beam welding, laser beam welding, friction stir welding
- Design of weld joints, weldability and testing of weldments.

Course Outcomes:
Ability to
- Summarize different welding processes and its applications.
- Suggest welding processes for metals.
- Realize the various applications, advantages and types of welding processes.
- Adapt different types of welding process for effective welding of structural components and complex shapes.
- Design welding joints & test of weldments.
- Relate the principles of metallurgy during the welding process.

Unit I - GAS AND ARC WELDING PROCESSES: Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electro slag welding processes – advantages, limitations and applications.

Unit II - RESISTANCE WELDING PROCESSES: Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes – advantages, limitations and applications.

Unit III - SOLID STATE WELDING PROCESSES: Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes – advantages, limitations and applications.


Unit V - DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS: Various weld joint designs – Weldability of Aluminium, Copper, and Stainless steels. Destructive and non-destructive testing of weldments.

Text books:

Reference books:
17ME2042 FOUNDRY TECHNOLOGY

Pre–requisite: Manufacturing processes [17ME2006]
Credits: 3:0:0

Course Objectives:
To impart Knowledge on:
- The process of solidification of pure metals and alloys.
- Sand molding and permanent die molding.
- Design of molds, casting defects, inspection and testing of castings and modernization of foundries.

Course outcomes:
Ability to:
- Understand the technology, variables and complexity involved in producing a casting.
- Select the furnace for a casting problem and design the pattern.
- Identify the type of sand for molds and cores for a molding process.
- Distinguish the special molding processes and when their use is acceptable.
- Understand the casting of ferrous and non–ferrous alloys
- Inspect and detect casting defects.

Unit I - MOULDING AND CASTING PROCESSES: Introduction to Moulding and casting process, Steps involved in casting process, Advantages and limitation of foundry process, Application of casting process, Pattern, types of Pattern, Pattern Allowances, Pattern Material, Pattern Making, Cores and core print, Core boxes and core making

Unit II - MANUAL MOULDING PROCESS: Moulding equipments and tools, Moulding sand ingredients and properties, Influences of ingredients on properties on moulding sand, sand preparation and control, sand testing, Machine molding, types of machines, applications, Core Blowers, Core Shooters.


Unit IV - FOUNDRY FURNACE: Introduction foundry furnace, Selection of furnace, Crucible, Oil fired Furnace, Electric Furnace – resistance furnace, Induction Furnace, Cupola furnace, non ferrous melting furnace, Pouring equipments, Inspection of casting, Destructive and non destructive test, casting defects, Casting defects – occurrence and causes.

Unit V - GATING SYSTEM, FOUNDRY LAYOUT AND AUTOMATION: Introduction to Gating system, Function of gating system, Types of gating system, Gating Ratio – simple problems, Function of Riser, types of riser, riser design problems, Foundry layout and Automation.

Text books:

References Books:

17ME2043 COMPUTATIONAL FLUID DYNAMICS

Pre–requisite: Fluid Mechanics and Machinery [17ME2013]
Credits: 3:0:0

Course Objectives:
To impart knowledge on
- The governing equations of fluid dynamics.
- Appropriate discretization method for the given formulation
- The solution methodologies of discretized equations for turbulence and combustion models.
Course Outcomes:
Ability to
- Formulate governing equations for a given flow problem.
- Select appropriate discretization method for the given formulation.
- Interpret and discretize the governing equation.
- Select an appropriate solver for the discretized equations.
- Interpret the solutions obtained from the solver.
- Prepare results in the form of graphs and tables.


Unit III - DISCRETIZATION OF HEAT CONDUCTION: Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems.

Unit IV - DISCRETIZATION OF CONVECTION AND DIFFUSION: Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes – Discretization equations for two dimensional convection and diffusion.


Text Books:

Reference books:

17ME2044 RENEWABLE ENERGY SOURCES

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Types renewable energy sources.
- The working principle and power generation techniques of renewable energy systems.
- The application and environmental aspects of renewable energy systems.

Course Outcomes:
Ability to
- Identify the various renewable energy sources.
- Summarize the application of solar energy systems.
- Develop a small size gasifier.
- Design a wind mill for water pumping application.
- Explain the method of electricity production from water.
- Develop a fuel cell.

**Unit I - NON–CONVENTIONAL ENERGY SOURCES:** Introduction, non–conventional energy systems, world energy features, non–conventional energy sources and their availability, prospectus of renewable energy sources, advantages and disadvantages of renewable energy sources, history of energy consumption pattern.

**Unit II - SOLAR ENERGY SYSTEMS:** Solar radiation, solar radiation measurements, flat plate collectors, solar air heaters, concentrating collectors, solar water heating, solar space heating, solar refrigeration, solar photo voltaic cells, solar cooking, solar chimney, calculation of collector efficiency, outlet temperature of fluid.

**Unit III - BIOMASS ENERGY SYSTEMS:** Biomass resources, biomass conversion technologies, thermo chemical conversion of biomass – pyrolysis, gasification, direct combustion, liquefaction. Gasifier – classification of biomass gasifiers, gasifier engine systems, application of gasifier. Ethanol production from biomass, biogas plants, calculation of volume of biogas digester, gas holder volume, volume of biogas generated.

**Unit IV - WIND ENERGY SYSTEMS:** The power in the wind, forces on the blades and thrust on turbines, wind energy conversion, site selection considerations, basic components of wind energy conversion systems, classification of wind energy conversion systems, wind energy collectors, performance of wind energy machines, application of wind energy, environmental impacts. Determination of power available in the wind.

**Unit V - OTHER RENEWABLE ENERGY SOURCES:** Ocean thermal energy conversion – calculation of power output from turbine. Tidal energy – determination of power available in the tidal energy, types. Wave energy conversion devices, small, mini, micro hydro systems. Geothermal energy – calculation of hot water temperature and pressure. Hydrogen energy, fuel cells, magneto hydro dynamic systems, nuclear fusion energy.

**Text books:**

**Reference books:**
2. Srivastava, Shukla and Jha, “Technology and Application of Biogas” Jain Brothers, New Delhi, 2000

**17ME2045 ADVANCED INTERNAL COMBUSTION ENGINES**

**Prerequisite:** Thermal Engineering I [17ME2011]

**Credits:** 3:0:0

**Course Objectives:**
To impart knowledge on
- SI and CI Engines
- Engine exhausts emission control and alternate fuels
- Introduce the recent developments in IC Engines

**Course Outcomes:**
Ability to
- Classify different types of internal combustion engines.
- Analyze performance of spark ignition and compression ignition engines.
- Predict concentrations of primary exhaust pollutants
- Evaluate alternative fuels for Internal Combustion engines.
- Perform basic calculations relating to the performance and emissions of automobile engines.
- Adapt emission control norms for engine design.
Unit I - SPARK IGNITION ENGINES: Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection -Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers


Text Books:

Reference Books

17ME2046 REFRIGERATION AND AIR CONDITIONING
Pre–requisite: Thermal Engineering II [17ME2018]
Credits: 3:0:0

Course Objectives:
To impart knowledge on
• Working principle of refrigeration and air–conditioning cycle
• Fundamentals of psychrometry and cooling load components
• Applications of refrigeration and air–conditioning

Course Outcome:
Ability to
• Identify various refrigeration and air–conditioning cycles
• Estimate the performance of various refrigeration and air–conditioning cycles
• Demonstrate different types of refrigerants
• Analyze psychometrics processes
• Evaluate the space cooling load
• Choose the refrigeration and air–conditioning systems for relevant applications


Text Books:

Reference Books:

17ME2047 BIOMASS ENERGY SYSTEMS

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Types of biomass resources and biomass conversion processes
- Construction of a small size gasifier and biogas plant
- The alcohol production methods from biomass

Course Outcomes:
Ability to
- Classify the thermo chemical conversion process of biomass
- Design a community biogas plant
- Select a biogas plant for the given application
- Develop a small size biomass gasifier
- Explain the application of bio–fuels
- Demonstrate the power generation techniques using biomass waste


Unit III - DIGESTER DESIGN: Design based on methane production rate, design based on end user requirements, scaling of biogas plants, digester sizing, problems related to biogas plants, starting a biogas plant, filling a digester for starting, fuel properties of biogas, selection of site for a biogas plant. Utilization of biogas – modification of SI and CI engine, biogas use in stationary power plants, mobile power plants, use of biogas in refrigerators, gas turbines. Purification, scrubbing, compression and storage of biogas, biogas burners.


Unit V - ELECTRICITY PRODUCTION FROM BIOMASS WASTES: Ethanol production from wood and sugar cane, methanol production, electricity production from municipal solid wastes, animal wastes, plant residues, pulp and paper industry wastes, distillery waste.
Text Books:

Reference Books:

17ME2048 ALTERNATIVE FUELS FOR IC ENGINES

Prerequisite: Thermal Engineering II [17ME2018]
Credits: 3:0:0

Course objectives:
To impart knowledge on
- The concepts of energy and its sources.
- The production & performance characteristics of alternative fuels.
- Emission control with alternate fuels.

Course Outcomes:
Ability to
- Describe the refining process of petroleum.
- Identify the various alternative fuel options available for conventional fuels and their performance and emission characteristics.
- Outline the production method of various alternative fuels.
- Analyze the performance and Emissions of alternate fuels.
- Apply emission control norms and alternate fuels used in IC engines.
- Design electric and hybrid vehicles.

Unit I - FUELS AND ITS PROPERTIES: Introduction, Structure of petroleum, Refining process, Products of refining process, Fuels for spark Ignition, Knock rating of SI engine fuels, Diesel fuels and Numerical, Properties of Petroleum products, lubricant and grading of lubricants, Specific gravity, Density, Molecular weight, Vapour Pressure, Viscosity, Flash point, Fire point, Cloud Point, Pour point, Freezing Point, Smoke Point and Char value, Aniline point, Octane number, performance number, Cetane number, Emulsification, Oxidation Stability, Acid value/Number, Distillation Range & sulphur content.

Unit II - ALTERNATIVE FUELS FOR IC ENGINES: Need for alternate fuels such as Ethanol, Methanol, LPG, CNG, Hydrogen, Bio gas and producer gas and the method of manufacturing Single fuel engines. Properties of alternate fuels use of alternate fuels in SI engines, Engine modification required performance in emission and emission characteristics of alternative fuels in SI mode of operation v/s Gasoline operation.

Unit III - DUAL FUEL ENGINE: Need and advantages, the working Principle, Combustion in dual fuel engines, Factors affecting combustion in dual fuel engine, use of alcohols, LPG, CNG, Hydrogen, Bio gas and producer gas in CI engine in dual fuel mode, Engine modification required, performance and emission characteristics of alternative fuels (mentioned above) in dual fuel mode of operation v/s diesel operation.

Unit IV - BIO AND SYNTHETIC FUELS: Biodiesels and ethanol, Need of biofuels, Properties of biodiesels v/s diesel, ethanol Vs petrol Performance and emission characteristics of biodiesel v/s diesel and ethanol Vs petrol operation. New fuels like BTL and DME, their availability and properties, use in IC engines.

Unit V - AVAILABILITY AND FUELS FOR HYBRID VEHICLES: Suitability & Future prospects of these gaseous fuels in Indian context. Environmental Pollution with Convection and alternative fuels, Pollution control methods and packages. Electric and Hybrid vehicles: types, batteries, applications.

Text books:
Reference books:

17ME2049 MODERN VEHICLE TECHNOLOGY

Credits: 3:0:0

Course objectives:
To impart knowledge on
- Principles of engines used for automobiles and different systems.
- The various transmission and drive line units of automobiles.
- The importance of sensors and fuel injection systems.

Course Outcomes:
Ability to
- Identify the importance and functions of vehicle chassis, components of IC Engines and cooling systems.
- Describe the types of steering and suspension systems.
- Demonstrate the functions of clutch and braking systems.
- Recognize and select drives for transmission.
- Summarize the working principles of sensors and actuators.
- Express the functions and components of fuel injection and ignition systems.


Unit IV - AUTOMOTIVE TRANSMISSION: Gear box: Need, types of gear transmission – sliding mesh, constant mesh and synchromesh gearboxes; Gearshift mechanisms; Epicyclic transmission. Universal joint – constant velocity joint – propeller shaft – Hotchkiss drive – Torque tube drive; Front and Rear axles: Types – stub axle; Differential: need and types; Four wheel drive.

Unit V - SENSORS AND ENGINE ELECTRONICS: Types of Sensors; Sensors for Speed, Throttle Position, Exhaust Oxygen Level, Manifold Pressure, Crankshaft Position, Coolant Temperature, Exhaust Temperature, Air–mass flow for engine application. Solenoids, Stepper–Motors, & Relay. Multi point fuel injection (MPFI), Gasoline Direct Injection (GDI); Common Rail Direct Injection (CRDI); Variable Timing Ignition (VTI), Engine Mapping; On–board Diagnostics; Electronically controlled Automatic Transmission System.

Text books:

Reference books:
17ME2050  POWER PLANT ENGINEERING

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- The concepts of various sources of power generation and engineering analysis of power plants.
- The economics of power plants and methods of optimum utilization of electrical energy.
- The environmental effects of power plants.

Course Outcomes:
Ability to
- Analyze performance and determine efficiency of a modified Rankine cycle steam power plant.
- Compare and contrast various air–preheating, combustion, condensing and cooling systems for modern thermal power plants.
- Analyze the performance of gas turbines with reheat, regeneration cycles and compute the efficiency of gas turbines.
- Recognize environmental impact of electric power production on air quality, climate change, water, and land.
- Recognize various methods and the significance of power generation from nuclear and renewable energy sources.
- Compute factors affecting economics of power distribution and conduct energy audit.

Unit III - NUCLEAR POWER PLANT: Basic nuclear physics and nuclear reactions related to nuclear reactors, nuclear reactor materials, types of reactors, radiation shielding, waste disposal.
Gas Turbine Power Plant: components and layouts. Open and closed cycle plants – combined gas turbines and steam power plants.
Unit IV - DIESEL ENGINE POWER PLANT: components and lay–outs, selection of engine type.
Environmental hazards of various power plants.
Unit V - ECONOMICS OF POWER PLANT: Load curve – definition – fixed and operating costs – comparison of economics of different types of power plants.
Unconventional Power Plants: Solar, Wind, Ocean thermal Tidal, Wave and Geothermal power plants. MHD concepts of energy conversion and energy audit.

Text books:

Reference books:

17ME2051 TURBOMACHINERY

Pre–requisite: Fluid Mechanics and Machinery [17ME2013]
Credits: 3:0:0

Course objectives:
To impart knowledge on
- Classification of turbo machines
- Types of pump, compressor, fan, and turbine
Course outcomes:
Ability to
- Define the terminology used in turbo machines
- Compare the performance of types of fans and blowers
- Illustrate the selection of fans and blowers for different applications
- Analyze the performance centrifugal compressor
- Evaluate the performance of axial flow compressor
- Develop axial and radial flow turbines for various applications

Unit I - PRINCIPLES: Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.
Unit II - CENTRIFUGAL FANS AND BLOWERS: Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, characteristics curves and selection, fan drives and fan noise.
Unit III - CENTRIFUGAL COMPRESSOR: Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.
Unit IV - AXIAL FLOW COMPRESSOR: Stage velocity triangles, enthalpy–entropy diagrams, stage losses and efficiency, work done factor, simple stage design problems and performance characteristics.
Unit V - AXIAL AND RADIAL FLOW TURBINES: Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, testing and performance characteristics.

Text Books:

Reference Books

17ME2052 DESIGN OF HEAT EXCHANGERS
Prerequisite: Heat and Mass transfer [17ME2024]
Credits: 3:0:0

Course Objectives:
To impart knowledge on
- various types of heat exchangers
- thermal analysis of heat exchangers
- the sizing and rating of the heat exchangers for various applications.

Course outcomes:
Ability to
- understand the working principle of different types of heat exchangers
- Design various types of heat exchangers
- Identify applications of heat exchangers
- Apply correlations for reducing errors in the design of heat exchangers
- Predict performance parameters of heat exchangers
- Design evaporator, condenser and cooling towers

Unit I - Introduction and classification of heat exchangers: Parallel flow, counter flow and cross flow; shell and tube and plate type; single pass and multi pass.
Unit II - Heat transfer correlations: Overall heat transfer coefficient, fouling factors, pressure drop calculations.
Unit III - Design of heat exchangers: LMTD and effectiveness NTU methods, sizing of finned tube heat exchangers, thickness calculations, tube sheet design using TEMA formula.
Unit IV - Compact and Plate Heat Exchangers: types, merits and demerits, design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.
Unit V - Design of evaporator and condensers: cooling tower - performance characteristics

Text Books:

Reference Books:

17ME2053 MECHATRONICS

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- The elements of Mechatronics systems
- Selection of sensors and actuators
- Application of mechatronics systems in automation

Course Outcomes:
Ability to
- Recognise the emerging trends in mechatronics and interpret the principle of sensors.
- Illustrate the working principles of valves, pneumatic and hydraulic drives
- Inference the suitable microprocessor or micro–controller for a real time application.
- Build a PLC program for an industrial application
- Design a ladder logic program for a particular application.
- Identify an appropriate drive for an industrial application


Unit II - PNEUMATIC AND HYDRAULIC ACTUATORS: DCVS, FCVs, special valves like Servo and Proportional Controls Valves, different types of Pumps and Motors – computation of performance of them.


Text Books:

Reference Books:

17ME2054 INDUSTRIAL SAFETY ENGINEERING

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Recognition, investigation, analysis, and control of hazards.
- Management’s role in safety and assess the importance.
- The multiple hazards associated with welding

Course Outcomes:
Ability to
- Apply the basic concepts and scope of engineering safety.
- Implement the standards of professional conduct that are published by professional safety organizations and certification bodies.
- Illustrate the importance of safety of employees while working with machineries
- Express Safety in terms of Risk and to recognize unacceptable/inappropriate levels of Risk
- Identify hazards arising from runaway reactions, explosions and fires
- Suggest the various methods to prevent the hazards working with machineries

Unit I - SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES:

Unit II - PRINCIPLES OF MACHINE GUARDING:
Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards – point of operation protective devices.

Unit III - SAFETY IN WELDING AND GAS CUTTING:
Gas welding and oxygen cutting, resistsances welding, arc welding and cutting, personal protective equipment, training, safety precautions during welding.

Unit IV - SAFETY IN COLD FORMING AND HOT WORKING OF METALS:
Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism.

Unit V - SAFETY IN FINISHING, INSPECTION AND TESTING:
Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing. Applicable standards in Industrial safety management.

Text books:

Reference books:
17ME2055 BASIC AUTOMOBILE ENGINEERING

Credits: 3:0:0

Course objectives:
To impart knowledge on
- basic principles of engines used for automobiles and different systems.
- various transmission and drive line units of automobiles.
- importance of sensors and fuel injection systems.

Course Outcomes:
Ability to
- Identify the importance and functions of vehicle frame.
- Describe the thermodynamic principles behind the working of petrol and Diesel.
- Recognize the construction and working principles of SI and CI engines.
- Express the functions and components of fuel injection and ignition systems.
- Summarize the functions and components of engine cooling, lubrication and ignition systems.
- Outline the functions and components of electric and hybrid vehicles.

Unit I - INTRODUCTION: Classification of vehicles, body and load (definition only) - Layout of an automobile chassis, Function of major components of a vehicle and introduction to their different systems such as Frame, transmission (clutch and gear box), braking system, steering and suspension systems (just line diagrams and utility)

Unit II - THERMODYNAMICS: Zeroth, First, second and third law of thermodynamics (concept only), Otto cycle, diesel cycle, fuel used properties of fuels, air requirement for complete combustion of fuel.

Unit III - IC ENGINES: Concept of two stroke and four stroke petrol and diesel engines and their applications to automobiles. Various terms, Valves and Actuating mechanisms – Inlet and Exhaust manifolds. Specification of automobile engines.

Unit IV - AUTOMOTIVE SYSTEMS: Automobile fuel system: Fuel tank, filters, spark plug, ignition systems, Multi point fuel injection (MPFI), Gasoline Direct Injection (GDI), Common Rail Direct Injection (CRDI), Cooling & Lubrication systems.

Unit V - AUTO INDUSTRY IN INDIA AND FUELS FOR HYBRID VEHICLES: History, leading manufacturers, development in automobile industry, trends, new products. Pollution control methods and packages. Electric and Hybrid vehicles: types, applications.

Text books:

Reference books:

17ME2056 INDUSTRIAL ROBOTICS

Credits: 3:0:0

Course Objective:
To impart knowledge on the fundamental principles of
- Robot configurations,
- Sensors and transducers,
- Actuating systems and Robot programming skills.

Course Outcomes (COs):
Ability to
- Infer the robot history and configurations.
- Assess various components of a robot and choose the control system.
- Compute the kinematic equations and select an actuator for robot configurations
- Identify the suitable sensor for a particular robot application.
• Write a robot program for an industrial application.
• Identify the robot application for a unique operation.


Unit II - COMPONENTS AND CONTROL SYSTEMS: Basic Components of robot – Manipulators, Grippers and effectors, Tools as end effectors, Basic control system concepts – Closed and open loop control systems. Examples of control systems.


Text books:

Reference books:

17ME2057 HEAT ENGINES AND FLUID MACHINERY

Credits: 3:1:0

Course Objective:
To impart knowledge on
• The basic principles of thermodynamics via real-world engineering examples, to show students how thermodynamics is applied in engineering practice.
• The basics of Fluid mechanics and fluid machinery components.
• The fundamentals of Heat Transfer and apply it to solve simple problems.

Course Outcome:
Ability to
• Understand the basic concepts in thermodynamics and its application in different fields.
• Apply the first law of thermodynamics for closed and open systems to solve simple engineering problems
• Understand and solve conduction, convection and radiation problems.
• Analyze the performance of Internal Combustion engines.
• Explain the fundamental aspects of fluid properties and flow behavior.
• Apply principles of fluid mechanics to the operation, design, and selection of fluid machinery such as pumps, blowers and turbines.

Unit I - FLUID PROPERTIES: Properties of fluids: density, specific weight, specific volume, specific gravity. Viscosity: units, kinematic viscosity, Newton’s law of viscosity, variation of viscosity with temperature, types of fluids. Surface tension and capillarity: surface tension on liquid droplet, hollow bubble. Manometers: Peizometer, u-
Tube manometer, single column manometer, tube differential manometer. Pumps: reciprocating pumps, centrifugal pumps – operating principles.

**Unit II - TYPES OF FLOW AND TURBINES:** Types of flow: steady and unsteady, uniform and non uniform, laminar and turbulent, compressible and incompressible, rotational and irrotational, one, two and three dimensional flows. Impact of jet impulse momentum equation - moment of momentum equation, jet on vertical plate, inclined, curved plate. Turbines: classification-working principles - Pelton wheel, Francis, Kaplan turbines. Simple problems.

**Unit III - THERMODYNAMICS:** Basic concepts - thermodynamic system - properties - processes - cycle - equilibrium - First law of thermodynamics - application of first law to non flow and flow process - Second law of thermodynamics - Kelvin Planck's statement - Clausius statement - Reversibility - Carnot theorem - heat engine.

**Unit IV - I.C.ENGINES:** Classification of I C engines-engine components-four stroke engines and two stroke engines differences-air standard cycles - air standard efficiency - Otto, Diesel - problems.

**Unit V - HEAT TRANSFER:** Modes of heat transfer – one dimensional steady state heat conduction equation – plain wall - convection - empirical relations - Radiation - laws of radiation.

**Text books:**

**Reference books:**

**17ME2058 FUNDAMENTALS OF THERMAL AND FLUID SCIENCES**
(Use of Steam tables, Heat and Mass Transfer Data Book is permitted)

**Credits:** 3:0:0

**Course Objectives:**
To impart Knowledge on
- The basic principles of thermodynamics via real-world engineering examples, to show students how thermodynamics is applied in engineering practice.
- The basics of Fluid mechanics and fluid machinery components.
- The fundamentals of Heat Transfer and apply it to heat exchangers.

**Course Outcomes:**
Ability to
- Understand the basic concepts in thermodynamics and its application in different fields.
- Apply the first law of thermodynamics for closed and open systems to solve simple engineering problems
- Understand and solve conduction, convection and radiation problems.
- Design and analyze the performance of heat exchangers.
- Explain the fundamental aspects of fluid properties and flow behavior.
- Apply principles of fluid mechanics to the operation, design, and selection of fluid machinery such as pumps, blowers and turbines.


**Unit II - HEAT TRANSFER:** Modes of heat transfer – One dimensional steady state heat conduction equation – Plain wall – Convection – Empirical relations – Radiation – Laws of radiation.


**Unit IV - FLUID PROPERTIES:** Properties of fluids: Density, Specific weight, Specific volume, Specific gravity – Viscosity: Units, Kinematic Viscosity, Newtons law of viscosity, Variation of viscosity with temperature, Types of

**Unit V - TYPES OF FLOW AND TURBINES:** Types of flow: Steady and unsteady, Uniform and non uniform, Laminar and turbulent, Compressible and incompressible, Rotational and irrotational, One, two and three dimensional flows – Turbines: Classification, Working Principle – Pelton wheel, Francis, Kaplan turbines, Simple problems.

**Text books:**

**Reference books:**

**17ME2059 MACHINE DESIGN**

**Credits: 3:0:0**

**Course Objectives:**
To impart knowledge on
- Design principles and basic design procedures.
- Using design data for the design of mechanical elements.

**Course Outcomes:**
Ability to
- Understand the standard design procedure for Design of machine elements.
- Analyse stresses acting on components and determine the size based on theories of failure.
- Design machine components for a given load condition using design data hand books.
- Decide specifications as per standards given in design data and select standard components to improve interchangeability.
- Design and develop nonstandard machine components.
- Prepare a detail design layout and drawing of machine components

**Unit I - FUNDAMENTALS OF MACHINE DESIGN:** General considerations in machine design – strength properties of engineering materials. Limits and tolerances – Types of Fits – simple stresses in machine elements – tension – compression – shear and bearing stresses. Torsional and bending stresses in machine parts-torsional stresses in shafts, bending stresses in beams – combined stresses. Theories of failure – Rankine’s and Guest theory


**Unit V - DESIGN OF ENGINE SYSTEM:** Design of Gear Box, Design of piston, Cylinder, connecting rod, and flywheel.
Text books:

Reference books:

Hand book:

17ME2060 HEAT POWER ENGINEERING

Credits: 2:0:1

Course Objectives:
To impart knowledge on
- fuels and combustion
- classification and principles of IC engines
- air compressors and boilers

Course Outcomes:
Ability to
- Evaluate the properties of fuels
- Classify different types of internal combustion engines.
- Analyze performance of spark ignition and compression ignition engines.
- Predict the efficiency of compressors and boilers
- Conduct a variety of experiments in internal combustion engines
- Determine the principle of various parameters in the performance of Boiler

Unit I - TYPES AND PROPERTIES OF FUELS: Fuels – types and properties-higher and lower heating values, their determination -properties of gas mixtures, ideal and real gases – Dalton’s law of partial pressures-Internal energy, enthalpy, entropy and specific heats of gas mixtures –Gibb’s function.

Unit II - COMBUSTION: Combustion of fuels, stoichiometric air requirement – excess air-gravimetric analysis and volumetric analysis of products of combustion and their conversions.


Unit V - PRACTICAL:
1. Measurement of performance parameters on two stage reciprocating air compressor
2. Performance test on variable compression ratio, 4 stroke petrol engine
3. Performance test on four–stroke twin cylinder vertical Diesel engine
4. Heat balance test on four stroke single cylinder Diesel engine
5. Retardation test on four stroke single cylinder vertical Diesel engine
6. Performance test and study on the boiler apparatus
Text Books:

Reference Books

17ME2061 CAD/CAM AND COMPUTER GRAPHICS

Credits: 0:0:2

Course Objectives:
To impart knowledge on
- Application of various line types, arcs and methods to draw using AutoCAD.
- Modelling products of industrial system.
- Computer Numerical Control (CNC) programming for various machining operation.

Course Outcomes:
Ability to
- Construct drawings using various line types, arcs, and circles using CAD software.
- Prepare drawings using modify, draw, layers and properties tool bars to draw orthographic views.
- Recognize the applications of software in 3D modelling/analysis of Mechanical Engineering components
- Construct the 3D model using various commands like extrude, mirror, revolve etc
- Model 3D mechanical components like knuckle joint, plumber block using appropriate modelling/assembling commands
- Prepare CNC Programming for different mechanical parts using G codes and M codes

List of Exercises:
1. Snap, Grid, Limits, OSNAP, line types and weights, text, pdf file creation and plotting.
2. Modifying Commands: Erase, trim, array, lengthen, break, mirror, offset, move, copy etc.
3. Methods of Drawing lines, arcs and circles and applications.
4. Isometric view of primitive solids and combination of primitive solids.
5. 3D modeling using Extrude, Round, Mirror commands
6. 3D modeling using Revolve, Hole, shell, and pattern commands
7. Assembly of Knuckle Joint or Universal Joint/Plummer block or flange coupling/ Lathe Tailstock
8. Advanced modeling commands Sweep and Blend.
9. Step turning in CNC
10. Taper turning in CNC
11. Ball Turning in CNC
12. Drilling in a CNC drilling machine

17ME3001 FINITE ELEMENT METHODS IN ENGINEERING

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- finite element analysis fundamentals.
- formulate the design problems into FEA.
- basic aspects of finite element technology and various types of elements.
- implementation of Galerkin’s formulation into the Finite Element Method for the solution of ordinary and partial differential equations.

Course Outcomes:
Ability to:
- identify mathematical model for solution of common engineering problems.
• formulate simple problems into finite elements.
• determine engineering design quantities for structural, heat transfer and fluid mechanics problems.
• use professional-level finite element software to solve engineering problems in Structural Mechanics, fluid mechanics and heat transfer.
• derive integral statements for linear partial differential equations, such as the Laplace/Poisson equation, the wave equation, and the elasticity equations.
• derive element matrix equation using different methods by applying basic laws in mechanics and integration by parts.

Unit I - INTRODUCTION: Basic concepts- General applicability of the method to structural analysis, heat transfer and fluid flow problems- general approach of finite element method with case studies - classical analysis techniques-finite element packages - Solution of equilibrium problems- solution of Eigen value problem -Solution of propagation problems

Unit II - GENERAL PROCEDURE: Discretization of Domain- basic element shapes- interpolation polynomials natural coordinates- formulation of element characteristic matrices and vectors-direct approach -variational approach and weighted residual approach-Continuity conditions-Formulation of one dimensional, two dimensional, three dimensional elements - isoparametric elements- curve sided elements-higher order elements-Lagrangian element-serendipity element.


Reference Books:

17ME3002 COMPUTER APPLICATION IN DESIGN

Credits: 3:0:0

Course Objectives:
To impart knowledge on
• how computer can be used in mechanical engineering design.
• the basics of CAD and Visual realism
• the assembly of parts, tolerance analysis, mass property calculation, solid modeling techniques and rapid prototyping.

Course Outcomes:
Ability to
• understand the basics and applications of CAD
• know the theory for geometry creation and transformation
• apply different CAD software for creating CAD Models.
• apply the knowledge of assembly modeling.
- determine the graphic standards used for solid modeling and surface modeling
- decide on the various data exchange formats to be used for advanced applications


Unit II - COMPUTER GRAPHICS ALGORITHMS: DDA Algorithm – Bresenham’s Algorithm – Coordinate systems – Transformation of geometry - Translation, Rotation, Scaling, Reflection, Homogeneous transformations – 2D Transformations - Concatenation – Clipping and Hidden line removal algorithms


Unit V - VISUAL REALISM & EXCHANGEFILE FORMATS: Hidden line- surface- Solid removal algorithms shading- coloring. Introduction to parametric and variational geometry based on software’s and their principles creation of prismatic and lofted parts using these packages. Rapid prototyping – data exchange- Documentation- Customizing- solid modeling system. IGES, GKS systems.

Reference Books:

17ME3003 ADVANCED MECHANICAL VIBRATIONS

CREDITS: 3:0:0

Course Objective:
To impart knowledge on
- formulating mathematical model for vibration problems
- analyzing the vibration behavior of mechanical systems subjected to loading
- methods to reduce vibration and the equipment used for collecting response data.

Course Outcome:
Ability to
- classify the systems of vibration and formulate equations of motion for vibratory systems.
- solve vibration problems with multi-degrees of freedom.
- suggest methods to regulate vibration
- perform vibration tests and acquire data from vibration measuring instruments.
- present the theoretical and the experimental principles of mechanical vibrations to gain practical understanding in the field of vibration
- understand unwanted vibration, noise in machines and proficient with instrumentation used in noise, vibration control tests


Unit III - NUMERICAL METHODS TO SOLVE VIBRATION PROBLEMS: Numerical methods in vibration problems to calculate natural frequencies - matrix iteration –Stodola’s method, Holzer’s method -mechanical impedance method –Matrix iteration technique.

Unit IV - ENGINEERING ACOUSTICS: Basic physical acoustics- acoustic levels and spectra- decibels, sound power, Sound pressure, power and intensity - Character of noise – Addition of two noise sources -Noise source identification. Noise radiation from vibrating bodies sound- properties of the various sources that create noise - Noise in machines and machine elements.


Reference Books:

17ME3004 ADVANCED STRENGTH OF MATERIALS

CREDITS: 3:0:0

Course Objectives:

To impart knowledge on

- thorough understanding of advanced topics concerning the response of materials and structural elements to applied forces of deformation.
- material behavior under various stress conditions.
- development of stresses in the material for various shape and loading conditions.

Course Outcomes:

Ability to

- apply concepts in stress, displacement, and transformations to 2D, and 3D solids under load.
- apply concepts in elasticity for calculating strength on components subjected to concentrated loads
- determine strength, predict failure, and incorporate design considerations in shafts and beams.
- determine stresses in open and closed sections in torsion and bending of standard sections.
- apply stress functions, and calculate stresses in plates and shells, thick circular cylinders, and discs.
- apply and use energy methods to find force, stress, and displacement in simple structures.


Unit II - PROBLEMS IN ELASTICITY: Introduction-Plain Elastic Problems-Governing Equations- Conversion between plane stress and plane strain problems-Airy’s Stress Function-Solution of Elasticity Problems-Thermal
Stresses-Basic Relations in Polar Coordinates-Stresses Due to Concentrated Loads- Stress Distribution Near Concentrated Loads-Stress Concentration Factors.


Unit IV - TORSION OF PRISMATIC BARS: Introduction-Elementary Theory of Torsion of -Stresses on Inclined Planes-General Solution of the Torsion Problem-Prandtl’s Stress Function-Prandtl’s Membrane Analysis-Theory of Narrow Rectangular Cross Section-Torsion of Multiply Connected Thin Walled Sections-Fluid Flow Analogy and Stress Concentration-Torsion of Restricted Thin-Walled Members of Open Cross Section.


Reference Books:

17ME3005 ENGINEERING MATERIALS AND APPLICATIONS

Credits: 3:0:0

Course Objectives:
To impart the knowledge on
- Structure, composition and behavior of Metals
- fracture behavior of materials
- the principles of design, selection and processing of materials.

Course Outcomes:
Ability to
- Apply the concepts of Materials Science for material selections towards new product development.
- Analyse the elastic and plastic behavior of materials
- Suggest modern metallic materials for engineering applications.
- Evaluate fracture behavior of materials in engineering applications.
- Appraise the utility of new age material for specific application.
- Synthesise and develop the unique customized composites for special needs.

Unit I - ELASTIC AND PLASTIC BEHAVIOR: atomic model of Elastic behavior – Rubber like Elasticity an elastic behavior - plastic deformation- slip- shear strength of perfect and real crystals- movement of dislocation
Unit II - FRACTURE BEHAVIOR: Ductile and Brittle fracture – Energy and stress intensity approach, fracture toughness- Ductile Brittle Transition Fatigue- Creep in Materials.
Unit III - MODERN METALLIC MATERIALS: Patented Steel wire - Steel martensite - micro alloyed steels-precipitation hardened aluminum alloys- Maraging steels – metallic glasses.
Unit IV - NEW AGE MATERIALS: Shape memory alloys smart Materials- TRIP Steels Ceramics and glasses: Properties, applications, Ceramic Structures- silicate ceramics- carbon –diamond- graphite imperfections and impurities in ceramics –applications

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Unit V - COMPOSITES: Metal matrix composites, polymer matrix and ceramic materials, Bio compatible, Materials for medical implants, Applications of composites.

Reference Books:

17ME3006 ADVANCED MECHANISM DESIGN

Credits : 3:0:0

Course Objectives:
To impart knowledge on
- the fundamentals of a mechanism and machines.
- kinematics of a mechanism.
- forces in the joints and links of a mechanism and a robot.

Course Outcomes:
Ability to
- identify the type and find degree of freedom of a given mechanism
- conduct kinematic analysis of a mechanism
- apply the path curvature theories in the analysis of a mechanism.
- synthesis of a mechanism for a given application.
- investigate forces in the joints and links of a mechanism.
- employ the capabilities of a robot in design.


Unit II - PATH CURVATURE THEORY: Path Curvature theory. Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, Bobilier’s construction constructions- Cubic of stationary curvature.


Unit IV - DYNAMICS OF MECHANISMS: Static force analysis with friction – inertia force analysis- combined static and inertia force analysis, shaking force, kinetostatic analysis. Introduction to force and moment balancing of linkages.


Reference Books:

17ME3007 EXPERIMENTAL STRESS ANALYSIS

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- applied stress and strain involved in solid mechanics.
- the relation between theory of mechanics and experimental stress and strain analysis
- experimental method of finding the response of the structure to different types of load.

Course Outcomes:
Ability to:
- use suitable instruments in the measurement of stress and strain
- analyse stress and strain in machine elements.
- apply appropriate techniques to measure stress and strain.
- apply photoelasticity methods to measure stress and strain
- extract stress magnitude using brittle coating
- apply Moire methods in the measurement of stress

Unit I - MEASUREMENTS AND EXTENSOMETER:
Principles of measurements, Accuracy, Sensitivity and range of measurements. Mechanical, Optical Acoustical and Electrical extensometers and their uses, Advantages and disadvantages.

Unit II - STRESS:
Stress at a point - Stress equations of Equilibrium - Laws of stress transformation Principal stresses- Maximum Shear

Unit III - STRAIN MEASUREMENT:
Principle of operation and requirements, Types and their uses, Materials for strain gauge. Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators.

Unit IV - PHOTOELASTICITY METHODS:

Unit V - MOIRE AND BIREFRINGENT COATING METHODS:

Reference Books:

17ME3008 ENGINEERING PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- modeling, simulation, material selection and GD & T.
- important practices followed during designing and developing a product in industries.
• product life cycle right from its conceptual stage to its development stage.

Course Outcomes:
Ability to
• apply the appropriate design process and modelling techniques to design components.
• categorize the models used in product design and use appropriately for product analysis.
• choose the right material selection process and calculate the economics of materials.
• design a product for sustainability, environment friendly considering human factors engineering.
• use GD & T principles for better product manufacturing.
• design and develop a product using quality, robust design and optimization.


Unit II - MODELING AND SIMULATION: The role of Models in Engineering Design-Mathematical modeling, Similitude and scale modeling, Simulation, Finite-Difference method, Geometric modeling on the computer, Finite Element Analysis-Introduction to simulation modeling-Simulation programming software-Monte Carlo Simulation


Reference Books:

17ME3009 ENGINEERING FRACTURE MECHANICS

Credits : 3:0:0
Course Objectives:
To impart knowledge on
• stress and strain field around a crack in a body for different fracture modes
• factors governing crack growth , crack arrest and fatigue.
• the applications of fracture mechanics.

Course Outcomes:
Ability to
• estimate stress and strain field around a crack.
• understand plastic material behaviour around the crack tip
• estimate the fracture toughness value of a material for various fracture modes.
• design of components that contain crack under static and fatigue load condition
• provide solution to prevent crack growth and fatigue failures.
• Analyze of fatigue crack propagation using empirical methods

Unit I - ELEMENTS OF SOLID MECHANICS: The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation – limit analysis – Airy’s function – field equation for stress intensity factor.


Unit V - APPLICATIONS OF FRACTURE MECHANICS: Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields - numerical methods.

Reference books:

17ME3010 DESIGN OF MECHANICAL SYSTEM ELEMENTS

Credits 3:0:0

Course Objectives:
To impart knowledge on
• applications and design of mechanical system elements
• applying the design concept in product design and development.

Course Outcomes:
Ability to
• understand the design principles of mechanical systems
• design the machine elements and systems
• design the material handling equipment
• learn about construction ,working principle and design of the conveyor systems
• select appropriate machine elements for mechanical systems
• design and develop new products which can be used in mechanical systems.

Unit I - MATERIAL HANDLING EQUIPMENTS: Types, Selection and applications, Method for determining stresses-Terminology and ligament efficiency-Application.

Unit II - INTRODUCTION: Stresses in a circular ring, cylinder-Membrane stress analysis of vessels shell components-Cylinder shells, to spherical heads, conical heads-Thermal stresses ,Discontinuity stresses in pressure vessels. Design Of Vessels: Design of tall cylinder self supporting process columns-Supports for short vertical vessels Stress concentration at a variable thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of reinforcement-Pressure vessel design.

Unit III - DESIGN OF AUTOMOTIVE TRANSMISSION SYSTEM: clutches – power transmitted brake – Cams – gear box.

Unit IV - DESIGN OF HOISTING ELEMENTS: Welded and roller chains-Hemp and wire ropes. –Design of ropes, pulleys, pulley system, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks crane grabs-lifting magnets-Grabbing attachments-Design of arresting gear-Brakes: Shoe, band and cone types.
Unit V - CONVEYORS: Types-description-Design and applications of belt conveyors, apron conveyors and escalators pneumatic conveyors, screw conveyors and vibratory conveyors.

Reference Books:

17ME3011 INDUSTRIAL TRIBOLOGY

Credits 3:0:0

Course Objectives:
To impart knowledge on
- friction, wear and lubrication aspects of machine components
- material properties which influence the tribological characteristics of surfaces.
- analytical behavior of different types bearings and design of bearings based on analytical/theoretical approach

Course Outcomes:
Ability to
- select material/surface properties based on the tribological requirements
- identify the methodology for deciding lubricants and lubrication regimes for different operating conditions
- analyse different types of bearings for given load/speed conditions.
- Outline the methods to improve surface engineering
- Identify wear mechanisms on macro-scale in metals.
- Apply concepts of friction mechanisms and analyze performance of design components based on relative motion.

Unit I - SURFACE INTERACTION AND FRICTION: Topography of Surfaces – Surface features-Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions –Thermal considerations in sliding contact


Unit IV - THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION: Reynolds Equation,- Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings-Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing- Pressure, flow, load and friction calculations-Stiffness considerations- Various types of flow

Unit V - HIGH PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION: Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives.

Reference Books:

17ME3012 QUALITY CONCEPTS IN DESIGN

Credits 3:0:0

Course Objectives:
To impart knowledge on
- the basic concepts in Total Quality Management
- statistical process control
- reliability computation and reliability improvement

Course Outcomes:
Ability to
- apply the basic tools of quality in product development
- analyze the basic tools of quality in improving or redesigning the production process
- adopt/adapt TQM and SPC tools in product/process Industries
- conduct experiments and to analyze the significance of proceeds parameters
- compute reliability of parallel, series and mixed configurations
- improve the reliability of the systems by redundancy


Unit II - STATISTICAL PROCESS CONTROL: DMAIC process for process and design improvement, Acceptance Sampling, SPC (Statistical Process Control), Process Capability, Gage Reproducibility and Repeatability, Quality Function Deployment.

Unit II - FAILURE ANALYSIS: Failure mode effect analysis, Fault-tree analysis APQP, Embodiment checklist-Advanced methods: systems modeling, mechanical embodiment principles.


Unit V - RELIABILITY: Definition, Survival and Failure rates-Series and parallel and mixed systems-Mean time between failure, Mean time to failure,-Availability models-redundancy

Reference Books:

17ME3013 ROTOR DYNAMICS

Credits 3:0:0

Course Objective:
To impart knowledge on
- rotor dynamics phenomena with the help of simple rotor models
- behavior of fluid film lubrication and rotor bearing system in rotor system
- performance of bearings under dynamic conditions
Course Outcome:
Ability to
- apply the principles of rotor dynamics in design and analysis of mechanical components
- analyze the bearing behavior under dynamic conditions
- acquire knowledge in rotor balancing
- measure vibration and conduct dynamic analysis in rotating machine elements
- model a rotating machine element theoretically
- study the effect of vibration in rotating machinery


Unit II - INSTABILITY IN ROTATING MACHINES: Oil whip and Oil whirl-stability analysis using linearized stiffness and damping coefficients-Instability due to stream whirl and seals-Theory of Balancing of Rotors-Rigid rotor classification-Balancing criteria-Balancing of rigid rotors-Balancing of flexible rotors-Balance criteria for flexible rotors.


Unit IV - BEARING IN ROTORS: Rolling element bearings-Hydrodynamic oil lubricated journal bearing-types of hydrodynamic bearing-Reynolds equation and its basic assumptions-Basic concepts and assumptions of fluid-film bearing models-Short and long hydrodynamic radial bearings-Dynamic characteristics of fluid-film bearings-Dynamic seals and its classifications.

Unit V - SIGNAL PROCESSING AND CONDITION MONITORING IN ROTOR DYNAMICS: Vibration generating mechanism-Condition monitoring-Noise spectrum-Signal processing in rotating machineries-Measurements in rotating machineries-Real time analysis & Knowledge based (data base)-Expert systems-Display of vibration measurement instruments-Signature Analysis of Common Rotor Faults-Signature Analysis of Common Rotor Faults.

Reference Books:

17ME3014 DESIGN FOR MANUFACTURING AND ASSEMBLY

Credits 3:0:0

Course Objectives:
To impart the knowledge on:
- Product functionality, product design, product planning and assembly.
- Developing quality products by incorporating the reliability, safety functions and robustness.
- Product and process sheet using Geometric Dimensioning and Tolerancing principles

Course Outcomes:
Ability to
- reproduce the DFM principles, poka-yoke and six signam concepts in a design process in order to visualize the creative engineering thinking and analysis.
- classify the tolerance analysis methods and solve the process capabilities for various tolerance grades.
- use Geometric Dimensioning and Tolerancing principles to compare the various tolerance positions and select appropriate datum for geometric analysis and applications.
• illustrate the interchangeable part manufacture and selective assembly features and redesign of castings based on parting line considerations.
• identify and classify different datum features for geometric analysis and applications
• prepare the process drawings for different operations and apply DFM principles for environmental issues.


Unit III - GEOMETRIC DIMENSIONING AND TOLERANCING: Introduction to GD&T, ASME Y 14.5 standard - Examples for application of geometric tolerances - True Position Theory - Comparison between co-ordinate and ordinate method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples.

Unit IV - DATUM FEATURES AND SELECTIVE ASSEMBLY: Datums, datum feature, simulate datum feature, datum targets - Grouped datum system with spigot and recess, pin and hole - computation of translational and rotational accuracy, geometric analysis and applications. Interchangeable part manufacture and selective assembly, deciding the number of groups - Model-I: Group tolerances of mating parts equal; Model-II: total and group tolerances of shaft equal. Control of axial play - introducing secondary machining operations, laminated shims, examples.

Unit V - FORM DESIGN OF CASTINGS AND WELDMENTS: Redesign of castings based on parting line considerations, minimizing core requirements, redesigning cast members using weldments, form design aspects of sheet metal components. Design for the environment- Introduction - Environmental objectives - Global issues - Regional and local issues - Basic DFE methods - Design guide lines - Example application.

Reference Books:

17ME3015 MODAL ANALYSIS OF MECHANICAL SYSTEMS

Credits 3:0:0

Course Objectives:
To impart knowledge on
• modal testing methods.
• mathematical models of mechanical systems
• modal analysis of single and multi- degree of freedom systems.

Course Outcomes:
Ability to
• helps the students to get familiarized with the modal testing,
• employ modal analysis of single and multi- degree of freedom systems.
• apply suitable measurement techniques
• extract the parameters using correct method
• understand the working principle of transducer and modal analyser


Reference Books:
2. Nuno Manuel Mendes Maia et al,” Theoretical and Experimental Modal Analysis”,

17ME3016 ADVANCED MANUFACTURING PROCESSES

Credit 3:0:0

Course Objectives:
To impart knowledge on
- advanced manufacturing and material processes.
- additive manufacturing processes.
- micro machining processes.

Course Outcomes:
Ability to
- understand the types of metal forming
- compare advanced manufacturing processes.
- select the techniques for material processing.
- choose appropriate micro machining processes.
- propose additive manufacturing processes.
- identify measurement techniques in Micro machining.

Unit I - METAL FORMING: Roll forming, High velocity hydro forming, High velocity Mechanical Forming, Electromagnetic forming, High Energy Rate forming (HERF), Spinning, Flow forming, Shear Spinning.

Unit II - ADVANCED WELDING, CASTING AND FORGING PROCESSES: Friction Stir Welding – Introduction, Tooling, Temperature distribution and resulting melt flow Advanced Die Casting - Vacuum Die casting, Squeeze Casting.


Unit IV - MICRO MACHINING AND ADDITIVE MANUFACTURING PROCESSES: Diamond micro machining, ultrasonic micro machining, micro electro discharge machining. Introduction and principles,
Development of additive manufacturing Technologies, general additive manufacturing processes, powder based fusion process, extrusion based system, sheet lamination process, direct write technologies


**Reference books:**

**17ME3017 CONTROL OF CNC MACHINE TOOLS**

Credits 3:0:0

**Course objectives:**
To impart knowledge on
- CNC programming, hydraulic system.
- CNC interpolation, DDA integrator.
- CNC control loops and architecture

**Course Outcomes:**
Ability to
- Design control systems for CNC machine tool.
- Understand the principles of motors and hydraulic system
- Compare the interpolation methods in CNC control system.
- Recommend PID controllers, servo controller, Numerical control Kernel types.
- Select the components of CNC architecture.
- Propose the PLC programming Languages.

**Unit I - INTRODUCTION TO CNC SYSTEMS AND PROGRAMMING:** Introduction to CNC systems, Coordinate systems of CNC machines, Economics. CNC programming- Interpolation, CNC programming - feed, tool and spindle functions (G-codes).

**Unit II - CNC DRIVES AND CONTROLLERS:** CNC drives Hydraulic systems, servo and stepping motors, response analysis, Feedback devices and counter.

**Unit III - CNC HARDWARE AND SOFTWARE INTERPOLATORS:** CNC Interpolation - Hardware interpolators- DDA integrator, linear, circular, complete interpolators, Software interpolators, Tustin method, NURBS and polynomial interpolators, Acceleration and deceleration control techniques.

**Unit IV - CNC CONTROL LOOPS:** CNC control loops, PID control, servo controller, gain tuning, feed forward control, Mathematical analysis of control loops.

**Unit V - CNC ARCHITECTURE:** CNC Architecture - Numerical control kernel- types, PLC, programming, languages, Human-Machine Interface functions, structure, Introduction to Open CNC architecture.

**Reference books:**
17ME3018 THEORY OF METAL CUTTING

Credits: 3:0:0
Course Objectives:
To impart knowledge on
- fundamentals of metal cutting theory, the types of tool and their nomenclature
- measurement of cutting force and cutting temperature
- mechanisms of tool wear, machine tool chatter

Course Outcomes:
Ability to
- identify cutting conditions suitable for machining a component.
- Select the machine tool based on the operation to be done
- Analyse and compare the optimized cutting conditions
- Select of cutting fluid to reduce the temperature during machining
- predict the tool life by reducing the tool wear
- diagnose vibration and chatter


Unit II - TOOL NOMENCLATURE AND CUTTING FORCES: Nomenclature of single point tool - Systems of tool Nomenclature and Conversion of rake angles - Nomenclature of multi point tools like drills, milling cutters and broaches. Forces in turning, drilling and milling - specific cutting pressure- measurement of cutting forces.


Unit IV - TOOL MATERIALS, TOOL LIFE AND TOOL WEAR: Essential requirements of tool materials - Developments in tool materials-ISO specifications for inserts and tool holders-Tool life- optimum tool life - Conventional and accelerated tool life tests- Concepts of machinability and machinability index - Economics of machining

Unit V - WEAR MECHANISMS AND CHATTER IN MACHINING: Reasons for failure of cutting tools and forms of wear-mechanisms of wear - chatter in machining - Factors effecting chatter in machining - types of chatters-Mechanism of chatter based on Force Vs Speed graph, Mechanism of grinding - Various parameters affecting grinding process.

Reference books:

17ME3019 COMPUTER INTEGRATED MANUFACTURING SYSTEMS

Credits: 3:0:0
Course objectives:
To impart knowledge on
- the use of computers in the area of manufacturing
- new technology in the area of manufacturing
- artificial intelligence and expert systems in manufacturing systems
Course outcomes:

Ability to

- employ computers in the area of manufacturing to reduce manual processing
- understand group technology,
- apply computer aided process planning,
- examine Material Requirement Planning (MRP) and Enterprise Resource Planning (ERP)
- apply computer aided quality control and Flexible manufacturing systems,
- recommend Artificial intelligence and Expert systems.


Unit III - COMPUTER AIDED PLANNING AND CONTROL: Production planning and control-cost planning and control-inventory management-Material requirements planning - (ERP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology automated data collection system.

Unit IV - PRODUCTION MONITORING: Types of production monitoring systems-structure model of manufacturing process-process control & strategies direct digital control-supervisory computer control-computer in QC - contact inspection methods non-contact inspection method - computer-aided testing - integration of CAQC with CAD/CAM.

Unit V - INTEGRATED MANUFACTURING SYSTEM: Definition - application - features - types of manufacturing systems-machine tools-materials handling system computer control system - DNC systems manufacturing cell. Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS – variable mission manufacturing system. Human labor in the manufacturing system-computer integrated manufacturing system benefits. Rapid prototyping - Artificial Intelligence and Expert system in CIM.

Reference Books

17ME3020 ADVANCED METROLOGY AND MEASUREMENT SYSTEMS

Credits: 3:0:0

Course Objectives:
To impart knowledge on

- the science of measurement and measuring machines commonly used.
- limits, fits and tolerances, geometric dimensioning aspects
- the methods of acceptance test for conventional machine tools.

Course Outcomes:

Ability to

- use different measuring instruments in industries.
- utilize Geometrical Dimensioning and Tolerancing symbols and apply them in inspection and testing process.
- apply the concepts of Laser metrology in quality control.
- examine the surface roughness of workpieces from various production processes.
- choose the modern manufacturing methods using advanced metrology systems.
- recommend calibration standards towards measuring instruments.
Unit I - INTRODUCTION TO MECHANICAL MEASUREMENTS: Science of measurement: Mechanical measurement – types, measurement standards– terms used in rating instrument performance. Precision and Accuracy.

Unit II - GEAR MEASURING MACHINES: Study of Measuring Machines, gear tooth measurement-measurement of gear profile, Isometric Viewing of Surface Defects, Image Shearing Microscope for Vertical Dimensions.


Unit IV - CALIBRATION AND SURFACE ROUGHNESS MEASUREMENT: Acceptance tests for machine tools and surface finish measurements, calibration of machine tools, introduction to ball bar measurement, Measurement of surface roughness.


Reference books:

17ME3021 INDUSTRIAL ROBOTICS

Credits 3:0:0

Course Objectives:
To impart knowledge on
- components and applications of robots.
- fundamentals of Robotics and primary actuating systems.
- sensors and transducers.

Course Outcome:
Ability to
- Illustrate the developments in robotics and familiarise the basic configurations.
- Inspect various end effectors and choose right one for an application.
- Solve the kinematic and dynamic equations associated with robot configuration.
- Identify an appropriate sensor for an industrial application.
- Design a robot programme for a particular application.
- Analyse the applications of robots in various industries.

Unit I - INTRODUCTION –ROBOT: Definition and Basic Concepts (Brief History), Robot configurations. Types of Robot drives, Basic robot motions - Point to point control & Continuous path control.

Unit II - ROBOT COMPONENTS: Basic control system concepts control system analysis, Robot actuators, Types of Robot end Effectors- Grippers, Tools as end effectors.

Unit III - MANIPULATORS AND SENSORS: Coordinate transformation, Direct and Inverse kinematics, Brief Robot dynamics. Range and Proximity sensing, Touch sensing, Force and Torque sensing, Introduction to Machine vision -Sensing and digitizing, Image processing and analysis.

Unit IV - ROBOT PROGRAMMING: Methods, Languages - Capabilities and Limitation. Artificial intelligence - Knowledge representation, Search techniques.
Unit V - APPLICATION OF ROBOTS: Application of robots in Machining, Welding & Assembly Applications, Material handling, Loading and unloading Applications, Hostile and remote environment applications., Application of Robots in CIM.

Reference books:

17ME3022 ADVANCED TOOL DESIGN

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Tool design and advanced cutting tool materials.
- design of cutting tools, forming tools and jigs
- press tool design and fixtures for CNC machines

Course Outcomes:
Ability to
- select appropriate materials for tool, jigs and fixtures
- understand the requirements and challenges in the development of cutting tools.
- design Jigs and fixtures for conventional machines
- develop Jigs and fixtures for CNC machines
- design Dies and Press tools for conventional machines
- develop Dies and Press tools for CNC machines


Unit II - DESIGN OF CUTTING TOOLS: Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters


Reference books:

17ME3023 DESIGN OF FLUID POWER SYSTEMS

Credits 3:0:0

Course Objectives:
To impart knowledge on:
- Laws and governing equations for hydraulics and pneumatics with ISO symbolic representations.
- Working principles of hydraulic and pneumatic drives and develop circuits for engineering applications.
- Trouble shooting the hydraulic and pneumatic systems.

Course Outcomes:
Ability to
- Interpret the standard symbols and laws used in FPC Systems
- Infer the working principles of pumps and motors
- Identify the suitable elements of a fluid power systems for a particular application.
- Examine hydraulic circuits for an industrial application.
- Assess the optimal components of pneumatic system
- Build a logic circuit for an industrial problems.

Unit I - FLUID POWER ELEMENTS: Industrial Prime Movers, basic laws, applications, types of fluid power systems, fluid types and properties. Comparison of power systems, Fluid power symbols. fluid reservoir, cylinders, Mechanics of cylinder loading, Pressure accumulators-types, DCV, FCV, relief valve, hydraulic servo systems, Cartridge valves, Hydraulic fuses, Temperature and pressure switches, Shock Absorbers, electromechanical devices like relays and solenoids.

Unit II - HYDRAULIC PUMPS AND MOTORS: Types – design and construction, gear pumps, vane pumps, piston pumps and pump performance, numerical problems, Hydraulic Motors – Types, theoretical torque, power and flow rate, performance and numerical problems.

Unit III - DESIGN OF HYDRAULIC CIRCUITS: Reciprocation, quick return, Speed control circuits, sequencing, synchronizing circuits, clamping and accumulator circuits, press circuits and hydro-pneumatic circuit.

Unit IV - DESIGN OF PNEUMATIC CIRCUITS: Basic elements - Compressor, cylinders, DCV, FCV, other special valves, Boolean algebra, truth tables, reciprocation, quick return circuit, cascade circuits/sequencing circuits like A + B + A - B , electro-pneumatic circuits.

Unit V - INDUSTRIAL APPLICATIONS: MPL control of Fluid power circuits, fluidic elements and fluidic sensors, Basic concepts of programmable logical control, Fail-safe Circuits, Intensifier circuits, Box-sorting System, Electrical Control of Regenerative Circuit, Hydro-pneumatic circuit. Fault finding and maintenance, Trouble Shooting In Fluid Power Systems, Piping Design for Fluid Power Systems

Reference books:
17ME3024 MANUFACTURING SYSTEM AND SIMULATION

Credits: 3:0:0

Course Objective:
To impart knowledge on
- various modeling techniques.
- random number generation
- manual and computer assisted simulation techniques.

Course Outcome:
Ability to
- Create model of the real manufacturing system.
- Generate random numbers for simulation experiments
- Resolve practical problems in manufacturing sectors using simulation.
- Analyse material handling problem and to give solutions.
- Optimise the performance of a discrete system
- Verify and validate the simulation model

Unit I - BASICS OF SIMULATION: Simulation-Introduction, advantages and limitations, areas of application, systems and system environment, components of a system, discrete and continuous system, models of a system, Types of models, Discrete event system simulation, steps in simulation study

Unit II - SIMULATION OF INVENTORY AND MAINTENANCE PROBLEMS: Random number generations Random numbers generation- methods and techniques-montecarlo simulation to solve inventory problem and maintenance problem. Queuing models: Review of terminology and concepts, characteristics of queuing systems, Queuing notations, Transient and steady state behavior-long run measures of performance of queuing systems


Unit IV - MANUFACTURING SIMULATION: Simulation of manufacturing & material handling system, manufacturing models - Types and uses, material handling –Goal and performance measures-Issues in Manufacturing &Material handling simulation-case studies-Introduction to softwares-SIMFACTORY,AIM,ARENA and TAYLOR II

Unit V - VERIFICATION AND VALIDATION: Simulation experiments, Verification and validation of simulation models. –Face validity-Validation of model assumptions, validation of input-output transformation-input-output validation

Reference books:
5. Nersing Deo, ”system simulation”, Prentice Hall of India Ltd, 2007

17ME3025 ADVANCED THERMODYNAMICS

Credits 3:0:0

Course Objectives
To impart knowledge on
- application of first and second law of thermodynamics to reactive systems.
- Prediction of availability and irreversibility associated with the thermodynamic processes and Chemical availability of reactive systems
- achieving of real gas equations and multi component systems.
Course Outcomes:
Ability to
- describe first and second laws of thermodynamics to thermal systems.
- Demonstrate concept of entropy to design effective thermal systems
- Apply correlations for the important properties
- Analyze the behavior of ideal and real gas mixture
- Assess chemical thermodynamics for reacting mixtures and combustion process
- formulate the concept of kinetic theory of gasses for performing statistical analysis

Unit I - FIRST LAW OF THERMODYNAMICS: Energy balance analysis, application to closed and open systems.
Unit II - SECOND LAW OF THERMODYNAMICS: Second-law efficiency, concept of entropy, exergy analysis, availability analysis of simple cycles.
Unit III - REAL GAS BEHAVIOUR AND MULTI-COMPONENT SYSTEMS: Equations of State Compressibility, fugacity coefficient, Real gas mixtures, Ideal solution of real gases, Gibbs phase rule.
Unit IV - THERMODYNAMIC PROPERTY RELATIONS: Thermodynamic Potentials, Maxwell relations, Generalised relations for changes in Entropy, Internal Energy and Enthalpy, Cp and Cv, Clausius-Clayperon Equation, Joule-Thomson Coefficient.
Unit V - COMBUSTION: First and second law of thermodynamics applied to combustion process, heat of combustion, Adiabatic flame temperature, stoichiometry and excess air.

Reference books:

17ME3026 ADVANCED HEAT TRANSFER

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Conduction, convection, radiation, heat transfer during boiling and condensation.
- design of heat exchangers.
- principles of mass transfer.

Course Outcomes:
Ability to
- solve problems of heat transfer in complex systems by selecting appropriate choice between exact and approximate calculations.
- model heat transfer in complex internal flow systems and external flow configurations.
- design and analyze the performance of heat exchangers.
- understand the basic modeling and empirical correlations of two-phase heat transfer in boiling and condensation.
- model and solve mass transfer problems with applications varying from evaporative cooling, mass diffusion in gases.
- analyze the radiative heat exchange between surfaces and in diffuse, gray enclosures


Unit III - HEAT EXCHANGER: Types – LMTD method and the effectiveness – NTU method.


Reference books:

17ME3027 ADVANCED FLUID MECHANICS

Credits 3:0:0

Course Objectives:
To impart knowledge on
• Continuity, momentum and energy equations of fluid flow.
• Irrotational flows, flow past cylinders and Rankine body.
• Concepts of boundary layer, Prandtl mixing length, turbulent theory, universal velocity profile

Course Outcomes:
Ability to
• Choose method to describe the fluid motion.
• Solve fluid flow problems using Conservation principles.
• Analyze the forces acting on a fluid particle.
• Understand irrotational and vortex flows.
• Analyze the fluid flow over cylindrical and spherical bodies.
• Understand boundary layer formation in external and internal flows.

Unit I - FLUID FLOW: Method of describing fluid motion– Lagrangian-Eulerian Method, Local and individual time rates of change, acceleration, Eulerian and Lagrangian equation of Continuity. Bernoulli’s equation from Euler’s equation– solved problems related to liquid motion, related to equation of continuity.

Unit II - MOMENTUM AND ENERGY EQUATION: Forces and stress acting on fluid particles. Differential momentum equation, Navier Stokes Equations of Motion for simple cases in rectangular, cylindrical and spherical coordinate. Energy Equation.

Unit III - VELOCITY POTENTIAL AND STREAM FUNCTION: Irrotational motion in two dimensions, sources and sink, Complex potential due to a source, due to a doublet, Images with respect to straight line, solved problem. Vortex motion-Vortex tube, Helmholtz’s vorticity theorem, velocity potential and stream function.


Unit V - BOUNDARY LAYER PRINCIPLES: Flat plate, conduits, curved solid bodies, Blasius Solution, Prandtl mixing length turbulent theory, universal velocity profile, and momentum eddy concept – simple applications. Von Karman integral equation to Boundary layer – with and without pressure gradient.
Reference books:

17ME3028 DESIGN OF THERMAL POWER EQUIPMENT

Credits: 3:0:0

Course Objectives:
The impart knowledge on
- thermal systems used in power generation.
- design considerations for boilers heaters and condensers.

Course Outcomes:
- compare and contrast different types of boilers for power plant application
- design of boilers for power plant applications according to standards
- recognize waste heat recovery options in power plants using accessories such as economizers, super heaters, re-heaters and air pre-heaters.
- design chimney and fans for the draught system in thermal power plants.
- design condensers and cooling towers for steam power plants
- recognize significance of water and steam purification mechanisms in thermal power


Unit IV - WATER AND STEAM PURIFICATION : Chemical treatment mechanical carry over – Silica carry over gravity separation – drum internals – steam washing typical arrangements of boiler drum internal in H.P. boilers.


Reference books:
17ME3029 COMBUSTION IN ENGINES

Credits: 3:0:0
Course Objectives:
To impart knowledge on
- the combustion principles and chemical kinetics
- combustion in SI and CI engines
- combustion in gas turbine, generated pollution

Course Outcomes
Ability to
- compute air requirements and adiabatic flame temperatures.
- differentiate between laminar and turbulent combustion.
- recognize reasons for differences among operating characteristics of SI engine types and designs
- recognize reasons for differences among operating characteristics of CI engine types and designs
- compare and contrast requirements for efficient performance of gas turbines with differing configurations of combustion chambers
- develop an understanding of the combustion process, engine emissions, pollutants and their harmful effects

Unit I - COMBUSTION PRINCIPLES: Thermodynamics concepts of combustion, first law and second law of thermodynamics applied to combustion process, heat of combustion, adiabatic flame temperature, stoichiometry and excess air, combustion calculations, minimum air required for complete combustion of fuel, chemical equilibrium and dissociation.

Unit II - COMBUSTION THEORIES AND KINETICS: Theories of combustion, homogeneous and heterogeneous mixtures, laminar and turbulent flame propagation in various engines.

Unit III - COMBUSTION IN SI AND CI ENGINES: Initiation of combustion, stages of combustion, flame front propagation, factors influencing the flame speed, knocking in SI Engines, effect of engine variables on knock, combustion chambers for SI engine, stratified charge engine and heat balance test in SI engine. Various stages of combustion in CI engines, air fuel ratio in CI engines, delay period or ignition lag, variables affecting delay period, diesel knock, air swirl, general functions and characteristics of the combustion chamber, comparison of some basic design of CI Engine combustion chambers and heat balance test in CI engine.

Unit IV - COMBUSTION IN GAS TURBINE: Flame stabilization, re-circulation, requirements of the combustion chamber, combustion process, combustible fuels for gas turbines, configuration of combustion chamber.

Unit V - COMBUSTION GENERATED POLLUTANTS, MONITORING AND CONTROL: Types of combustion generated pollutants, monitoring techniques, control measures of each pollutants- its merits and demerits, present technologies in control of pollutants, harmful effects on living organisms and ecology, Indian and Euro emission norms.

Reference Books

17ME3030 ENERGY CONSERVATION AND MANAGEMENT

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- energy conservation
- energy auditing
- energy management
Course Outcomes

Ability to

- State the importance of energy conservation
- Discuss the present status of national energy scenario
- Apply various energy auditing methods
- Analyze the energy conservation areas in thermal systems
- Estimate the energy conservation areas in electrical systems
- Choose the different financial management methods

Unit I - ENERGY RESOURCES AND PATTERN: Introduction - Energy resources - Energy use patterns - Scope for conservation - World energy supply and demand - National status – Programs and decisions - Difference between energy conservation and efficiency

Unit II - ENERGY AUDITING: Importance of energy auditing - energy auditing in engineering and process industry - Types of energy auditing - Identification of areas for energy auditing


Unit V - ENERGY MANAGEMENT: Energy management principles, need for organization and goal setting - Life cycle costing and other methods - Factors affecting economics - Introduction to financial management - Simple payback period - Net present value method - Internal rate of return method.

References


17ME3031 ADVANCED INSTRUMENTATION IN THERMAL ENGINEERING

Credits: 3:0:0

Course Objectives:

To impart knowledge on

- The working of measuring instruments and errors associated with them
- error analysis and uncertainty of measurements
- the measurement and data acquisition applicable to a thermal systems

Course Outcomes:

Ability to

- identify experimental data and predict correlation
- interpret uncertainties in various measurements
- apply measurement techniques of intensive and extensive properties
- analyze specific functional characteristics of thermal instruments.
- estimate the control system parameters using analog and digital controllers
- formulate concepts to reduce errors in measurements

Unit I - MEASUREMENT CHARACTERISTICS: Introduction to measurements, errors in measurements, statistical analysis of data, regression analysis, correlation, estimation of uncertainty and presentation of data.

Unit II - MEASUREMENTS IN THERMAL SYSTEMS: Basic Electrical measurements, Transducers and its types, Measurement of temperature, pressure, velocity, flow - simple and advanced techniques.
Unit III - MEASUREMENT OF THERMO-PHYSICAL PROPERTIES: Thermal conductivity, viscosity, surface tension, specific heat capacity, radiation properties of surfaces.

Unit IV - MEASUREMENT OF FUEL PROPERTIES: Flame ionisation detector, non-dispersive infrared analyser, smoke meters, and gas chromatography.

Unit V - DATA LOGGERS: Data logging and acquisition, sensors for error reduction, elements of computer interfacing, timers and counters.

Reference books:

17ME3032 ADVANCED REFRIGERATION AND AIRCONDITIONING SYSTEMS

Credits 3:0:0

Course Objectives:
To impart knowledge on
- working principle of refrigeration and air-conditioning cycle
- components of cooling load
- air distribution system

Course Outcomes
Ability to
- identify various refrigeration and air-conditioning cycles
- estimate the performance of refrigeration and air-conditioning cycles
- analyze psychometrics processes
- evaluate the space cooling load
- design the duct
- choose the fan for the desired applications

Unit I - REVIEW OF THERMODYNAMIC PRINCIPLES: Bell Colemen cycle - vapour compression cycle - Theoretical and actual - multi stage system - cascade system - performance evaluation - COP comparison

Unit II - REFRIGERATION: Thermoelectric refrigeration - Vortex refrigeration - Steam jet refrigeration - Pulse tube refrigeration. Introduction to cryogenics - manufacture of dry ice – liquefaction of gases – Linde and Claude system.

Unit III - VAPOUR ABSORPTION SYSTEMS: Theory of mixtures, enthalpy composition diagrams, absorption system calculations, aqua ammonia systems, LiBr water system, Three fluid absorption systems, solar refrigeration system.

Unit IV - COOLING LOAD ESTIMATION IN AIRCONDITIONING SYSTEMS: Review of psychometric process - Sensible heat factor and bypass factor - RSHF, GSHF, ESHF -Cooling load estimation using ISHRAE Standards


Reference books:
17ME3033 DESIGN AND ANALYSIS OF HEAT EXCHANGERS

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- the classification of Heat exchangers
- the basic design methods of heat exchangers
- the design of Shell and tube, Compact heat exchangers

Course Outcomes
Ability to
- identify the constructional aspects of various types of heat exchangers.
- Predict the effectiveness of heat exchangers NTU method.
- Calculate the design parameters of shell-and-tube heat exchanger.
- analyze compact heat exchanger.
- Evaluate the performance of condensers.
- Formulate concepts of single and multi-effect evaporators.

Unit I - VARIOUS TYPES OF HEAT EXCHANGER: Introduction; Recuperation and regeneration; Transfer processors; Geometry of construction, tubular heat exchangers, plate heat exchangers, extended surface heat exchangers; Heat transfer mechanisms, Flow arrangements; Selection of heat exchangers.

Unit II - BASIC DESIGN METHODS OF HEAT EXCHANGERS: Arrangement of flow path in heat exchangers; basic equations in design; Overall heat transfer coefficient; LMTD and NTU methods for heat exchanger analysis, Heat exchanger design calculation, Variable overall heat transfer coefficient, Heat exchanger design methodology.

Unit III - SHELL AND TUBE HEAT EXCHANGER: Basic components-shell types, tube bundle types, tubes and tube passes, tube layout, baffle type and geometry, allocation of stream; basic design procedure of a heat exchanger-unit size, performance rating.

Unit IV - COMPACT HEAT EXCHANGER: Plate-fin heat exchanger, tube-fin heat exchangers, Heat transfer, pressure drop in finned-tube and plate-fin heat exchanger.

Unit V - CONDENSERS AND EVAPORATORS: Shell-and-tube condensers-horizontal shell-side condensers, vertical tube-side condensers, horizontal in-tube condensers; steam turbine exhaust condensers; Plate condensers; Air-cooled condensers; Direct contact condensers; Thermal design of shell-and-tube condensers, Single and multi-effect evaporators.

Reference books:

17ME3034 BIOMASS ENERGY

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- classify the biomass resources and biomass conversion processes
- construct a small size gasifier and biogas plant
- explain the alcohol production method from biomass

Course Outcomes:
Ability to
- list the thermo chemical conversion process of biomass
• design a community biogas plant
• select a biogas plant for the given application
• develop a small size biomass gasifier
• explain the application of bio-fuels
• demonstrate the power generation techniques using biomass waste

Unit I - ENERGY FROM BIOMASS: biomass resources, energy plantation, design and management of energy plantation, advantages of energy plantation, plants proposed for energy plantation, photosynthesis, biomass conversion technologies, thermo chemical conversion, direct combustion, biochemical conversion, biodegradability.

Unit II - BIOGAS GENERATION: classification of biogas plants, biogas generation, anaerobic digestion, floating drum plant, fixed dome type plant, continuous and batch type, Janta biogas plant, Deen Bandhu biogas plant, khadi and village industries type biogas plant, ferro-cement digester biogas plant, biogas from plant wastes, wet and dry fermentation, problem in straw fermentation, pilot plants using plant wastes, community biogas plants, materials used for biogas generation, additives, factors affecting bio-digestion.

Unit III - DIGESTER DESIGN: design based on methane production rate, design based on end user requirements, scaling of biogas plants, digester sizing, methods for maintaining biogas production, problems related to biogas plants, starting a biogas plant, filling a digester for starting, fuel properties of biogas, selection of site for a biogas plant.

Unit IV - UTILIZATION OF BIOGAS: modification of SI and CI engine, biogas use in stationary power plants, mobile power plants, use of biogas in refrigerators, gas turbines, economic viability of biogas technology, biogas technology scenario in India, purification, scrubbing, compression and storage of biogas, biogas burners. Gasifier: gasification process, gasification of wood, wood gas purification and shift conversion, gasification equipment, use of wood gas in engines, classification of biomass gasifiers, fixed bed gasifier, fluidized bed gasifier, applications of the gasifier, problems in development of gasifiers.

Unit V - ELECTRICITY PRODUCTION FROM BIOMASS WASTES: pyrolysis, pyrolysis yields from the dry wood, types of pyrolysis, biodiesel from vegetable oil and pyrolysis oil, use of biodiesel in engine, alcohol fuels, ethanol production from wood and sugar cane, methanol production, electricity production from municipal solid wastes, animal wastes, plant residues, pulp and paper industry wastes, distillery waste, high rate digester for industrial waste water treatment.

Reference books:

17ME3035 ADVANCED TURBOMACHINERY

Credits: 3:0:0

Course Objectives:
To impart knowledge on
• list the types of turbine, pump and compressor
• analyze the performance and efficiency of turbines, pumps and compressors.
• examine the fluid flow pattern in turbo machines
• discuss about the application of turbo machines

Course Outcomes:
Ability to
• Classify the types of turbine, pump, and compressors
• Explain the working principle of turbines, pumps and compressors
• Compare the performance of turbo machines
• Summarize the application of turbo machines
• Analyze the flow pattern in turbo machines
• Develop micro and small turbo machines

Unit I - TURBO MACHINERY: Introduction, application of pi theorem, incompressible fluid in turbo machines, effects of Reynolds Number and Mach number, energy transfer between a fluid and a rotor, Euler turbine equation, components of energy transfer, impulse and reaction turbine efficiencies.

Unit II - RADIAL FLOW PUMPS AND COMPRESSORS: head capacity relationship, axial flow pumps and compressors, degree of reaction, dimensionless parameters, efficiency and utilization factor in turbo Machinery. Centrifugal pumps and centrifugal compressors, inlet section, cavitation, NPSH, flow in the impeller channel, flow in the discharge casing, pump and compressor characteristics.

Unit III - THERMODYNAMICS OF TURBO MACHINE PROCESSES: compression and expansion efficiencies, stage efficiency, Infinitesimal stage and finite stage efficiencies.

Unit IV - FLOW OF FLUIDS IN TURBO MACHINES: flow and pressure distribution over an airfoil section, effect of compressibility, blade terminology, cascades of blades, blade spacing, radial pressure gradient, free vortex flow, losses in turbo machines.


Reference books:

17ME3036 TWO PHASE FLOW AND HEAT TRANSFER

Credits 3:0:0
Course Objectives:
To impart knowledge on
• Two phase flow and circulation in boiler
• Heat transfer with change of phase in condensation and boiling
• Fluidized beds and gas-liquid fluidization

Course Outcomes:
Ability to
• Understand vertical, horizontal and inclined two phase flow
• Determine effective pressure head in boiler tubes
• Choose various types of fluidized beds
• Evaluate heat transfer during condensation
• Analyze heat transfer with change of phase in boiling
• Explain various Gas-Liquid fluidization

Unit I - TWO PHASE FLOW: simultaneous flow of liquids and gases, horizontal two phase flow, lock hart and Martenelli procedure flow factor method, vertical two phase flow, Two phase flow through inclined pipes

Unit II - CIRCULATION IN BOILER: natural and forced circulation, effective pressure head in boiler tubes, variation of major parameters of drum during transient conditions, The hydodynamics stability of vapour – liquid system.

Unit III - FLUIDIZED BEDS: simultaneous flow of fluids and solids, dynamics of particles submerged in fluids, flow through packed bed. Fluidization, calculation of pressure drop in fixed bed, determination of minimum
fluidization velocity, Expanded bed, dilute phase, moving solids fluidization, Elutriation in fluidized Bed, Semi fluidization, applications, Pulsating column, oscillating fluidized beds.

**Unit IV - CONDENSATION AND BOILING:** Film wise condensation of pure vapours, Drop wise condensation in plated surfaces, condensation in presence of non-condensable gas, Pool boiling, Boiling in forced flow inside tubing.


**Reference books:**

17ME3037 SOLAR ENERGY UTILIZATION

**Credits:** 3:0:0

**Course Objectives:**
To impart knowledge on
- Solar energy and techniques to utilize it efficiently and cost effectively.
- Conversion of sunlight to heat for either direct usage or further conversion to other energy carriers.
- Design a solar thermal system for a given criteria.

**Course Outcomes:**
At the end of the course students will be able to
- Understanding of the available solar energy and the current solar energy conversion and utilization processes.
- Analyze performance of flat plate collectors.
- develop skills to design, model, analyze and evaluate solar thermal systems.
- Understand how photovoltaic cells operate.
- Estimate the PV array requirement for small residential and industrial applications.
- Solve simple to complex problems of solar thermal energy conversion and storage.


**Unit II - FLAT PLATE COLLECTORS:** Energy balances equation and collectors efficiency – collector performance – collector improvements, effect of incident angle, dust and shading – thermal analysis of flat plate collector and useful heat gained by the fluid - collector design – heat transfer factors

**Unit III - CONCENTRATION COLLECTORS AND REFLECTORS:** Parabolic concentrators, non-imaging concentrators, other forms of concentrating collectors. Tracking – receiver shape and orientation – performance analysis – reflectors – reflectors orientation – performance analysis.

**Unit IV - SOLAR ENERGY STORAGE:** stratified storage – well mixed storage – comparison – Hot water system – practical consideration – solar ponds – principle of operation and description of Non-convective solar pond – extraction of thermal energy application of solar ponds.

**Unit V - APPLICATIONS OF SOLAR ENERGY:** Solar electric power generation, photo voltaic cells. Solar furnace, Solar Chimney, heaters – power generation system. Tower concept – solar refrigeration system, thermo electric refrigeration system.

**Reference Books:**
Course Objectives:
To impart knowledge on
- The fundamental terms and concepts of nuclear power engineering
- The neutron life cycle, heat flow, radiation, fluidized bed reactor.
- The safety principles and methods utilized in designing, constructing and operating a safe nuclear power plant.

Course Outcomes:
Ability to
- Explain fundamental physics that applies to a broad range of nuclear technologies.
- Understand the coolant channel orificing, hot spot factors.
- Acquire knowledge on reactor hydraulics, different bed reactors.
- Determine thermal reaction equation, temperature, pressure coefficient.
- Estimate safety calculations in support of the preparation of an abbreviated Safety Analysis Report for an advanced reactor.
- Demonstrate an understanding of social, professional, and ethical issues related to the safe and wise development of nuclear science and engineering.


Unit V - SAFETY OF NUCLEAR PLANTS: Nuclear plant safety – safety systems-changes and consequences of an accident-criteria for safety.

Reference books:
17ME3039 VIBRATION LABORATORY

Credits: 0:0:1

Course objectives:
- To train students with the sensors, signal conditioning and associated instrumentation for vibration measurement
- To instruct fundamentals of digital data acquisition, signal processing, data reduction and display.
- To impart knowledge on the use of vibration measurement equipment

Course outcome:
Ability to
- study the effect of dynamics on vibrations
- be proficient with instrumentation used in vibration control tests
- understand the working principle of vibration measuring instruments
- adapt and evaluate the way to measure vibration.
- learn fundamental information about vibration phenomenon and find remedy of the vibration problems encountered in machineries.
- understand the behaviour of vibration in simple mechanical systems.

List of Experiments
1. Longitudinal Vibration for single degree of freedom system
2. Torsional vibration for single degree of freedom system
3. Forced vibration for spring mass system
4. Multiple degree of freedom system
5. Transmissibility ratio for vibration table
6. Vibration measurement using vibrometer for rotating machinery
7. Frequency measurement using Impact hammer
8. Real Time PC based vibration measurement
9. Measurement of Acoustic Emission signals
10. Real time FFT Analysis

(The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD and notify it at the beginning of each semester)

17ME3040 ADVANCED COMPUTER AIDED ENGINEERING LABORATORY

Credits: 0:0:2

Course Objectives:
To impart knowledge on
- how to prepare drawings for various mechanical components using any commercially available 3D modeling software’s
- the use of Finite Element Analysis software to solve various field problems in mechanical engineering to optimize and verify the design of machine elements.

Course Outcomes:
Ability to
- get familiarized with the computer applications in design
- prepare drawings for various mechanical components.
- model and analyze various physical problems
- select appropriate elements and give boundary conditions
- solve structural, thermal, modal and dynamics problems.
- conduct coupled structural and thermal analysis

List of Experiments:
1. Assembly of knuckle joint
2. Assembly of plummer block
3. Structural analysis of 2D Truss
4. Analysis of Bicycle frame
5. 2D static analysis of bracket
6. Thermal Analysis of 2D chimney
7. 3D Fin Analysis
8. 2-D Transient mixed boundary
9. Design optimisation
10. Velocity Analysis of fluid flow in a channel
11. Modal analysis of cantilever beam
12. Harmonic analysis of cantilever beam
13. Coupled structural and thermal analysis
14. Magnetic Analysis of solenoid actuator

(The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD and notify it at the beginning of each semester)

17ME3041 CAD/CAM LABORATORY

Credit 0:0:2
Course Objectives:
To impart knowledge on
- Usage of computers and modelling softwares in design and Manufacturing.
- Visualization of objects in three dimensions and producing orthographic views, sectional views and auxiliary views of it.
- Writing the codes for CNC VMC and Tuning centres to produce components.

Course Outcome:
Ability to
- Model the components using the commands such as extrude, revolve, fillet, hole pattern.
- Use the commands rib, chamfer, draft and 3D sketch to modify the parts
- Create an assembly model of knuckle joint and screw jack and convert them into orthographic sketches.
- Write CNC codes for linear, circular interpolation step turning ball turning and external threading.
- Write CNC codes for creating holes on components using CNC drilling machine.
- Write CNC program for creating square pockets using vertical milling centre.

List of experiments
1. 3D Modeling with Extrude, Round (Fillet) and Mirror Commands
2. 3D Modeling With Revolve, Hole Pattern Commands
3. 3D Modeling With Rib, Chamfer, Draft and 3D sketching Commands
4. Modeling, Assembly and Drafting of Knuckle Joint
5. Modeling, Assembly and Drafting of Screw Jack
6. Advanced modeling commands-Sweep and Blend (Loft)
7. Study of CNC XL Mill Trainer and CNC XL Turn trainer
8. Profile cut using linear and circular interpolation
10. Square pocketing and Drilling in a VMC/CNC drilling machine
11. Step turning and external thread cutting in a CNC lathe
12. Ball turning in a CNC turning Centre

17ME3042 HEAT TRANSFER LABORATORY

Credits: 0:0:1
Course Objectives
To impart knowledge on
- To study the heat transfer characteristics of various advanced heat transfer apparatus
- To perform design calculations of different modes of heat transfer
- To understand the behavior of two phase heat transfer system at different operating conditions

Course Outcomes
At the end of the course students will be able to
- Demonstrate skills in conducting condensation heat transfer experiment
- Demonstrate skills in finding the critical heat flux in two phase heat transfer
- Demonstrate skills in finding the nucleate pool boiling heat transfer coefficient
• Demonstrate skills in finding the performance capacity factors in air conditioning
• Analyze the properties of air and water vapour mixtures
• Analyze the performance parameters of transient heat conduction

List of Experiments
1. Drop wise and film wise condensation heat transfer
2. Investigation of lumped thermal capacitance method of transient temperature analysis
3. Determination of bypass and capacity factors in air conditioning test rig
4. Experiments on psychrometric properties of air
5. Nucleate boiling experiment
6. Critical heat flux apparatus

17ME3043 AUTOMATION AND ROBOTICS LABORATORY

Credits: 0:0:1

Course Objectives:
To impart the knowledge on
• the design of pneumatic and electro pneumatic components for automation
• components, ladder logic design, programming for PLC/Microcontroller and robot
• the configuration of robot and reconfigure them for a custom application

Course Outcomes:
Ability to
• manipulate and program the Industrial Robot
• program the Robot for Pick and place operations
• program and control the different movements of robots.
• program logic circuitss
• design electro pneumatic circuits to control sequential circuits
• write Ladder logic program to control Motors and Traffic signals

List of Experiments:
1. Pick And Place Programming Using Fanuc
2. Pick and place programming using Mini robot
3. Pick and place programming using Scara robot
4. Pneumatic AND,OR logic circuit
5. Electro-Pneumatic Circuit For Reciprocating and Dual cylinder sequential circuit
6. Logic circuit design to control traffic light signals, motor using PLC or microcontroller

Reference Books

17ME3044 ADVANCED COMPUTATIONAL FLUID DYNAMICS LABORATORY

Credits: 0:0:2

Course Objectives:
To impart knowledge on
• Finite volume Computational Fluid Dynamics codes working strategies.
• actual setting up of the problem and solution procedure
• extracting the required data, post process and compare with available data

Course Outcomes:
Ability to
• familiarize computer applications in fluid dynamics
• model and analyze various physical problems
• select appropriate mesh type and give boundary conditions
• solve heat transfer and fluid flow problems.
• extract the post processing data and compare with available data
• examine the pictorial results of the problem

List of Experiments:
1. One dimensional steady state diffusion
2. One dimensional steady state diffusion with volume source
3. One dimensional steady state diffusion with surface source
4. One dimensional unsteady heat conduction
5. Conjugate heat transfer
6. Periodic flow and heat transfer
7. Laminar flow
8. Turbulent flow
9. Flow through porous media
10. Flow around an aerofoil
11. Modelling radiation and natural convection
12. Modelling solidification process
# LIST OF COURSES

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**15ME2001 DYNAMICS LABORATORY**

**Co/Prerequisite:** Dynamics of Machinery [14ME2027]

**Credits:** 0:0:2

**Course Objective:**
To impart knowledge on
- Principle and operations of vibration based systems
- Measuring devices used for dynamic testing
- Effect of forces on various equipments based on theoretical and experimental methods

**Course Outcome:**
Ability to
- Demonstrate the parameters of vibration using single and Multi degree of freedom system
- Demonstrate the effects of forces, moments of rotary masses, governor and gyroscope.

**LIST OF EXPERIMENTS**
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

**15ME2002 CAM LABORATORY**

**Prerequisite:** Lathe Shop [14ME2012], Special Machines Laboratory [14ME2013]

**Course Objective:**
To impart knowledge on
- NC programming for CNC turning and milling operation and execution.
- Selection of tool for a machining operation.
- Simulation and verifying machining processes.

**Course Outcome:**
Ability to
- Interpret part drawing and write CNC program using G codes and simulate.
- Select Cutting tools for different machining operations and demonstrate machining the component in CNC machine tool.
LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

15ME3013 ADVANCED WELDING PROCESSES

Credits: 3:0:0

Course Objectives:
- Learn the basic principles behind the operation of advanced welding processes.
- Study the welding processes for various metals, nonmetals and dissimilar materials.
- Impart knowledge on the pre and post welding treatment processes.

Course Outcomes:
Ability to
- understand the applications of advanced welding processes.
- analyze the effects of process parameters on the quality of cast and weld products.
- select the pre and post welding treatment processes for weld components.


References:

15ME3014 POWDER METALLURGY

Credits: 3:0:0

Course Objective:
- To understand procedures for preparing powders for processing
- To understand techniques to manufacture products based on powder processing methods
- To understand powder metallurgy application in aerospace, automobile and machining materials.

Course Outcomes:
- ability to identify materials for powder metallurgy
- suggest suitable powder metallurgy processing techniques for different materials
- develop engineering parts using powder metallurgy technique

Materials for powder metallurgy, Powder manufacture and conditioning – mechanical methods, physical methods, powder conditioning, heat treatment, blending and mixing, self-propagating high-temperature synthesis (SHS), nano powder production methods, Characteristics and testing of metal powders, Powder compaction, isostatic pressing, powder rolling, forging and extrusion, explosive compaction. Sintering, finishing operations, special sintering processes, field assisted sintering, sintering of nanostructured materials. Applications.
References:

16ME1001 MECHANICAL MACHINES AND SYSTEMS

Credits: 3:0:0

Course Objective:
- To impart knowledge on mechanical machines and systems: automobile, fluid power systems, refrigeration, air conditioning, power plants, manufacturing and material handling.

Course Outcomes:

Ability to
- know the working principle of automobile Engines, flight and Power plants.
- Know the working principle of pump, refrigeration and air-conditioning.
- select appropriate metal processing methods.


References:
16ME1002 ENGINEERING DRAWING LAB

Credits: 0:0:2

Course Objective:
- To improve visualization skills and to inculcate proper understanding of the theory of projection.
- To enable students to understand various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient.
- To understand the usage of various line types, arcs and methods to draw using AutoCAD.
- To understand standard, modify, draw, layers and properties tool bars and use it to draw orthographic and isometric views

Course Outcome:
Ability to
- visualize the objects from the drawings and to apply the theory of projection and conventions to graphically represent details of engineering components.
- apply usage of various line types, arcs, and circles to draw using CAD software.
- apply, modify, draw, layers and properties tool bars and use it to draw orthographic and isometric views.

LIST OF EXPERIMENTS

Geometrical Drawing:
1. Geometrical constructions
   i) Introduction and use of drawing instruments & Lettering practice.
   ii) Construction of polygons using
       a. Semicircle and Bi-section of given side method
       b. Inscribing polygon in a circle method
       c. Special Method for Hexagon
   iii) Dimensioning practice of lines, circles, arcs using aligned and chain dimensioning systems.
2. First and third angle projections. Conversion of pictorial views into orthographic views (in first angle projection) of simple machine elements like V- block and bearing block.
3. Projection of points in different quadrants.
4. Projection of lines in first quadrant
   a. Parallel to both planes.
   b. Inclined to one plane and parallel to other.
   c. Parallel to one plane and perpendicular to other plane.
5. Projections of solids- prism, pyramid, cylinder and cone - axis parallel to one plane and perpendicular to the other plane. Parallel to both planes.
6. Introduction to Isometric projection, Isometric views of basic solids - prism, pyramid, cylinder and cone.

Computer Aided Drafting:
7. Snap, Grid, Limits, Osnap, line types and weights, text, pdf file creation and plotting
8. Modifying Commands: Erase, trim, array, lengthen, break, mirror, offset, move, copy etc.
9. Methods of Drawing lines, arcs and circles.
10. Application of lines, arcs and circles to draw simple geometries.
11. Dimensioning, hatching methods to show different materials, title block and layers.

12. Isometric view of primitive solids and combination of primitive solids.

References:

16ME1003 ENGINEERING PRACTICE

Credits: 0:0:2

Course Objective:
• Students would acquire mechanical engineering domain skill sets which are required in day-to-day life

Course Outcome:
Ability to
• apply the acquired skills for the project work
• realize the practical difficulties encountered in industries during any assembly work
• carryout simple electronic and electrical work throughout their career.
• solve simple problem related with fitting works, carpentry works and pipe fittings

LIST OF EXPERIMENTS

1 ELECTRICAL SCIENCES
1. Soldering Simple Electronics Circuits
2. Characterization of basic Electronics Devices.
3. Wiring of Tube Lights & Staircase Wiring
4. Thermocouples & application
5. Assembly of PC
6. Installation of Operating System (OS) and Disc Partitioning
7. Mechanical joining- carpentry and fitting
8. Machining and Mechanical Measurements
9. Assembly and dismantling of Centrifugal pump/vacuum cleaner / Two wheeler engine
10. Simple pipe layout connection with different fittings and valves-Plumbing
11. Physical Joining -Welding
12. Sheet metal working, smithy and Casting

Reference Books:
16ME2001 AUTOMOTIVE CHASSIS

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- constructional details and theory of important drive lines, Structural, Steering, Braking and Suspension Systems of Automobiles.
- solving problems in Steering Mechanism, Propeller Shaft, Braking and Suspension Systems.

Course Outcomes:
Ability to
- demonstrate working principle of steering ,drive line and differential systems of automotive chassis.
- design suspension systems and select wheels, tyres and rear axles for different loading conditions.
- design braking system of automobiles.


References:

16ME2002 VEHICLE DYNAMICS

Credits: 3:0:0

Course Objective:
- To impart knowledge on the application of basic principles of mechanics for carrying out dynamic analysis of vehicles.

Course Outcomes:
Ability to
- determine magnitude and frequency of free un-damped, damped and externally excited vibrating systems.
- predict passenger comfort by carrying out dynamic analysis of vehicle due to forces from tyre, wind and acceleration.
- design systems to improve vehicle stability.


References:

16ME2003 VEHICLE DESIGN AND DATA CHARACTERISTICS

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- technical specifications of an automobile.
- vehicle performance parameters and design parameters.

Course Outcomes:
Ability to
- design vehicle considering air and rolling resistance to vehicle motion and estimate power.
- analysis of performance of the vehicle with performance curves.
- Determine turning moments and gear ratios.


References:
16ME2004 VEHICLE MAINTENANCE

Credits: 3:0:0

Course Objective:
- To impart knowledge on the various methods of maintaining vehicles and their subsystems.

Course Outcomes:
Ability to
- diagnose engine systems and suggest procedures for maintenance.
- diagnose transmission systems and suggest procedures for maintenance.
- diagnose electrical subsystems and suggest procedures for maintenance.


References:
6. Vehicle Service Manuals from reputed manufacturers.

16ME2005 VEHICLE BODY ENGINEERING

Credits: 3:0:0

Course Objective:
To impart knowledge on
- the design and construction of external body of the vehicles.

Course Outcomes:
Ability to
- apply knowledge of construction of vehicle, aerodynamic, concept and paneling to various vehicle layout.
- design the passenger car body taking into consideration of forces acting on the body.
- determine methods to visualize forces acting on the body and protect the body.

References:

16ME2006 AUTOMOTIVE ENGINES

Credits: 3:0:0

Course Objective:
- To impart knowledge on the basic principles of engines used for automobiles and different systems.

Course Outcomes:
Ability to
- demonstrate the construction, principle of operation of fuel systems.
- troubleshoot problems arising from combustion, super charging, turbo-charging, cooling and lubrication systems of automotive engines.
- propose suitable testing procedure to evaluate the engine performance.


References:
16ME2007 AUTOMOTIVE TRANSMISSION

Credits: 3:0:0

Course Objective:
- To impart knowledge on the various transmission and drive line units of automobiles.

Course Outcomes:
Ability to
- demonstrate the working principles of clutch, gear box and hydrodynamic transmission.
- demonstrate the working principles of fluid-coupling and epicyclic gear boxes in automatic transmission.
- identify and select drives for transmission.


References:

16ME2008 MACHINING PRACTICE

Credit: 0:0:2
Co/Pre-requisite: Machining Processes [14ME2005]

Course Objectives:
To impart knowledge on
- basic knowledge about Metal cutting operation and execute it.
- selection of tools for machining operations.

Course Outcome:
Ability to
- demonstrate skills to machine components using Special Machines/Lathe.
- select appropriate cutting tools.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.
16ME2009 THERMAL ENGINEERING LABORATORY

Credits: 0:0:2
Co/Pre-requisite: Thermal Engineering II [14ME2016]

Course Objectives:
To impart knowledge
- working principles of various thermal equipment like air blower, reciprocating compressors, Refrigeration & Air Conditioning Systems, Boilers.
- performance of different IC engines like air cooled, water cooled, low speed, single and twin cylinder engines.

Course Outcomes:
Ability to
- demonstrate engine performance tests and estimate emission contents in the exhaust gases through emission test.
- determine the performance of different thermal equipment like air blower, reciprocating compressors, refrigeration & air conditioning systems, Boilers.

LIST OF EXPERIMENTS
The faculty member conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

16ME2010 HEAT TRANSFER LABORATORY
(Use of standard Heat and Mass Transfer data book is permitted.)

Credit: 0:0:2
Co/Pre-requisite: Heat and Mass Transfer [16ME2011]

Course Objectives:
To impart knowledge on
- conducting the heat transfer experiments and
- determining heat transfer coefficients, thermal Conductivity, emissivity and effectiveness.

Course Outcomes:
Ability to
- demonstrate experiments in heat conduction, convection and radiation
- analyze the performance of various types of heat exchangers and perform boiling and condensation experiments

LIST OF EXPERIMENTS
The faculty member conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.
16ME2011 HEAT AND MASS TRANSFER
(Use of standard Heat and Mass Transfer data book is permitted.)

Credits: 3:0:0
Prerequisite: Engineering Thermodynamics [14ME2014]

Course Objectives:
To impart knowledge on
- conduction, convection and radiation heat transfer.
- design of heat exchangers.
- basic principles of mass transfer.

Course Outcomes:
Ability to
- solve heat transfer problems by applying the principles of heat conduction, convection, radiation and mass diffusion.
- design heat exchanger systems for enhanced heat transfer performance.
- analyze and predict the flow patterns in two phase flow and heat transfer.


References:

16ME3001 NON-CONVENTIONAL MANUFACTURING PROCESSES

Credits: 3:0:0

Course Objective
- To impart knowledge on different types of non-conventional manufacturing processes.

Course Outcomes
- Ability to evaluate and select suitable manufacturing processes for specific applications.
- Apply appropriate manufacturing process for fabrication of desired component and shape.
- Develop new products by making use of new materials and processes.
Course Description:
Construction, working principle, types, process parameters, derivations, problems, merits, demerits and applications of non-conventional machining processes, non-conventional solid state welding processes, non-conventional forming processes and other non-conventional manufacturing processes such as Electrical discharge machining, Chemical machining, Ultrasonic machining for very hard fragile materials, for work pieces too flexible or slender, for intricate and highly complex shapes

Reference books

14ME1001 GEOMETRIC DRAWING

Credits: 0:0:2

Course Objectives:
To impart knowledge on
- theory of projection for improving visualization.
- dimensioning, conventions and standards related to working drawings.
- drawing and modifying lines, arcs and other geometric elements in AutoCAD and dimensioning them.
- orthographic and isometric views and use layers and hatching.

Course Outcomes:
Ability to
- demonstrate theory of projection to graphically represent engineering components and buildings.
- apply CAD tools to draw, edit and modify drawings.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:
14ME1002 WORKSHOP PRACTICE

Credits: 0:0:2

Course Objectives:
To impart knowledge on
- characterization of electronic devices and soldering techniques.
- wiring of tube lights and lights used in stair case.
- assembly and trouble shooting of PC.
- fitting, carpentry and plumbing work.

Course Outcomes:
Ability to
- demonstrate skills to carry out fitting, piping and carpentry work.
- develop simple electronic and electrical circuits.
- demonstrate skills to assemble computer hardware components.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

14ME1003 BASIC MECHANICAL ENGINEERING

Credits: 3:0:0

Course Objective:
- To impart knowledge on IC Engines, external combustion engines, boilers, power plants, metal forming, metal joining, machining process and materials.

Course Outcomes:
Ability to
- demonstrate the working principle of Engines, Boilers and Power plants.
- analyze stress and strain for ductile materials.
- select appropriate metal processing methods.


References:

14ME2001 ENGINEERING MECHANICS

Credits: 3:0:0  (Version 1.1)

Course Objectives:
To impart knowledge on
- forces acting on particle and rigid bodies.
- free body diagrams for solving problems with structural members.
- geometrical properties of surfaces and solids.
- concepts of kinematics, kinetics of particle and rigid bodies.

Course Outcomes:
Ability to
- classify system of forces and resolve the components of force system in space.
- determine centroid and moment of inertia of solids and recognize their application in mechanics.
- analyze the motion of connected bodies and apply D’Alembert’s principle.


References:

14ME2002 METALLURGY LABORATORY

Credits: 0:0:1  (Version 1.1)

Course Objective:
To impart knowledge on metallographic techniques for studying the microstructures of alloys.

Course Outcomes:
Ability to
- demonstrate the working principle of optical microscope and prepare specimens for testing.
- identify the microstructures of different types of steels, aluminum and copper.
LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2003 MATERIAL SCIENCE AND ENGINEERING
Credits: 3:0:0

Course Objective:
- To impart knowledge on materials science, the structure of alloys, crystal defects, mechanical properties, phase diagrams, and heat treatments with their effects on properties.

Course Outcomes:
- identify crystal structures of common engineering materials and defects.
- analyze failures and predict service behavior of materials for various applications.
- determine the right compositions of metals, heat treatment procedures.


References:

14ME2004 MANUFACTURING PROCESSES
Credits: 3:0:0

Course Objectives:
- To impart knowledge on principle, procedure and applications of casting and welding processes.
- principle, procedure and applications of bulk metal forming, sheet metal forming and powder metallurgy process.

Course Outcomes:
- Ability to demonstrate the principles associated with basic operations involving casting, bulk forming of materials.
- demonstrate the principles associated with basic operations welding, sheet metal and powder metallurgy of engineering materials.
- recommend the most appropriate manufacturing process and material.

References:

14ME2005 MACHINING PROCESSES

Credits: 3:0:0 (Version 1.1)

Course Objectives:
To impart knowledge on
- concept and basic mechanics of metal cutting.
- working of machine tools such as lathe, shaping, milling, drilling, grinding and broaching.
- methods of gear manufacturing and to know the working concepts of Non-conventional machining processes.

Course Outcomes:
Ability to
- determine cutting force and machining parameters through metal cutting mechanics.
- recognize metal cutting operations done through traditional and nontraditional manufacturing processes.
- identify cutting tools for different manufacturing processes.


References

14ME2006 METROLOGY AND MEASUREMENT SYSTEMS

Credits: 3:0:0 (Version 1.1)

Course Objectives:
To impart knowledge on
- concept of measurements.
- various measurement systems.

Course Outcomes:
Ability to
- recognize the need of measurement standards and apply.
- identify appropriate measurement methods and instruments to measure product dimensions, shape and surface structure.
- demonstrate handling of measuring instruments to compare the quality of products with reference standards.


References:

14ME2007 FLUID POWER CONTROL ENGINEERING

Credits: 3:0:0 (Version 1.1)

Course Objectives:
To impart the knowledge on
- components of pneumatic and hydraulic circuits.
- Design and selection of components for an industrial application.

Course Outcomes:
- apply boolean algebra for logic design of FPC circuits with standard symbols.
- demonstrate working principles and constructional details of Fluid Power Control System components and drives.
- design and develop low cost automation circuits for industrial problems.
Introduction, application and design of pneumatic, hydraulic, electro pneumatic, electro hydraulic systems
- Circuit and graphic symbols - Actuators - valves Cylinders - Energy transfer and preparation -
Measuring instruments- Equipment combinations - Electrical circuit symbols - Electro-hydraulic control
- Hydraulic circuit diagram - Electrical circuit diagram - Function diagram - Procedure for the
construction of an electro-hydraulic system - Actuation of a single-acting cylinder - Direct solenoid valve
actuation - Indirect solenoid valve actuation - Boolean basic logic functions - Actuation of a double-
acting cylinder - Hydraulic Drives - Constant and Variable delivery types, gears, vane and piston pumps
- linear motor cylinder and piston drives - Hydraulic and pneumatic Circuits - Reciprocation - quick
return - sequencing - synchronizing - clamping and accumulator circuits - press circuits - fluidic
elements - Fluidic sensors

References:
1997.

14ME2008 FOUNDRY, SMITHY, WELDING AND SHEET
METAL LABORATORY

Credits: 0:0:2

Course Objectives:
To impart knowledge on
- principles and procedures of casting, welding, forming processes.
- handling tools and equipment for casting, welding and forming processes.

Course Outcome:
- Demonstrate process plans for components made of casting, welding and sheet metal processes.
- Select tools and equipment for casting, welding and sheet metal parts and produce.

LIST OF EXPERIMENTS
The faculty member conducting the Laboratory will prepare a list of 12 experiments and get the approval
of HoD/Director and notify it at the beginning of each semester.

14ME2009 METROLOGY LABORATORY

Credits: 0:0:1

Course Objectives:
To impart knowledge on
- working principles of linear and angular measuring instruments.
- measurement of linear and angular dimensions of a typical work piece specimen using the
measuring instruments.
- methods of form measurements.

Course outcomes:
Ability to
- measure product dimensions, shape and surface structure using appropriate measurement methods
and instruments.
• demonstrate measurement of linear and angular dimensions of a work-piece.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2010 FLUID POWER CONTROL AND MECHATRONICS LABORATORY
Credits: 0:0:2 (Version 1.1)
Course Objectives:
To impart knowledge on
• fluid power and Mechatronics systems and primary actuating systems.
• programming skills in Programmable logic controllers.
• pneumatics and hydraulics systems.
Course Outcomes:
Ability to
• apply boolean algebra for logic design of FP circuits using standard symbols.
• design and develop low cost automation circuits for industrial problems.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2011 CAM LABORATORY
Credits: 0:0:1 (Version 1.1)
Prerequisite: Lathe Shop [14ME2012], Special Machines Laboratory [14ME2013]
[OR] 16ME2008 Machining Practice

Course Objectives:
To impart knowledge on
• NC programming for CNC turning and milling operation and execution.
• selection of tool for a machining operation.
• simulation and verifying machining processes.
Course Outcomes:
• demonstrate the working principles of CNC machine.
• produce components from CNC programs using G codes and M codes.

LIST OF EXPERIMENTS
The faculty member conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.
14ME2012 LATHE SHOP

Credits: 0:0:1

Course Objective:
- To impart knowledge on various operations on Lathe.

Course Outcomes:
- Demonstrate skills to machine components in lathe.
- Select appropriate cutting tools.

LIST OF EXPERIMENTS
The faculty member conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2013 SPECIAL MACHINES LABORATORY

Credits: 0:0:1

Prerequisite: Lathe Shop [14ME2012]

Course Objectives:
To impart knowledge on
- basic knowledge about metal cutting operation and execute it.
- selection of tools for machining operations.

Course Outcome:
- Demonstrate skills to machine components using special machines.
- Select appropriate cutting tools.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2014 ENGINEERING THERMODYNAMICS

(Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart are permitted)

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- basic concepts of engineering thermodynamics.
- first and second law of thermodynamics, properties of pure substances, gas mixtures and psychrometry.

Course Outcomes:
Ability to
- apply the concept of entropy to design thermal systems.
- determine steam quality using steam tables and Mollier chart and properties of Gas mixtures.
- analyze psychrometric processes.

Microscopic and macroscopic approach, modes of work, zeroth law of thermodynamics - First law of thermodynamics - application to closed and open systems. Kelvin’s and Clausius statements of second law, reversibility and irreversibility, Carnot cycle, concept of entropy, availability. Thermodynamic properties of pure substances in solid liquid and vapour phases. Properties of ideal and real gases, Vander

References:

14ME2015 THERMAL ENGINEERING I
Credits: 3:0:0
Prerequisite: Engineering Thermodynamics [14ME2014]

Course Objectives
To impart knowledge on
- steam generators, nozzle, turbine.
- air compressors, refrigeration systems.

Course Outcomes:
Ability to
- analyze the performance of a steam generator and steam nozzles
- determine the efficiency of the impulse and reaction turbine using velocity triangles
- evaluate the efficiency of a reciprocating compressor and demonstrate the working principle of refrigeration systems


References:
14ME2016 THERMAL ENGINEERING II
(Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant, property tables are permitted.)

Credits: 3:0:0
Prerequisite: Engineering Thermodynamics [14ME2014]

Course Objectives:
To impart knowledge on
- testing and performance of IC Engines.
- various Gas Power cycles.

Course Outcomes:
Ability to
- evaluate the performance of an internal combustion engine and various gas power cycles.
- analyze gas turbines cycles and compare the operational aspects of jet engines.
- determine cooling loads in air-conditioning systems.


References:

14ME2018 POWER PLANT ENGINEERING

Credits: 3:0:0

Course Objective
- To impart knowledge on various power generating systems.

Course Outcomes:
Ability to
- demonstrate the working principles of conventional and unconventional power plants.
- predict the fixed and operating costs of power plants.
- identify and solve environmental hazards of various power plants.

plant. Power plant economics - load curve - fixed and operating costs - comparison of economics of various power plants - energy audit.

References:

14ME2019 HEAT AND MASS TRANSFER
(Use of standard Heat and Mass Transfer data book is permitted.)

Credits: 3:1:0
Prerequisite: Engineering Thermodynamics [14ME2014]

Course Objectives:
To impart knowledge on

- conduction, convection and radiation heat transfer.
- design of heat exchangers.
- basic principles of mass transfer.

Course Outcomes:
Ability to

- solve heat transfer problems by applying the principles of heat conduction, convection, radiation and mass diffusion.
- design heat exchanger systems for enhanced heat transfer performance.
- analyze and predict the flow patterns in two phase flow and heat transfer.


References:
14ME2020 THERMAL ENGINEERING LABORATORY

Credits: 0:0:1
Co/Prerequisite: Thermal Engineering I [14ME2015]

Course Objective:
- To impart knowledge on working principles of various thermal equipments like air blower, reciprocating compressors, Refrigeration & Air Conditioning Systems, Boilers.

Course Outcomes:
- apply thermal engineering concepts to find solutions in thermal systems.
- determine the performance of different thermal equipment like air blower, reciprocating compressors, refrigeration & air conditioning systems, Boilers.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2022 HEAT TRANSFER LABORATORY
(Use of standard Heat and Mass Transfer data book is permitted.)

Credits: 0:0:1
Prerequisite: Heat and Mass Transfer [14ME2019]

Course Objective:
- To impart knowledge on conducting the heat transfer experiments and practically learns how to find heat transfer coefficients, thermal Conductivity, emissivity and effectiveness.

Course Outcomes:
- demonstrate heat conduction, convection and radiation through experiments.
- analyze the performance of various types of heat exchangers and perform boiling and condensation experiments.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2023 INTERNAL COMBUSTION ENGINES LABORATORY

Credits: 0:0:1
Co/Prerequisite: Thermal Engineering II [14ME2016]

Course Objective:
- To impart knowledge on the performance of different IC engines like air cooled, water cooled, low speed, single and twin cylinder engines.

Course Outcomes:
- demonstrate engine performance tests.
- estimate emission contents in the exhaust gases through emission test.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.
14ME2025 COMPUTER AIDED DESIGN AND MANUFACTURING

Credits: 3:0:0 (Version 1.1)

Course Objectives:
To impart knowledge on
- the application of computer in the design and manufacturing.
- graphical elements used in CAD/CAM.
- computer numerical programming.

Course Outcomes:
Ability to
- develop algorithms for display of graphic entities.
- apply principles of geometric modeling for 2D and 3D modeling.
- prepare part programs for machining of components in CNC machines.


References:

14ME2026 MECHANICS OF MACHINES

Credits: 3:1:0 (Version 1.1)

Prerequisite: Engineering Mechanics [14ME2001]

Course Objectives:
To impart knowledge on
- linkages, mechanisms and cams.
- principles involved in the displacement, velocity and acceleration at any point in a link of a mechanism.
- concepts of toothed gearing and kinematics of gear trains.
- the effects of friction in motion transmission and in machine components.

Course Outcomes:
- determine mobility, position, velocity and acceleration of links in mechanism.
- design cam motion profiles, for different types of follower mechanisms.
- analyze gear trains and design transmission devices considering friction.


References:

14ME2027 DYNAMICS OF MACHINERY

Credits: 3:1:0
Prerequisite: Mechanics of Machines [14ME2026]

Course Objectives:
To impart knowledge on
- analysis of forces acting in mechanisms.
- effects of unbalance forces
- modeling and analyzing the vibration behavior of spring mass damper system
- the principles in mechanisms used for governing of machines.

Course Outcome:
- analyze the effect of static and dynamics forces on linkages
- analyze the dynamics of rotary and reciprocating masses in engines and subsystems - flywheels, governors and gyroscopes.
- determine vibration parameters of SDOF systems and study their effects

References:

14ME2028 DESIGN OF TRANSMISSION SYSTEMS
(Use of Design Data Book is permitted)

Credits: 3:0:0
Prerequisite: Design of Machine Elements [14ME2029]

Course Objectives:
To impart knowledge on
- concepts, procedures and the data, to design and analyse machine elements in power transmission systems.
- specification and selection of mechanical components for transmission systems.

Course Outcomes:
Ability to
- apply basic engineering principles and procedures to design the transmission elements.
- select appropriate engineering design data from standard data books for the design of mechanical transmission components.
- design the transmission systems components for given conditions using Design data hand book.


References:

Hand Book
Course Objectives:
To impart knowledge on
- applying elementary design principles and basic design procedures for design of machine elements.
- handling and interpreting design data for the design of mechanical elements.

Course Outcome:
Ability to
- analyze stresses acting on components and determine the size based on theories of failure.
- design machine components for a given load condition using design data handbooks.
- follow standards as per design data handbooks and select standard components to improve interchangeability.


References:
LIST OF EXPERIMENTS
The faculty member conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2032 MACHINE DRAWING

Credits: 0:0:2 (Version 1.1)

Course Objectives:
To impart knowledge on
- representing engineering components with the help of professional drawings.
- Orthographic views and cross sections of machine parts.
- Combine parts to develop assembly drawings.

Course Outcomes:
Ability to
- prepare part drawings according to drafting standards and specify appropriate tolerances for machine design applications.
- develop sectional views of machine components and construct assembly drawings.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:
4. Revised IS codes; 10711, 10713, 10714, 9609, 1165, 10712, 10715, 10716, 10717, 11663, 11668, 10968, 11669, 8043, 8000.

14ME2036 MECHANICAL VIBRATIONS

Credits: 3:0:0 (Version 1.1)
Prerequisite: Dynamics of Machinery [14ME2027]

Course Objectives:
To impart knowledge on
- modeling a vibratory system to find its response.
- analyzing the vibration behavior of mechanical systems under different types of loading.
- importance of vibration and methods of reducing unwanted vibration.

Course Outcome:
Ability to
- formulate mathematical models of problems in vibrations using Newton's second law or energy principles.
- solve for the motion and the natural frequency for free, forced vibration of un-damped motion and damped motion.
- recognize and apply vibration and Noise control strategies.

Relevance and need of vibrational analysis - Mathematical modelling of vibrating systems -Types of vibrations - single degree of freedom systems for free and forced vibration. Damped free vibration -

References

14ME2038 TRIBOLOGY IN DESIGN

Credits: 3:1:0
Prerequisite: Design of Machine Elements [14ME2029].

Course Objectives:
To impart knowledge on
- the application of basic theories of friction, wear, and lubrication.
- frictional behavior of commonly encountered sliding interfaces.

Course Outcomes:
Ability to
- interpret tribological characteristics.
- classify types of wear of metals, ceramic and polymers.
- improve the performance of mechanical components using lubricants, coatings and surface modification.

Introduction, surface topography, Hertzian contact, friction - stick slip motion - measurement of friction, wear - simple theory of sliding wear mechanism of sliding wear of metals - abrasive wear - materials for adhesive and abrasive wear situations - corrosive wear - surface fatigue wear situations, hydrodynamic lubrication hydrostatic lubrication, elasto-hydrodynamic lubrication, boundary lubrication, lubricants - study of types of oils and grease used in automobiles and general mechanical industry - surface modification, latest technologies in surface modification. Mechanical dynamic tribology and testing methods - simple tribological mechanical dynamic test machines and test methods, dry sand - rubber wheel test, wet sand rubber wheel test, slurry abrasivity test, solid particle erosion test, pin-on-disk wear test, rolling wear test, drum wear test, drill wear test.

References:
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14ME3043 INSTRUMENTATION AND ERROR ANALYSIS

Credits 3:0:0

Course Objectives
To import knowledge on
- kinds of errors and uncertainty
- types of fluid flow and flow measuring devices
- temperature measuring devices and calibration methods
- solar radiation measuring instruments and solar collectors
- data acquisition and processing systems

Course Outcome
Ability to
- describe the kinds of errors and uncertainty
- analyze the types of fluid flow
- explain the temperature measuring instruments
- choose the solar collector for a particular application
- make use of data acquisition and processing systems

Review of static and dynamic measurements, kinds of errors and uncertainty analysis, planning the experiments from error analysis, flow Measurements - pitot tubes, rotameter, orifice meter, venturimeter, magnetic flow meter, flow visualization methods, holographic flow motors, NMR flow meter, temperature measurements - thermocouples, transient response of thermal systems, calibration methods, temperature controller, gas composition analysis - gas chromatography, thermal conductivity detector, mass spectrometer, pressure measurements - manometers, pressure gauges, data acquisition and processing, analysis of experimental data, solar radiation measurements, solar collectors, pH meter, elemental analyzer, gas calorimeter.

Reference Books

15ME3001 VIBRATION LABORATORY - I

Credits: 0:0:1

Course Objectives:
To impart knowledge on
- Fundamentals of mechanical vibrations
- Use of vibration measurement equipments

Course Outcomes:
Ability to
- Determine the parameters of free, forced and torsional vibrations
- Measure vibration characteristics using instruments

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.
Course Objectives:
To impart knowledge on
- Rotor dynamics phenomena with the help of simple rotor models
- Behavior of fluid film lubrication and rotor bearing system in rotor system
- Performance of bearings under dynamic conditions

Course Outcomes:
Ability to
- Apply the principles of rotor dynamics in design and analysis of mechanical components
- Diagnose vibration of bearings considering rotor dynamics
- Measure vibration and conduct dynamic analysis in rotating machine elements

Description:

References:
15ME3003 MODAL ANALYSIS OF MECHANICAL SYSTEMS

Credits: 3:0:0

Course Objectives:
To impart knowledge
- Modal testing and modal analysis of single-degree of freedom systems
- Modal testing and modal analysis of multi-degree of freedom systems
- Techniques used for estimation of modal parameters.

Course Outcomes:
Ability to
- Perform modal analysis of single and multi-degree of freedom systems
- Excite and measure vibration parameters of structural members
- Extract modal parameters of components using different techniques

Description:

References:
15ME3004 NUCLEAR POWER ENGINEERING

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Principles and methods in designing, constructing and operating a safe nuclear power plant.
- Fundamental concepts of nuclear power engineering.
- Safety of nuclear power plants.

Course Outcomes:
Ability to
- Apply the concepts of nuclear physics for power generation
- Design power plants and reactor systems
- Suggest safety systems and shielding methods in nuclear power plant

Description:

References:
15ME3005 SOLAR ENERGY UTILIZATION

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Solar radiation and its measurement.
- Classification and analysis of solar collectors.
- Applications of solar energy.

Course Outcomes:
Ability to
- Estimate solar radiation flux using different techniques.
- Analyze the performance of solar collectors.
- Design solar energy storage systems.
- Suggest methods for using solar energy for various applications.

Description:

References:
15ME3006 DESIGN OF FLUID POWER SYSTEMS

Credits: 3:0:0

Course Objectives:
To impart knowledge on:
- Laws and governing equations for hydraulics and pneumatics with ISO symbolic representations.
- Working principles of hydraulic and pneumatic drives and develop circuits for engineering applications.
- Trouble shooting the hydraulic and pneumatic systems.

Course Outcomes:
Ability to
- Identify the components and apply symbolic notation in a fluid power system.
- Select and suggest hydraulic and pneumatic drives for an engineering application.
- Design and develop pneumatic, hydraulic and PLC circuits for automation

Description:

References Books:
15ME3007 ADVANCED TOOL DESIGN
(Use of Design Data Book is permitted)

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Concepts, procedures to design cutting tools, work holding and tool holding devices.
- Standard parts in design.
- Tooling requirements for CNC machine tools

Course Outcomes:
Ability to
- Select suitable materials, components and standards for the design of jigs, fixtures and tools.
- Design jigs, fixtures, gages and tools using data books
- Design tooling for CNC machine tools.

Description:

References:
15ME3008 ADVANCED INSTRUMENTATION IN THERMAL ENGINEERING

Credits 3:0:0

Course Objectives:
To impart knowledge on
- Advanced instrumentation, experimental methods and measurement techniques.
- Operation and specific functional characteristics of thermal instruments.
- Analytical calculations and their uncertainties which may arise in the various instruments and their measurement techniques.

Course Outcomes:
Ability to
- Analyze experimental data and predict correlation
- Quantify uncertainties and errors in various measurements
- Apply measurement techniques of intensive and extensive properties

Description:
Introduction to measurements, Errors in measurements, Statistical analysis of data, Regression analysis, correlation, estimation of uncertainty and presentation of data. Measurement of field quantities like temperature, pressure, velocity by intrusive and non-intrusive techniques. Measurement of derived quantities like heat flux, volume/mass flow rate, temperature in flowing fluids. Measurement of thermo-physical properties such as thermal conductivity, viscosity, surface tension, specific heat capacity, radiation properties of surfaces. Computer assisted data acquisition, analysis of experimental data presentation.

References:
15ME3009 ADVANCED REFRIGERATION AND AIR-CONDITIONING SYSTEMS

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Types and applications of refrigeration systems.
- Psychrometry concepts and applications of air-conditioning systems.
- Air distribution systems.

Course Outcomes:
Ability to
- Apply thermodynamic principles to various refrigeration cycles
- Design refrigeration and air-conditioning systems.
- Analyze fan and duct system

Description:

References:
15ME3010 DESIGN AND ANALYSIS OF HEAT EXCHANGERS

Credits: 3:0:0

Course objectives:
To impart knowledge on
- Construction of heat exchangers and applications of heat exchangers
- Design and analysis of heat exchangers
- Performance of heat exchangers

Course outcomes:
Ability to
- Select and design the heat exchanger for a particular application
- Determine the size and rating of a heat exchanger
- Design evaporator, condenser and cooling tower specific to an application

Description:

References:
15ME3011 ADVANCED TURBO MACHINERY

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Working principle of pumps, compressors, fans, and turbines
- Application of turbo machines
- Performance of pumps, compressors, fans, and turbines

Course outcomes:
Ability to
- Determine flow velocity in pumps and compressors
- Select pump and compressor for a particular application
- Analyze the performance of pumps, compressors, fans, and turbines

Description:
Classification of turbo machinery, Euler’s equation, blade terminology, radial and axial flow pumps and compressors, degree of reaction, dimensionless parameters, effects of Reynolds Number and Mach number, compressor and pump efficiencies, losses in turbo machines—cavitations, pumps and compressors characteristic curves, types of fan, efficiencies, classification of steam turbine, compounding of turbine, performance of steam turbine, classification of hydraulic turbines, specific speed, governing, efficiencies, performance and characteristic curves, types of gas turbine, performance, characteristic curves.

References:
Course Objectives:
To impart knowledge on
- Two phase flow pattern maps.
- Computational modeling of two phase flow
- Thermodynamics of boiling and condensation.

Course Outcomes:
Ability to
- Analyze two phase flow patterns for horizontal and vertical systems.
- Apply analytical tools for design and performance assessment of two-phase devices
- Determine critical heat flux and burn out condition for pool and flow boiling

Description:
Introduction: Two phase flow pattern maps for horizontal and vertical systems: Governing equations for homogeneous, drift-flux, particle trajectory and two-fluid models; Analyses of two phase flow regimes; Introduction to computational modeling; Measurement of two-phase flow parameters Thermodynamics of boiling; pool, flow boiling: onset of nucleation, heat transfer coefficients, critical heat flux, effect of sub-cooling; post burnout heat transfer. Condensation.

References:
14ME3001 COMBUSTION IN ENGINES (V-1.1)

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Combustion principles and chemical kinetics.
- Combustion in SI and CI engines.
- Combustion in gas turbine.

Course Outcomes:
Ability to
- Interpret the concept of combustion and recognize their applications in IC engines and gas turbines.
- Recommend appropriate measures for minimizing combustion generated environment pollution.
- Build energy efficient combustion equipment/ gadgets which satisfy the prevailing emission standards

Description:
Principles and Thermodynamics concepts of combustion, Combustion calculations, Chemical equilibrium and dissociation, Chemical kinetics, Theories of combustion, types of flames, combustion generated pollutants, Combustion in SI and CI engines, Knock, Delay period, Ignition lag, Heat balance, Combustion chamber design, Combustion in gas turbines, Various configurations of gas turbine combustion chambers.

References:
14ME3002 ADVANCED THERMODYNAMICS (V-1.1)

Credits 3:0:0

Course Objectives:
To impart knowledge on
- Entropy, availability, thermodynamic relations
- Combustion process
- Kinetic theory of gases

Course Outcomes:
Ability to
- Apply first and second laws of thermodynamics to thermal systems.
- Analyze the behavior of ideal and real gas mixture
- Apply chemical thermodynamics for reacting mixtures

Description:

References:
14ME3003 ADVANCED FLUID MECHANICS (V-1.1)

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Continuity, momentum and energy equations of fluid flow.
- Irrotational flows, flow past cylinders and rankine body.
- Concepts of boundary layer, prandtl mixing length, turbulent theory, universal velocity profile

Course Outcomes:
Ability to
- Apply continuity equation to solve numerical flow problems
- Apply momentum equation to determine velocity distribution in the fluid flow
- Apply energy equation to determine the temperature distribution in the fluid flow
- Analyze flow using boundary layer theory

Description:

References:
Course Objectives:
To impart knowledge on
- Design of boiler, furnace, condenser and cooling tower
- Boiler performance and their accessories
- Water and steam purification methods and equipments

Course Outcomes:
Ability to
- Design boilers, furnaces, condensers and cooling towers
- Design economizer, super heater, reheater and analyse their performance
- Design air preheater, draft system and chimney

Description:

References:
Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Application of computers in manufacturing.
- Computer assisted materials requirement planning and production monitoring systems.
- Automatic material handling systems and flexible manufacturing systems.

Course Outcomes:
Ability to
- Integrate planning, scheduling and monitoring the manufacturing activities of a plant
- Apply computer assisted techniques for carrying-out process planning, inventory and quality control.
- Suggest modern manufacturing systems for automated production

Description:

References:
Course Objectives:
To impart knowledge on
- Use of computer in mechanical engineering design.
- Surface and solid modeling techniques.
- Advanced modeling concepts.

Course Outcomes:
Ability to
- Represent geometric entities mathematically.
- Apply algorithms to perform operations such as transformations on geometric entities
- Use advanced modeling techniques in product design.

Description:

References:
14ME3007 ENGINEERING MATERIALS AND APPLICATIONS  (V-1.1)

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Structure and composition and behavior of Metals
- Principles of design, selection and processing of materials

Course Outcomes:
Ability to
- Select materials based on specific properties.
- Interpret material properties used in various applications
- Identify the failure behavior of materials.

Description:

References:
Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Potential applications of strength of materials.
- Material behavior under various stress conditions.
- Development of stresses depending upon material shape and wall thickness.
- Development of stresses under various loading conditions.

Course Outcomes:
Ability to
- Determine stress conditions of engineering structures and components
- Analyze structural members subjected to torsion and bending loads
- Analyze cylinders subjected to static and cyclic loading

Description:
Introduction to potential applications of strength of materials, methods of analysis. Introduction to theory of elasticity, concept of stress, and their relationships. Material behaviour under various stress conditions. Torsion in circular, non–circular, rectangular cross sections and in thin–wall sections.. Bending behaviour of beams depending upon their cross sections, curvature and elasticity of foundations. Energy methods– Castigliano’s Theorem, Methods of virtual work, Stress and strain in cylinders depending upon their wall thickness. Materials under static and cyclic loading.

References:
14ME3011 COMPUTER AIDED ENGINEERING LABORATORY (V-1.1)

Credits: 0:0:2

Course objectives:
To impart knowledge on
- Software tools like NASTRAN and ANSYS for Engineering Simulation.
- Application of the tools in various fields of engineering.

Course outcome:
Ability to
- Create geometries and mesh using software packages
- Apply knowledge of engineering (structural, thermal and fluids) to solve engineering problems
- Analyze and document results

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME3016ADVANCED METROLOGY (V1.1)

Credit 3:0:0

Course Objectives:
To impart knowledge on
- Science of measurement and measuring machines commonly used.
- Limits, fits and tolerances, geometric dimensioning aspects
- Methods of acceptance test for conventional machine tools.
- Concepts of Laser metrology and surface roughness.

Course Outcomes:
Ability to
- Use measuring instruments.
- Perform acceptance test for machine tools using conventional and modern techniques
- Represent part features using standards, geometrical dimensioning and tolerancing symbols.

Description:

References:
14ME3017 ADVANCED HEAT TRANSFER LABORATORY (V-1.1)

Credits: 0:0:1

Course Objective:
To impart practical skills in conducting and analyzing heat transfer experiments

Course Outcomes:
Ability to
- Analyze heat transfer systems
- Measure heat transfer parameters using measurement techniques
- Predict uncertainties in the heat transfer systems.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME3018 AUTOMATION AND ROBOTICS LABORATORY (V-1.1)

Credits: 0:0:2

Course Objectives:
To impart knowledge on
- Designing pneumatic and electro pneumatic components for automation.
- Components, ladder logic design, programming for plc/microcontroller and robot configuration of robot and reconfigure them for a custom application

Course Outcomes:
Ability to
- Select fluid power control components and design circuits for automating applications.
- Write PLC programs for industrial automation
- Configure and operate robots for practical applications.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.
Course Objectives:
To impart knowledge on
- Conduction, convection, radiation, heat transfer during boiling and condensation.
- Design of heat exchangers.
- Principles of mass transfer.

Course Outcomes:
Ability to
- Apply the principles of conduction, convection and radiation to thermal systems
- Analyze heat transfer performance of thermal systems
- Determine flow patterns for two phase flow.

Description:

References:
14ME3023 DESIGN OF MECHANICAL SYSTEM ELEMENTS (V-1.1)

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Working principles, operation and applications of various mechanical transmissions systems and pressure vessels.
- Design of mechanical elements.

Course Outcomes:
Ability to
- Analyze the behavior of material handling equipment under dynamic load conditions.
- Apply engineering principles and procedures to design pressure vessels.
- Design automotive transmission systems and material handling elements based on the requirements.

Description:

References:
14ME3024 DESIGN FOR MANUFACTURING AND ASSEMBLY (V-1.1)

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Product functionality, product design, product planning and assembly.
- Developing quality products by incorporating the reliability, safety functions and robustness.

Course Outcomes:
Ability to
- Represent part features according to geometrical dimensioning and tolerancing principles
- Design components considering constraints of manufacturing processes
- Apply principles of DFA to increase manufacturing efficiency in assembly processes.

Description:
Design principles for manufacturing: mechanisms and selection, Process capability – Feature and geometric tolerances, assembly limits and Datum Features. Form design: Principle, Factors, Material and manufacture design, Design for machining consideration: drills, milling cutters, keyways and counter sunk screws, simplification by separation and amalgamation– Design for machinability, economy, clampability, accessibility and assembly. Design for casting and welding considerations: Redesign of castings based on parting line, core requirements and machined holes, Redesign of weld members based on different factors and considerations, Redesign for manufacture and case studies: Design for Assembly Automation, group technology – Design for reliability and safety, Robust and quality design.

References:
Course Objectives:
To impart knowledge on
- Various modeling techniques and assembly lines.
- Manual and computer assisted simulation techniques.

Course Outcomes:
Ability to
- Represent manufacturing systems by models
- Design and evaluate different manufacturing systems using simulation.
- Simulate job shop system and queuing system

Description:

References:
Course Objectives:
To impart knowledge on
- Understand the fundamentals of kinematics
- Analyze four-bar mechanisms.
- Synthesize mechanisms and manipulators

Course Outcomes:
Ability to
- Determine degrees of freedom of multi-loop kinematic chains.
- Derive position, velocity and acceleration equations of four bar mechanisms.
- Determine forces at joints and supports of simple mechanisms.
- Analyze mechanisms by applying Denavit-Hartenbarg parameters.

Description:

References:
14ME3027 INDUSTRIAL TRIBOLOGY (V-1.1)

Credits 3:0:0

Course Objectives:
To impart knowledge on
Application of basic theories of friction, wear, and lubrication to predictions about the frictional behavior of commonly encountered sliding interfaces.

Course Outcomes:
Ability to
- Apply the principles of friction, wear and lubrication for engineering applications.
- Identify and analyze friction and wear-related problems
- Suggest methods to solve friction and wear related problems

Description:

References:
3. J. A. Williams, Engineering Tribology, Cambridge University Press, 2005
14ME3028 ADVANCED MECHANICAL VIBRATIONS (V-1.1)

Credits: 3:0:0

Course objectives:
To impart knowledge on
- Formulating mathematical model for vibration problems
- Skills in analyzing the vibration behavior of mechanical systems subjected to loading
- Vibration control and the equipment used for collecting response data.

Course outcomes:
Ability to
- Formulate equations of motion of vibratory systems.
- Solve vibration problems with multiple degrees of freedom.
- Suggest methods to regulate vibration
- Acquire data from vibration measuring instruments

Description:

References:
14ME3030 INDUSTRIAL ROBOTICS (V-1.1)

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Components, sensing elements used programming techniques and Applications of robots.
- Fundamentals of Robotics and primary actuating systems, sensors and transducers.

Course Outcomes:
Ability to
- Design feedback systems for control of robots
- Apply forward and reverse kinematics to determine position of manipulators
- Select end effectors and sensing systems for robots employed in industrial applications.

Description:

References:
14ME3033 ENGINEERING PRODUCT DESIGN AND DEVELOPMENT STRATEGIES (V-1.1)

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Important practices followed during designing and developing a product in industries.
- Product life cycle right from its conceptual stage to its development stage.
- Various concepts like modelling, simulation, material selection and GD & T.

Course Outcomes:
Ability to
- Follow appropriate methodology to design components.
- Make use of technologies like CAD, CAM and CAE in designing and developing a product
- Improve the quality of the design of the final product.

Description:

References:
14ME3034 CONTROL OF CNC MACHINE TOOLS (V-1.1)

Credits: 3:0:0

Course Objectives:
To familiarize the students about functioning of CNC machine tool from the control point of view.

Course Outcomes:
Ability to
- Recognize functions of the CNC control systems.
- Design control systems for CNC machines.
- Design and implement interpolators for CNC systems

Description:

References:
14ME3036 BIOMASS ENERGY (V-1.1)

Credits 3:0:0

Course Objectives:
To impart knowledge on
- Thermal biomass conversion and biological pathways.
- Power generation techniques.
- Design, selection, construction and operation of biogas plants.

Course Outcomes:
Ability to
- Analyze biomass conversion process for better yield
- Design of bio-mass systems considering economic and environmental aspects.
- Apply biomass energy systems for practical applications.

Description:

References:
14ME3037 QUALITY CONCEPTS IN DESIGN (V-1.1)

Credits 3:0:0

Course Objectives:
To impart knowledge on
- Basic concepts in Total quality Management
- Taguchi methods for robust design

Course Outcomes:
Ability to
- Practice the concepts of six sigma, TQM and SPC in work place.
- Design and conduct experiments for optimizing processes and products.
- Improve quality and reliability of systems

Description:

References:
14ME3039 EXPERIMENTAL STRESS ANALYSIS (V-1.1)

Credits: 3:0:0

Course Objectives:
- To impart knowledge on applied stress and strain involved in solid mechanics.
- To impart knowledge on the relation between theory of mechanics and experimental stress and strain analysis.

Course Outcomes:
Ability to
- Analyse stress and strain in machine elements.
- Apply appropriate techniques to measure stress and strain.
- Make use of devices to find stress and strain experimentally.

Description:

References:
Course Objectives:
To impart knowledge on
- Stress and strain field around a crack in a body for different fracture modes
- Factors governing crack, crack arrest and fatigue.
- The applications of fracture mechanics.

Course Outcomes:
Ability to
- Analyze the distribution of stress and strain field near a crack.
- Determine fracture toughness value of a material for various fracture modes.
- Apply the principles of fracture mechanics to prevent crack growth and fatigue failures

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<td>14ME3014</td>
<td>Refrigeration Machinery and components</td>
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<td>14ME3015</td>
<td>Theory of Metal Cutting</td>
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<td>14ME3017</td>
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<td>14ME3018</td>
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<td>14ME3024</td>
<td>Design for Manufacturing and Assembly</td>
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<td>14ME3026</td>
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<td>Industrial Tribology</td>
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<td>Advanced Mechanical Vibrations</td>
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<td>Vibration Laboratory</td>
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<td>14ME3030</td>
<td>Industrial Robotics</td>
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<td>14ME3031</td>
<td>Cogeneration and Waste heat Recovery</td>
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<td>14ME3032</td>
<td>Drives and Control Systems for Robot</td>
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<td>14ME3033</td>
<td>Engineering Product Design and Development Strategies</td>
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<td>14ME3034</td>
<td>Control of CNC Machine Tools</td>
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<td>14ME3035</td>
<td>Solar Thermal Energy Conversion</td>
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<td>14ME3036</td>
<td>Biomass Energy</td>
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<td>14ME3037</td>
<td>Quality Concepts in Design</td>
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<td>14ME3038</td>
<td>Renewable Energy Sources</td>
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<td>14ME3039</td>
<td>Experimental Stress Analysis</td>
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<td>14ME3040</td>
<td>Engineering Fracture Mechanics</td>
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<td>14ME3041</td>
<td>Applied Mechatronics</td>
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<td>14ME3042</td>
<td>Automation in Manufacturing</td>
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<tr>
<td>14ME4001</td>
<td>Friction Stir Welding and Processing Technology</td>
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2014 | Department of Mechanical Engineering
13ME301 ERGONOMICS FOR SPECIAL GROUPS

Credits: 4:0:0

Objective:
- To understand the Ergonomics for Disabled and Elderly peoples.
- To provide the knowledge about Ergonomic Assessment Methods and Techniques.
- To learn about the principles of Human Factors and Engineering.
- To give skills on special solutions for people with lower back problems and Bed ridden

Outcome:
- Knowledge in techniques to assess elderly and disabled persons.
- Ability to design of assistive devices for elderly and disabled persons.
- Ability to design for persons with disabilities
- Knowledgeable on human factors engineering

Unit I

Unit II

Unit III

Unit IV
DESIGN FOR MOVEMENT: Special solutions for the very small and big, for those with lower back problems and for bedridden persons, Overview-Design for Motion Instead of Posture- Design to Fit Body Dimensions-Design for Very Small and Very Big People-Design to Avoid Harm and Injury.

Unit V

Text Books:

Reference Books:

13ME302 DESIGN AND USE OF ASSISTIVE TECHNOLOGY

Credits: 4:0:0

Objective:
- To familiarize student with Human Body and its functioning.
- To give knowledge about Ethics in design of Assistive Device Technologies.
- To give exposure to Myths of Natural Technology.
- To equip students with skills on Need and Task Based Design

Outcome:
- Knowledgeable on Human Body and its functioning.
- Ability to design of Assistive Device Technologies, Ethics and Surveys.
- Knowledgeable on Evaluate Assistive Technology

Unit I
The Human Body: Body Sizes-Mobility, Muscular work, Body Strength and load handling- The human mind, How we see, How we hear, How we sense objects and Energy, How we experience indoor and outside climates.

Unit II

Unit III

Unit IV

Unit V

Text Books:

Reference Books:

13ME303 COMPOSITE MATERIALS

Credits 4:0:0

Objective:
- To provide a basic understanding of composite materials and to understand how composite materials are obtained and discuss the nature of the various forms of reinforcement and matrix.
- To learn about various types of composites including processing.
- To understand the various testing of composite materials and its constituents.

Outcome:
- Ability to understand the basics of Composite materials and its properties and applications.
- Ability to know the processing methods of MMCs and their properties and applications.
- Knowledge about Processing of Polymer and Ceramic Metal matrix composites and curing methods of Polymer Metal matrix composites.
- Ability to understand the various testing methods of Composite materials and its constituents.

Unit I
INTRODUCTION:

Unit II
MECHANICS OF COMPOSITES:

Unit III

Unit IV

Unit V
COMPOSITE STRUCTURES: Fatigue –S-N curves – Fatigue behaviors of CMCs – Fatigue of particle and whisker reinforced composites – Hybrid composites – Thermal fatigue. Introduction to structures - selection of
material, manufacturing and laminate configuration - design of joints - bonded joints - bolted joints - bonded and bolted

**Text Books:**

**Reference Books:**

**14ME1001 GEOMETRIC DRAWING**

**Credits: 0:0:2**

**Course Objective:**
- To impart and inculcate proper understanding of the theory of projection.
- To improve visualization skills.
- To enable students to understand various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient.
- To understand the usage of various line types, arcs, and methods to draw using AutoCAD.
- To understand standard, modify, draw, layers and properties tool bars and use it to draw 2D drawings and plotting.
- To understand suitable hatching methods, dimensioning, and apply orthographic and isometric views.

**Course Outcome:**

**Ability to**
- Understand theory of projection and conventions to graphically represent the details of engineering components.
- Visualize the objects from the drawings.
- Represent engineering components in terms of orthographic and isometric drawings with different line types, arcs and circles using CAD software.
- Reconstruct the drawings with modify, layers and properties tool bars using CAD software.
- Describe simple building drawings with suitable hatching methods.

**LIST OF EXPERIMENTS**
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

**Reference Books:**
14ME1002 WORKSHOP PRACTICE

Credits: 0:0:2

Course Objective:
- To enable students to practice soldering techniques
- To facilitate students to practice characterization of electronic devices.
- To familiarize wiring of tube lights and lights used in stair case
- To train students in the assembly of PC and trouble shooting of the same.
- To give basic training on fitting joints and Carpentry joints as well as on plumping practices.

Course Outcome:
Ability to
- Apply the acquired skills for their mini project works as well as end semester project work.
- Asses the practical difficulties encountered in industries during any assembly work and solve the same
- Formulate methods and means for fitting works, carpentry works and pipe fittings
- Design and develop electronic and electrical circuits throughout their career
- Make use of their computer literacy to solve core engineering problems

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

Reference Books:

14ME1003 BASIC MECHANICAL ENGINEERING

Credits: 3:0:0

Course Objective:
- To provide knowledge about IC Engines, External combustion Engines, boilers, power plants, metal forming, metal joining, machining process and materials.

Course Outcome:
Ability to
- summarise thermal energy systems.
- summarise materials and manufacturing processes


Reference Books:
**14ME2001 ENGINEERING MECHANICS**

**Credits:** 3:0:0

**Course Objective:**
To impart knowledge on
- forces acting on particle and rigid bodies.
- free body diagrams for solving problems with structural members.
- geometrical properties of surfaces and solids
- concepts of kinematics, kinetics of particle and rigid bodies

**Course Outcome:**
Ability to
- Classify the system of forces and resolve the components of force system in space
- Determine centroid and moment of inertia of solids and understand their application in mechanics.
- Analyse the motion of connected bodies
- Apply D-Alembert’s principle on motion of bodies

**Statics of particle:** Concurrent forces in space: Components of force in space, Equilibrium of a

**References Books:**


**14ME2002 METALLURGY LABORATORY**

**Credit:** 0:0:1

**Course Objective:**
- To impart knowledge on metallurgical techniques for studying the microstructures of alloys.

**Course Outcome:**
Ability to
- Understand the working principle of optical microscope (upright type and inverted type)
- Prepare samples for metallurgical studies following appropriate metallographic procedure
- Identify the microstructures of different types of steels, aluminum and copper
- Demonstrate skills to extract metallographic images from samples
- Conduct experiments to determine the properties of foundry sand.
LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2003 MATERIAL SCIENCE AND ENGINEERING

Credits: 3:0:0

Course Objective:
To impart knowledge on materials science, the structure of alloys, crystal defects, mechanical properties, phase diagrams, and heat treatments with their effects on properties.

Course Outcome:
Ability to
- Understand crystal structures of common engineering materials
- Summarize various types of defects in crystal and identify the different strengthening mechanisms
- Analyse different types of failures and predict service behavior of materials for various applications
- Determine the right compositions of metals, heat treatment procedures for different mechanical engineering applications.


References Books:

14ME2004 MANUFACTURING PROCESSES

Credits: 3:0:0

Course Objective:
To impart knowledge on
- principle, procedure and applications of casting and welding processes
- principle, procedure and applications of bulk metal forming, sheet metal forming and powder metallurgy process

Course Outcome:
Ability to
- Apply cutting mechanics to metal machining based on cutting force and power consumption.
- Learn the basic operation of various traditional and non-traditional manufacturing processes.
- Learn how various products are made using traditional and non-traditional manufacturing processes.
- Justify the most appropriate manufacturing process and material for a given product.
- Select/Suggest process for producing gear.

Reference Books
4. Nagpal G.R. “Metal forming processes”, Khanna publishers, New Delhi, 2004

14ME2005 MACHINING PROCESSES

Credits: 3:0:0

Course Objective:
To impart knowledge on
- concept and basic mechanics of metal cutting,
- working of machine tools such as lathe, shaping, milling, drilling, grinding and broaching,
- methods of gear manufacturing and to know the working concepts of Non-conventional machining processes

Course Outcome
- Ability to select and apply appropriate machining processes to develop products


Reference Books
5. Gary F Benedict, ‘Non traditional Manufacturing Processes’, Marcel Dekker Inc,2005

14ME2006 METROLOGY AND MEASUREMENT SYSTEMS

Credits: 3:0:0

Course Objective:
To impart knowledge on
- concept of Measurements,
- various measurement systems.
Course Outcome:
- Ability to select and employ suitable instruments for measurement.
- Ability to demonstrate the use of advanced measurement techniques.


Reference books:

14ME2007 FLUID POWER CONTROL ENGINEERING

Credits: 3:0:0

Course Objective:
To impart the knowledge on components of pneumatic and hydraulic circuits.

Course Outcome:
- Ability to apply boolean algebra for logic design of FPC circuits.
- Interpret the standard symbols used in FPC Systems.
- Demonstrate the working principles and constructional details of Fluid Power Control System components and drives.
- Design and develop low cost automation circuits for industrial problems.


Reference books:
14ME2008 FOUNDRY, SMITHY, WELDING AND SHEET METAL LABORATORY

Credits: 0:0:2

Course Objective:
- To impart knowledge on principles and procedure of casting, welding, forming processes.
- To provide hands on training in all manufacturing processes such as casting, welding and forming

Course Outcome:
Ability to
- Apply the acquired skills for their mini project works as well as end semester project work.
- Assess the practical difficulties encountered in industries during any manufacturing processes with hand tools and solve the same
- Formulate methods and means for casting, welding forming and sheet metal processes
- Design process planning for production processes

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2009 METROLOGY LABORATORY

Credits: 0:0:1

Course Objective:
To impart knowledge on
- working principles of linear and angular measuring instruments
- measurement of linear and angular dimensions of a typical work piece specimen using the measuring instruments
- methods of form measurements

Course outcome:
Ability to
- Carry out measurements with linear and angular measuring instruments
- measure linear and angular dimensions of a typical work piece specimen using the measuring instruments

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2010 FLUID POWER CONTROL AND MECHATRONICS LABORATORY

Credits: 0:0:2

Course Objectives:
To impart knowledge on
- fundamentals of fluid power and Mechatronics systems and primary actuating systems.
- programming skills in Programmable logic controllers.
- principles of pneumatics and hydraulics and apply them to real life problems.

Course Outcome
Ability to
- Apply boolean algebra for logic design of FPC circuits.
- Design and demonstrate low cost automation circuits with PLC for industrial problems.
LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2011 CAM LABORATORY

Credits: 0:0:1

Prerequisite: Lathe Shop [14ME2012], Special Machines Laboratory [14ME2013]

Course Objective:
To impart knowledge on
- NC programming for CNC turning and milling operation and execution.
- Selection of tool for a machining operation.
- Simulation and verifying machining processes.

Course Outcome:
Ability to
- Understand features and applications of CNC turning and machining centers.
- Write CNC Programming for different mechanical components using G codes and M codes
- Implement the communication procedure for transmitting the CNC part program from an external computer to the control of the CNC machine tool.
- Operate a modern industrial CNC machine tool for actual machining of simple and complex mechanical parts.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2012 LATHE SHOP

Credit: 0:0:1

Course Objective:
- To impart knowledge on various operations on Lathe.

Course Outcome:
Ability to
- Demonstrate skills to machine components in lathe
- Select appropriate cutting tools for a given operation
- Interpret component drawing and compare the dimensions of the components using vernier caliper

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2013 SPECIAL MACHINES LABORATORY

Credits: 0:0:1

Prerequisite: Lathe Shop [14ME2012]

Course Objective:
To impart knowledge on
- basic knowledge about Metal cutting operation and execute it.
- selection of tools for machining operations.
Course Outcome:
- Ability to perform various metal machining operations using special machines

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2014 ENGINEERING THERMODYNAMICS
(Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart are permitted.)

Credits: 3:0:0

Course Objective:
To impart knowledge on
  - basic concepts of engineering thermodynamics.
  - first and second law of thermodynamics, properties of pure substances, gas mixtures and psychrometry.

Course Outcome:
Ability to
  - Analyse a given system applying laws of thermodynamics.
  - Apply concept of entropy to design effective thermal systems.
  - Determine steam quality using steam tables and Mollier chart.
  - Understand and analyse psychrometric processes


Reference Books:

14ME2015 THERMAL ENGINEERING I

Credits 3:0:0

Prerequisite: Engineering Thermodynamics [14ME2014]

Course Objective
To impart knowledge on
  - steam generators, nozzle, turbine.
  - air compressors, refrigeration systems.

Course Outcome
Ability to
  - Estimate the performance of a steam generator
  - Explain the flow through steam nozzles
  - Determine the efficiency of the impulse and reaction turbine using velocity triangles
  - Estimate the efficiency of a reciprocating compressor
Describe the working principle of Refrigeration systems


Refrigeration cycles.

Reference Books

14ME2016 THERMAL ENGINEERING II
(Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant, property tables are permitted.)

Credits: 3:0:0

Prerequisite: Engineering Thermodynamics [14ME2014]

Course Objective:
To impart knowledge on
- testing and performance of IC Engines.
- various Gas Power cycles.

Course Outcome:
Ability to
- Evaluate the performance of an internal combustion engine and various gas power cycles
- Understand the computational aspects of isentropic flow through variable area
- Analyze gas turbines cycles and compare the operational aspects of jet engines.
- Estimate cooling loads in air-conditioning systems


Reference Books:
14ME2017 BASIC AUTOMOBILE ENGINEERING

Credits 3:0:0

Course objective:
To impart knowledge on
- automotive chassis structure, transmission and suspension systems
- engine and its working
- fuel supply, cooling and lubrication systems
- thermodynamic systems
- history of Automobile

Course outcome
Ability to
- Identify the importance of vehicle frame.
- Understand the thermodynamic principles behind the working of petrol and Diesel Engines.
- Understand the construction and working principles of SI and CI engines.
- Outline the functions and components of clutch and transmission systems.
- Outline the functions and components of engine cooling, lubrication and ignition systems.


Reference Books:

14ME2018 POWER PLANT ENGINEERING

Credits 3:0:0

Course Objective
To impart knowledge on various power generating systems.

Course Outcome
Ability to
- Explain working principles of conventional and unconventional power plants
- Asses the performance of power plants.
- Predict the fixed and operating costs of power plants.
- Identify environmental hazards of various power plants.

Reference Books:
1. Arora and Domkundwar, “Power Plant Engineering”, Dhanpat Rai & Sons, 2005

14ME2019 HEAT AND MASS TRANSFER
(Use of standard Heat and Mass Transfer data book is permitted.)

Credits: 3:1:0

Prerequisite: Engineering Thermodynamics [14ME2014]

Course Objective:
To impart knowledge on
- conduction, convection and radiation heat transfer.
- design of heat exchangers.
- basic principles of mass transfer.

Course Outcome:
Ability to
- Understand principles of heat conduction, convection, radiation and mass diffusion and apply to solve heat transfer problems
- Design heat exchanger systems for enhanced heat transfer performance
- Analyse and predict the flow patterns in two phase flow and heat transfer


Reference Books:

14ME2020 THERMAL ENGINEERING LABORATORY

Credits: 0:0:1

Co/Prerequisite: Thermal Engineering I [14ME2015]

Course Objective:
- To impart knowledge on working principles of various thermal equipments like air blower, reciprocating compressors, Refrigeration & Air Conditioning Systems, Boilers

Course Outcome:
Ability to
1. Understand the thermal engineering concepts and apply them to thermal systems
2. Estimate the performance of different thermal equipments like air blower, reciprocating compressors, refrigeration & air conditioning systems, Boilers

**LIST OF EXPERIMENTS**
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

**14ME2021 MODERN VEHICLE TECHNOLOGY**

**Credits: 3:0:0**

**Course objective:**
To impart knowledge on
- Modern automobile vehicle systems.
- Sensors and Fuel injection Systems

**Course outcome:**
Ability to
- Select a suitable vehicle chassis.
- appreciate the functions of modern vehicle systems.


**Reference Books:**

**14ME2022 HEAT TRANSFER LABORATORY**
(Use of standard Heat and Mass Transfer data book is permitted.)

**Credit: 0:0:1**

**Prerequisite:** Heat and Mass Transfer [14ME2019]

**Course Objective:**
- To impart knowledge on conducting the heat transfer experiments and practically learns how to find heat transfer coefficients, thermal Conductivity, emissivity and effectiveness.

**Course Outcome:**
Ability to
- Demonstrate skills in conducting, heat conduction, convection and radiation heat transfer experiments
- Analyse the performance of various types of heat exchangers
• Perform boiling and condensation experiments

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2023 INTERNAL COMBUSTION ENGINES LABORATORY

Credits: 0:0:1

Co/Prerequisite: Thermal Engineering II [14ME2016]
Course Objective:
• To impart knowledge on the performance of different IC engines like air cooled, water cooled, low speed, single and twin cylinder engines

Course Outcome:
Ability to
• Conduct a variety of experiments in internal combustion engines
• Demonstrate skills in minimizing the losses by performance test
• Estimate the emission contents in the exhaust gases through emission test

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2024 MECHATRONICS

Credits: 3:0:0

Course Objective:
To impart knowledge on
• fundamentals of Mechatronics systems and primary actuating systems, sensors and transducers.
• programming skills in Programmable logic controllers
• data presentation systems and electrical drives, Microprocessor and microcontrollers and apply them to real life problems.

Course Outcome:
Ability to
• apply the knowledge in selecting suitable Sensors and transducers for real life or industrial problems
• design and develop Mechatronics systems and primary actuating systems.


Reference Books:

14ME2025 COMPUTER AIDED DESIGN AND MANUFACTURING

Credits: 3:0:0

Course Objective:
- To impart knowledge on the application of computer in the design and manufacturing
- To impart knowledge on graphical entities of CAD/CAM
- To impart fundamental knowledge on computer numerical programming

Course Outcome:
Ability to
- use suitable graphical entities to design a product
- use CAD software for solid and surface modeling
- program and operate CNC Machines and to identify proper tools


References Books:

14ME2026 MECHANICS OF MACHINES

Credits: 3:1:0

Prerequisite: Engineering Mechanics [14ME2001]

Course Objective:
To impart knowledge on
- linkages, mechanisms and cams
- principles involved in the displacement, velocity and acceleration at any point in a link of a mechanism.
- concepts of toothed gearing and kinematics of gear trains.
- the effects of friction in motion transmission and in machine components.

Course Outcome:
Ability to
- Understand different mechanisms and calculate the mobility
- Analyse position, velocity and acceleration of links in mechanisms
Design cam motion profiles, for different types of follower motions
Understand gear nomenclature and analyse gear trains
Design transmission devices considering frictional aspects.


References Books:

14ME2027 DYNAMICS OF MACHINERY

Credits: 3:1:0

Prerequisite: Mechanics of Machines [14ME2026]

Course Objective:
To impart knowledge on
- analysis of forces acting in mechanisms.
- effects of unbalance forces
- modeling and analyzing the vibration behavior of spring mass damper system
- the principles in mechanisms used for governing of machines.

Course Outcome:
Ability to
- determine the forces acting on various linkages when a mechanism is subjected to external forces
- identify and correct the unbalances of rotating body
- analyze the vibratory motion of SDOF systems
- reduce the magnitude of vibration and isolate vibration of dynamic systems.
- determine dimensions of Governors for speed control.

References Books:

14ME2028 DESIGN OF TRANSMISSION SYSTEMS
(Use of Design Data Book is permitted)

Credits: 3:0:0

Prerequisite: Design of Machine Elements [14ME2029]

Course Objective:
- To provide knowledge about the concepts, procedures and the data, to design and analyse machine elements in power transmission systems.
- To impart competency to specify, select and design the mechanical components for transmission systems.

Course Outcome:
Ability to
- Identify the working principles of mechanical components employed in mechanical transmission systems.
- Apply suitable theories and basic engineering principles and procedures to design the transmission elements.
- Select appropriate engineering design data from standard data books for the design of mechanical transmission components
- Design the transmission systems components for given conditions using Design data hand book.


References Books:

Hand Book
14ME2029 DESIGN OF MACHINE ELEMENTS
(Use of approved data books is permitted)

Credits: 3:1:0

Course Objectives:
- To impart knowledge and skills in applying elementary design principles, basic design procedures and use of design data for the design of mechanical elements.

Course Outcome:
Ability to
- Analyse stresses acting on components and determine the size based on theories of failure
- Design machine components for a given load condition using design data hand books
- Decide specifications as per standards given in design data and select standard components to improve interchangeability

Design of springs, Design and drawing of shafts, keys, couplings, riveted joints, pressure vessels and structures, screw joints, cotter joints knuckle joints and pipe joints. Design and drawing of engine components- piston, connecting rod, crankshaft, and flywheel

Reference books:

14ME2030 DESIGN OF HEAT EXCHANGERS

Credits: 3:0:0

Prerequisite: Heat and Mass transfer [14ME2019]

Course objective
To impart the
- working principle and different types of heat exchangers
- basic design methods of heat exchangers
- the applications of heat exchangers

Course outcome
Ability to
- understand the working principle and different types of heat exchangers
- understand the basic design methods of heat exchangers
- get familiarized with the applications of heat exchangers

Introduction and classification of heat exchangers - parallel flow, counter flow and cross flow; shell and tube and plate type; single pass and multi pass. Heat transfer correlations, Overall heat transfer coefficient, Design of heat exchangers - LMTD and effectiveness NTU methods - sizing of finned tube heat exchangers, U tube heat exchangers, fouling factors, pressure drop calculations, Mechanical design of shell and tube type - thickness calculations, tube sheet design using TEMA formula. Compact and Plate Heat Exchangers - types - merits and
demerits. Design of Compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations. Design of surface and evaporative condensers - cooling tower - performance characteristics

Reference Books

14ME2031 COMPUTER AIDED DESIGN AND ENGINEERING LABORATORY
Credits: 0:0:2
Course Objective:
To impart knowledge on
- the application and use of the analysis software
- constructing models, selecting appropriate elements and meshing them
- solving structural, thermal and fluid problems.

Course Outcome:
Ability to
- Gain practical experience in 3D modelling/analysis software
- Model 3D mechanical components such as knuckle joint, plummer block using appropriate modelling/assembling commands
- Identify the domain of the problem and select element, boundary condition, solvers for 2D structural and thermal problems

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2032 MACHINE DRAWING
Credits: 0:0:2
Course Objective:
To impart knowledge on
- representing any matter/object with the help of picture.
- working drawings.
- orthographic drawing of different machine parts.
- developing assembly drawings.

Course Outcome:
Ability to
- Understand drafting fundamentals and standards.
- Interpret drawings and extract required information
- Create part drawings and sectional views of machine components.
- Develop assembly drawings from part drawings.
- Carry out tolerance analysis and specify appropriate tolerances for machine design applications
LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

Reference books:
4. Revised IS codes: 10711, 10713, 10714, 9609, 1165, 10712, 10716, 10717, 11663, 11668, 10968, 11669, 8043, 8000.

14ME2033 DYNAMICS LABORATORY
Co/Prerequisite: Dynamics of Machinery [14ME2027]

Credits: 0:0:1

Course objective:
- To supplement the principles learnt in Mechanics of Machines
- To train the students with the principle and operations of vibration based systems
- To impart knowledge of measuring devices used for dynamic testing
- To train to study the effect of forces on various equipments based on theoretical and experimental methods

Course outcome:
Ability to
- Demonstrate the effect of unbalances resulting from rotary motions
- Study the effect of dynamics on vibrations in single and multi degree of freedom system
- Understand the working principle of governor/gyroscope and demonstrate the effect of forces and moments on their motion
- Evaluate cutting forces using dynamometer

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME2034 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

Credits: 3:0:0

Course Objective:
To impart knowledge on
- The principles of designing jigs, fixtures and press tools.
- Use of standard parts in design.

Course Outcome:
Ability to
- adopt standard procedure for the design of Jigs, fixtures and press tools.
- design Jigs, fixtures and press tools according to the requirement.
- identify and use standard parts.
- be proficient in the development of jigs and fixtures.

Locating and clamping principles - Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used. Design and development of jigs and fixtures - General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures –

Reference Books:

14ME2035 INDUSTRIAL SAFETY ENGINEERING

Credits: 3:0:0

Prerequisite: Machining Processes [14ME2005]

Course Objective:
To impart knowledge on
- basic Fundamentals of Safety Engineering and Management
- recognition, investigation, analysis, and control of hazards.
- management’s role in safety and assess the importance.
- recognize the multiple hazards associated with welding.

Course Outcome:
Ability to
- Understanding the main safety and ethical issues that may arise from chemical industrial processes.
- communicate the difference between Hazard and Risk. Be able to express Safety in terms of Risk and to recognize unacceptable/inappropriate levels of Risk.
- Understanding hazards arising from runaway reactions, explosions and fires, and how to deal with them.


Reference books:
14ME2036 MECHANICAL VIBRATIONS

Credits: 3:0:0

Prerequisite: Dynamics of Machinery [14ME2027]

Course Objective:
- To impart knowledge on importance of vibration and its analysis
- To impart knowledge on mathematical modeling of a vibratory system and find the response
- To impart skills in analyzing the vibration behavior of mechanical systems under different types of loading.
- To impart knowledge about the methods of reducing unwanted vibration.

Course Outcome:

Ability to
- Classify vibration systems and derive equations of motion from free-body diagrams.
- Solve vibration problems with multi degrees of freedom.
- Identify modes of a system and compute its natural frequencies.
- Propose solutions to reduce vibration using Isolation
- Identify instruments used in noise and vibration control tests


Reference Books

14ME2037 PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

Credits: 3:0:0

Course Objective:
- To impart knowledge on the product life cycle and its implication.
- To impart knowledge on the design consideration of a product
- To impart knowledge on design and selection of the standard mechanical elements.

Course Outcome:

Ability to:
- Select the right material for product development.
- Select the desired fabrication method for required product.

loading and material on form design - form design of castings, forging and plastics. Influence of space, size, weight, etc., on form design, aesthetic and ergonomic considerations. Dimensioning and tolerancing.

References Books:

14ME2038 TRIBOLOGY IN DESIGN

Credits 3:1:0

Prerequisite: Mechanics of Machines[14ME2026], Design of Machine Elements [14ME2029],

Course Objectives:
- To Impart knowledge on application of basic theories of friction, wear, and lubrication to predictions about the frictional behavior of commonly encountered sliding interfaces.

Course Outcomes:
Ability to
- demonstrate basic understanding of friction, lubrication and wear processes.
- familiar with mathematical tools used to analyze tribological processes
- describe the detailed operation of selected anti-friction or anti-wear components.
- prepare technical project reports and technical presentations.


References Books:
3. J. A. Williams, Engineering Tribology, Cambridge University Press, 2005
14ME2039 COMPOSITE MATERIALS

Credits: 3:0:0
Prerequisite: Material science and Engineering [14ME2003]

Course Objective:
To impart knowledge on
- the processes and behavior of composite material
- general design consideration, and failure of composites
- stiffness and strength analysis of continuous-fiber-reinforced laminated composites

Course Outcome:
Ability to
- design and analyse reinforced laminated composites
- select different manufacturing methods for composites as per design requirements
- identify the applications of different types of composites


References Books:

14ME2040 DESIGN FOR MANUFACTURE

Credits: 3:0:0

Course objective:
To impart knowledge on
- design principles to be followed for different manufacturing process.
- factors influencing the manufacturability of components.
- use of tolerances in manufacturing.

Course outcome:
Ability to:
- Design the components suitable for various manufacturing process such as welding, casting, machining
- Identify and design components according to standards

Economics of Process selection – General design principles of manufacturability – Proper material selection – Strength and Mechanical factors. Casting Design and Weldment Design, Formed Metal Components and Non Metallic Parts Design - Design considerations for the manufacture of extruded, cold headed metal parts – Tube and section bends – powder metal parts – Thermo settings plastic parts - Reinforced – Plastic and Composite parts Machined Components Design for the manufacture of Turned parts-drilled parts-milled parts, Planned, shaped and
slotted parts-Ground parts-parts produced by Electrical discharge machining. Design For Assembly – DFA –Index – impact on quality.

Reference Books

14ME2041 TURBO MACHINERY

Credits: 3:0:0

Prerequisite: Mechanics of Fluids [14CE2003]

Course objective:
To impart knowledge on
- classification of turbo machines
- types of pump, compressor, fan, and turbine
- efficiencies and performance of turbo machines

Course outcome
Ability to understand the
- types of turbo machines
- working principles of pump, turbine, compressor, and fan
- applications of turbo machines in power stations.


Reference Books

14ME2042 MECHATRONICS AND CONTROL SYSTEMS

Credits: 3:0:0

Course Objective:
To impart knowledge on
- the fundamentals of Mechatronics and control systems.
- data presentation systems, electrical drives, microprocessor, PLCs and microcontrollers.

Course Outcome:
Ability to
- Understand measurement and mechatronics control systems
- Build pneumatic, hydraulic, electro pneumatic and electro-hydraulic circuits for automation
- Understand working principles of electromechanical devices.
- Suggest actuators for mechatronic systems.
- Design a simple mechatronics system using PLC.


Reference Books:

14ME2043 INDUSTRIAL ENGINEERING

Credits: 3:1:0

Course Objective:
To impart knowledge on
- work study techniques towards productivity improvement
- industrial engineering concepts towards manufacturing management
- quality engineering and reliability tools

Course Outcome
Ability to
- apply various work study techniques towards productivity improvement
- apply industrial engineering concepts in real life environment
- Improve product design through quality engineering and reliability tools


Reference Books:
14ME2044 INDUSTRIAL DESIGN

Credits: 3:0:0

Course Objective:
To impart knowledge on
  - teamwork, critical thinking, creativity and independent learning
  - business practices, economic viability, environmental sustainability and social consequences of technology
  - fundamental principles and concepts of human factors.

Course Outcome:
Ability to
  - practice recent trends in design process and methods.
  - design products and processes based on scientific methods.
  - solve ergonomic problems.


Reference Books

14ME2045 RAPID PROTOTYPING AND TOOLING

Credits: 3:0:0

Course Objectives:
Impart knowledge on
  - product development using rapid prototyping processes
  - rapid prototyping processes

Course Outcome
Ability to
  - select and employ appropriate rapid prototype methods for product development.
  - develop prototypes of products.


**References Books:**

**14ME2046 METAL CUTTING THEORY AND PRACTICE**

**Credits 3:1:0**

**Prerequisite:** Machining Processes [14ME2005]

**Course Objective:**
To impart knowledge on
- fundamentals of metal cutting theory
- different types of tool and their nomenclature,
- measuring cutting force and cutting temperature
- mechanism of tool materials wear
- the cause of machine tool chatter

**Course outcome:**
Ability to
- Understand metal cutting theories.
- Interpret the nomenclature of single point and multi point cutting tools and select appropriate tool according to ISO specifications
- Explain heat distribution in work and tool during machining
- Suggest solutions to reduce tool wear and chatter and increase tool life
- Evaluate machinability of different materials using specific cutting forces and surface finish


**References Books:**
1. David A Stephenson,John S Agapiou, Metal Cutting theory and practice, CRC Press 2005
14ME2047 WELDING TECHNOLOGY

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- fundamental principles of welding processes, welding metallurgy and welding of dissimilar metals.
- principles of modern welding processes followed in Industries.

Course Outcome:
Ability to
- select and employ appropriate welding process for an engineering application.


Reference Books

14ME2048 FOUNDRY TECHNOLOGY

Credits 3:0:0

Course Objective:
- To impart knowledge on various foundry processes.

Course Outcome
Ability to
- design patterns and molds for foundry process.
- make sound castings.


References Books:
14ME2049 RENEWABLE ENERGY SOURCES

Credits: 3:0:0

Course objective:
- To impart knowledge on the solar, wind and bio energies
- To impart knowledge on tapping the energy from oceans
- To expose the students towards the current developments in Hydrogen production and fuel cell technologies.

Course outcome:
Ability to:
- recognize the need of renewable sources for the present day energy crisis
- employ renewable energy technology in a given situation.
- work for the future development of renewable energy technologies.


Reference Books

14ME2050 ADVANCED INTERNAL COMBUSTION ENGINES

Credits: 3:1:0

Prerequisite: Thermal Engineering II [14ME2016]

Course Objective:
To impart knowledge on
- SI and CI Engines
- engine exhaust emission control and alternate fuels
- the recent developments in IC Engines

Course Outcome:
Ability to
- analyze performance of SI and CI Engines.
- recognize emission control norms.
- Use alternate fuels in IC engines.


**Reference Books:**

**14ME2051 REFRIGERATION AND AIR-CONDITIONING**

**Credits:** 3:1:0

**Prerequisite:** Thermal Engineering I [14ME2015]

**Course objective:**
To impart knowledge on
- working principle of refrigeration and air-conditioning cycle
- fundamentals of psychrometry
- applications of refrigeration and air-conditioning

**Course outcome:**
Ability to
- Understand various refrigeration systems
- Demonstrate the working of refrigeration equipments
- Understand various psychrometric processes
- Design the space cooling load
- Explain the air-conditioning equipment


**Reference Books:**
2. N.F. Stoecker and Jones, ‘Refrigeration and Air Conditioning’, TMH, New Delhi, 2003
14ME2052 BIOMASS ENERGY SYSTEMS

Credits: 3:0:0

Course objective:
To impart knowledge on
- thermo chemical conversion of biomass
- power generation techniques using biomass
- design, selection, construction and operation of biogas plants

Course outcome:
Ability to
- familiarize with the thermo chemical conversion process of biomass
- summarize the power generation techniques using biomass waste
- design the biogas plants
- suggest the biofuels for practical applications


Reference Books:
3. O.P.Chawla, “Advances in biogas technology” Indian council of agricultural research, New Delhi,2009

14ME2053 ALTERNATIVE FUELS FOR I.C. ENGINES

Credits: 3:0:0

Prerequisite: Thermal engineering II [14ME2016]

Course objective:
To impart knowledge on
- concepts of energy and its sources.
- manufacturing and performance characteristics of alternate fuels.
- emission tests procedure
- performance of dual fuel engine.

Course outcome:
- Ability to design power plant equipment such as boilers, condensers, cooling tower, economizers, etc. which contribute to increased efficiency in power generation and minimizing environmental pollution.

Introduction to dual fuel engine - use of alcohols, LPG, CNG, hydrogen, bio gas and producer gas in CI engine in dual fuel mode, performance and emission characteristics of alternative fuels in dual fuel mode of operation v/s diesel operation. Production of bio diesel, properties, performance and emission characteristics. Environmental impact, pollution control methods.

Reference Books
14ME3001 COMBUSTION IN ENGINES

Credits: 3:0:0

Course Objective:
To impart knowledge on
- the combustion principles and chemical kinetics.
- combustion in SI and CI engines.
- combustion in gas turbine.

Course Outcome:
- Ability to explain theoretical foundations of combustion
- Knowledge on the application of engineering science (thermo, fluids, heat transfer) to analyze the operation and performance of an internal combustion engine.
- Gaining an appreciation of the environmental concerns in designing combustion systems
- Exposure to standards and public policy concerning the regulation of combustion emissions.

Principles and Thermodynamic concepts of combustion, Combustion calculations, Chemical equilibrium and dissociation, Chemical kinetics, Theories of combustion, types of flames, combustion generated pollutants, Combustion in SI and CI engines, Knock, Delay period, Ignition lag, Heat balance, Combustion chamber design, Combustion in gas turbines, Various configurations of gas turbine combustion chambers.

Reference Books:

14ME3002 ADVANCED THERMODYNAMICS

Credits 3:0:0

Course Objective:
To impart knowledge on
- entropy, availability, thermodynamic relations
- Combustion process
- Kinetic theory of gases

Course Outcome:
Ability to
- apply first and second law analysis on thermal systems.
- find the stoichiometric ratio for complete combustion of fuels.

temperature – stoichiometry and excess air – chemical equilibrium and dissociation. Kinetic Theory of Gases, Perfect gas model, Distribution of translational velocities distribution function, molecular collisions and mean free path, equi partition of energy.

**Reference Books:**

**14ME3003 ADVANCED FLUID MECHANICS**

**Credits:** 3:0:0

**Course Objective:**
To impart knowledge on
- continuity, momentum and energy equations of fluid flow.
- irrotational flows, flow past cylinders and Rankine body.
- concepts of Boundary layer, prandtl mixing length, turbulent theory, universal velocity profile

**Course Outcome:**
Ability to
- Analyze numerical flow problems
- Identify different types of flows and analyze them


**Reference Books:**

**14ME3004 DESIGN OF THERMAL POWER EQUIPMENT**

**Credits:** 3:0:0

**Course Objective:**
To impart knowledge on
- The design of boiler, furnace, condenser and cooling tower
- boiler performance and their accessories
- water and steam purification methods and equipments

**Course Outcome:**
Ability to
• design boiler, furnaces, condenser and cooling tower
• design economizer, super heater, reheater and analyse their performance
• design air preheater, draft system and chimney


Reference Books:

14ME3005 COMPUTER INTEGRATED MANUFACTURING SYSTEMS

Credits: 3:0:0

Course Objectives:
To impart knowledge on
• application of computers in manufacturing,
• Computer assisted materials requirement planning and production monitoring systems.
• automatic material handling systems and Flexible Manufacturing systems.

Course Outcome:
Ability to
• use computers in manufacturing to increase the productivity,
• reduce cost and time involved in planning and monitoring production systems.
• use computer assisted techniques for process planning, inventory and quality control for increased productivity.


Reference Books:

**14ME3006 COMPUTER APPLICATIONS IN DESIGN**

**Credits: 3:0:0**

**Course Objective:**
To impart knowledge on
- use of computer in mechanical engineering design.
- surface and solid modeling techniques.
- advanced modeling concepts.

**Course Outcome:**
Ability to
- handle computer for solving design problems.
- Design new products using computer aided design.
- Use advanced modeling techniques in product design.


**References Books:**

**14ME3007 ENGINEERING MATERIALS AND APPLICATIONS**

**Credits: 3:0:0**

**Course Objective:**
- To impart the knowledge on structure and composition and behavior of Metals
- To impart the principles of design, selection and processing of materials

**Course Outcome:**
- Ability to apply concepts of Materials Science for material selections.
- Ability to suggest modern metallic materials, composite materials for engineering applications.

Ceramics and glasses: Properties, applications, Ceramic Structures- silicate ceramics- carbon –diamond- graphite-
 imperfections and impurities in ceramics –applications

Reference Books:

14ME3008 ADVANCED STRENGTH OF MATERIALS

Credits: 3:0:0

Course Objectives:
To impart knowledge on
- Potential applications of strength of materials.
- Material behavior under various stress conditions.
- Development of stresses depending upon material shape and wall thickness.
- Development of stresses under various loading conditions.

Course Outcome:
Ability to
- Apply principles of advanced strength of materials  to design engineering structures and components

Introduction to potential applications of strength of materials, methods of analysis. Introduction to theory of elasticity, concept of stress, and their relationships. Material behaviour under various stress conditions, Torsion in circular, non circulcar, rectangular cross sections and in thin-wall sections, Bending behaviour of beams depending upon their cross sections, curvature and elasticity of foundations. Energy methods- Castigliano’s Theorem, Methods of virtual work, Stress and strain in cylinders depending upon their wall thickness. Materials under static and cyclic loading.

Reference Books:
14ME3009 PRINCIPLES OF MECHANICAL MEASUREMENTS AND INSTRUMENTATION

Credits 3:0:0

Course Objective:
To impart knowledge on
- measurement techniques for measuring process parameters in industry and in research

Course outcome:
Ability to
- Choose measuring instruments suitable for specific application.
- Design and fabricate a system for measuring simple parameters.
- Apply the knowledge in during the measurement process.


Reference Books:

14ME3010 MECHATRONICS AND MACHINE CONTROLS

Credits: 3:0:0

Course objective:
To impart
- knowledge on control systems and Programmable logic circuits
- Fluidic Controls and Process control Pneumatics

Course outcome:
Ability to
- design mechatronic systems composed of mechanical and electrical parts.
- to develop modern and smart electro-mechanical products.

**References Books:**


**14ME3011 COMPUTER AIDED ENGINEERING LABORATORY**

**Credits:** 0:0:2

**Course objective:**
To impart

- Fundamental knowledge on using software tools like ANSYS, FLUENT, etc., for Engineering Simulation.
- Knowledge on how these tools are used in Industries for solving real time problems.
- Understanding about various fields of engineering where these tools can be effectively used to improve the output of a product.

**Course outcome:**

Ability to

- Appreciate the utility of the tools like ANSYS or FLUENT in solving real time problems and day to day problems.
- Become versatile in using these tools for any engineering and real time applications.
- Acquire knowledge on utilizing these tools for a better project in their curriculum.
- Face the challenges in industry with confidence when it matters to use these tools in their employment.

**LIST OF EXPERIMENTS**

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

**14ME3012 CAD/CAM LABORATORY**

**Credits:** 0:0:2

**Course Objective:**
To impart the knowledge on the

- usage of computer in design and Manufacturing.
- visualization of objects in three dimensions and producing orthographic views, sectional views and auxiliary views of it.

**Course Outcome:**

Ability to

- develop 2D and 3D models using software.
- write CNC Program for different components for manufacturing.
- create parts, and assemble it to create a functional assembly.

**LIST OF EXPERIMENTS**

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.
14ME3013 SOLAR REFRIGERATION AND AIR-CONDITIONING

Credits: 3:0:0

Course Objective
To impart knowledge on
- the different types of solar cooling systems
- the thermodynamic modeling
- the Economics of different cooling systems

Course Outcome:
Ability to
- apply basic thermodynamic modeling concept
- carry out design and evaluation of solar cooling systems.
- economically use the solar cooling systems


Reference Books:

14ME3014 REFRIGERATION MACHINERY AND COMPONENTS

Credits: 3:0:0

Course Objective:
To impart knowledge on
- the working principle of various components
- the accessories and controls in refrigeration systems
- the BIS standards for appliance testing practice

Course Outcome:
- Ability to design and develop refrigeration systems.
- Ability to apply the BIS standards for appliance design and testing.


Reference Books:
5. Recent release of BIS Code for relevant testing practice. ASHRAE Hand book (Fundamentals & Equipments), 2005

14ME3015 THEORY OF METAL CUTTING

Credits: 3:0:0

Course Objective:
To impart knowledge on
- Chip formation, tool nomenclatures and cutting forces.
- heat distribution and thermal aspects of machining
- tool materials, tool life and tool wear.
- Economics of machining

Course Outcome:
Ability to
- analyze cutting forces in turning, drilling and milling
- select the parameters to reduce cutting temperature, tool wear and tool failure.
- reduce the cost of machining by selecting proper cutting conditions.


Reference Books

14ME3016 ADVANCED METROLOGY

Credit 3:0:0

Course Objective:
- To introduce the science of measurement and measuring machines commonly used.
- To impart knowledge about limits, fits and tolerances, geometric dimensioning aspects
- To introduce the methods of acceptance test for conventional machine tools.
- To familiarize students with the concepts of Laser metrology and surface roughness.

Course Outcome:
- Students will be able to work in metrology divisions in industries
- Students will be able to understand GD and T symbols and apply them.
- Students will be able to understand the advanced metrology systems.

References Books:

14ME3017 ADVANCED HEAT TRANSFER LABORATORY

Credits: 0:0:1

Course Objective:
• To impart the practical skills in conducting and analyzing the heat transfer experiments

Course Outcome:
• Ability to apply the practical knowledge in designing various heat transfer systems and will be conversant with measurement techniques

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME3018 AUTOMATION AND ROBOTICS LABORATORY

Credits: 0:0:2

Course Objective
To impart knowledge on
• designing pneumatic and electro pneumatic components for automation.
• components, ladder logic design, programming for PLC/Microcontroller and robot
• configuration of robot and reconfigure them for a custom application

Course Outcome
Ability to
• select components for automation.
• develop programs for different application
• configure robot for practical applications.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.
References
3. Fanuc PLC Manual

14ME3019 ENERGY CONSERVATION AND MANAGEMENT

Credits: 3:0:0

Course Objective
To impart knowledge on
- energy auditing in engineering and process industry
- energy conservation in buildings, thermal and electrical systems

Course Outcome
Ability to
- identify areas of energy conservation in thermal and electrical systems
- apply the principles energy management for conservation.

Energy resources, energy use patterns and scope for conservation, world energy supply and demand, national energy systems, policies, Programs and decisions. Energy Auditing in engineering and process industry, identification of areas for energy conservation. Energy conservation in buildings, thermal and electrical systems. Energy management principles, need for organization and goal setting, basic discounting, life cycle costing and other methods, factors affecting economics, energy pricing and incentives for conservation, financial management.

Reference Books:

14ME3020 ADVANCED MANUFACTURING PROCESSES

Credits: 3:0:0

Course objective:
To impart knowledge on
- different types of non-conventional manufacturing processes.
- the mechanism and capabilities of non-conventional manufacturing processes.
- the latest manufacturing process for micro-fabrication and devices.

Course outcome:
Ability to
- evaluate and select suitable manufacturing processes for particular applications.
- apply the latest manufacturing process for micro-fabrication.
- develop new products by making use of new materials and processes.


References:

14ME3021 COMPOSITE MATERIALS

Credits: 3:0:0

Course Objective:
To impart knowledge on
- types and applications of composite materials
- nature of various forms of reinforcement and matrix.
- processing and testing of composite materials.

Course outcome:
Ability to
- process composite materials based on their properties and applications
- test composite materials for finding their suitability in industrial applications.


Reference Books:
14ME3022 ADVANCED HEAT TRANSFER

Credits: 3:0:0

Course Objective:
To impart knowledge on
- Conduction, convection, radiation, heat transfer during boiling and condensation.
- Design of heat exchangers.
- Principles of mass transfer.

Course Outcome:
- Ability to apply the knowledge in analyzing the heat transfer performance of thermal systems


Reference Books:

14ME3023 DESIGN OF MECHANICAL SYSTEM ELEMENTS

Credits: 3:0:0

Course Objective:
- To study the working principle, operation and applications of various mechanical transmissions systems and pressure vessels.
- To impart competency to specify and design the mechanical elements.

Course Outcome:
Ability to
- Identify the working principle of mechanical components employed in Mechanical system elements
- Apply suitable theories and engineering principles to design the mechanical elements.
- Design Mechanical systems elements based on the requirements.


**Reference Books**


**14ME3024 DESIGN FOR MANUFACTURING AND ASSEMBLY**

**Credits: 3:0:0**

**Course Objective:**
To impart knowledge on
- product functionality, product design, product planning and assembly.
- developing quality products by incorporating the reliability, safety functions and robustness.

**Course Outcome:**
Ability to
- identify and describe the integrated design, manufacturing and assembly process.
- identify the production plans for machining, casting and welding with ease of manufacturing and assembly to reduce the overall costs of the product.

**Design principles for manufacturing:** mechanisms and selection, Process capability – Feature and geometric tolerances, assembly limits and Datum Features. **Form design:** Principle, Factors, Material and manufacture design, **Design for machining consideration:** drills, milling cutters, keyways and counter sunk screws, simplification by separation and amalgamation– Design for machinability, economy, clampability, accessibility and assembly. **Design for casting and welding considerations:** Redesign of castings based on parting line, core requirements and machined holes, Redesign of weld members based on different factors and considerations. **Redesign for manufacture and case studies:** Design for Assembly Automation, group technology –Design for reliability and safety, Robust and quality design.

**Reference Books:**

14ME3025 MANUFACTURING SYSTEM AND SIMULATION

Credits: 3:0:0

Course Objective:
To impart knowledge on
- the various modeling techniques and assembly lines.
- Manual and computer assisted simulation techniques.

Course Outcome:
Ability to
- create model of the real manufacturing system.
- resolve practical problems in manufacturing sectors using simulation.


Reference Books:

14ME3026 ADVANCED MECHANISM DESIGN

Credits: 3:0:0

Course Objective
Ability to
- Understand the fundamentals of kinematics
- analyse four-bar mechanisms.
- synthesize mechanisms and manipulators

Course Outcome
- capable of analysing and synthesizing mechanisms to meet industrial requirements


Reference Books

14ME3027 INDUSTRIAL TRIBOLOGY

Credits 3:0:0

Course Objectives:
- To Impart knowledge on application of basic theories of friction ,wear , and lubrication to predictions about the frictional behavior of commonly encountered sliding interfaces.

Course Outcomes:
Ability to
- demonstrate basic understanding of friction, lubrication and wear processes.
- familiar with mathematical tools used to analyze tribological processes
- describe the detailed operation of selected anti-friction or anti-wear components.
- prepare technical project reports and technical presentations.


References Books:
3. J. A. Williams, Engineering Tribology, Cambridge University Press, 2005

14ME3028 ADVANCED MECHANICAL VIBRATIONS

Credits: 3:0:0

Course objective:
To impart
- Knowledge on formulating mathematical model for vibration problems
- skills in analyzing the vibration behavior of mechanical systems subjected to loading
- Awareness on methods to reduce vibration and the equipment used for collecting response data.

Course outcome:
Ability to
Classify the systems of vibration and construct the equation of motion from free-body diagrams.

Solve vibration problems that contain multiple degrees of freedom.

Reduce unwanted vibration and to handle equipment used for collecting response data.

Present the theoretical and the experimental principles of mechanical vibrations to gain practical understanding in the field of vibration.

Overview of Mechanical vibrations:
- Types of vibrations
- Damping models
- Solutions of problems for one degree of freedom systems for static, transient and harmonic response using Newton’s method, Energy method and Rayleigh’s method.
- Isolation of vibrations and transmissibility
- Vibration of two and Multi degree of freedom systems
- Semi definite systems
- Vibration absorber
- Vibration of continuous system like strings, beams and rods
- Identifying natural frequencies for vibration problems using numerical methods like matrix iteration, Stodola, Holzer and mechanical impedance
- Vibration measuring instruments
- Vibration Tests
- Data acquisition
- FFT analysis.

Reference Books:

14ME3029 VIBRATION LABORATORY

Credits: 0:0:2

Course objective:
- To supplement the principles learnt in Mechanical Vibrations
- To train students with the sensors, signal conditioning and associated instrumentation for vibration measurement
- To instruct fundamentals of digital data acquisition, signal processing, data reduction and display.
- To impart knowledge on the use of vibration measurement equipments

Course outcome:
- Able to study the effect of dynamics on vibrations
- Proficient with instrumentation used in vibration control tests
- Capable to understand and adapt the way to measure vibration.

LIST OF EXPERIMENTS
The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14ME3030 INDUSTRIAL ROBOTICS

Credits: 3:0:0

Course Objective:
To impart knowledge on
- components, sensing elements used programming techniques and Applications of robots.
- fundamentals of Robotics and primary actuating systems, sensors and transducers.
Course Outcome

Ability to

- design and develop Robot with basic drivers and controllers.
- select suitable Sensors and transducers for real life or industrial problems.

Robot - Definition - Basic Concepts - configurations - Types of drives - Basic motions - Point to point control - Continuous path control. Basic control system concepts and analysis - robot actuation and feedback, Manipulators - director and inverse kinematics, Coordinate transformation - Brief Robot dynamics. Types of Robot and effectors - Grippers, Tools, End - effector interface.


Reference Books:

14ME3031 COGENERATION AND WASTE HEAT RECOVERY SYSTEMS

Credits: 3:0:0

Course objective:
To impart knowledge on

- the basic energy generation cycles
- the concept of cogeneration, its types and probable areas of applications
- significance of waste heat recovery systems and carryout its economic analysis

Course outcome:

Ability to

- Analyse the basic energy generation cycles
- do the economic analysis of waste heat recovery systems


Reference Books:
14ME3032 DRIVES AND CONTROL SYSTEMS FOR ROBOTS

Credits: 3:0:0

Course Objective:
To impart
- fundamental principles of various robot drives and to develop skills to recognize and analyze the problems associated with.
- skills on hydraulic, pneumatic and electric drives for development of robots in various applications.
- necessary skills, motivation and training to work and communicate with confidence in interdisciplinary areas.

Course Outcome:
Ability to
- select suitable drives for robots.
- utilize the Robots for the production of various products.


Reference Books:

14ME3033 ENGINEERING PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

Credits: 3:0:0

Course Objective:
To impart knowledge on
- the important practices followed during designing and developing a product in industries.
- the entire product life cycle right from its conceptual stage to its development stage.
- various concepts like modelling, simulation, material selection and GD&T.

Course Outcome:
Ability to
- design and develop a product in industries.

Reference Books:

14ME3034 CONTROL OF CNC MACHINE TOOLS

Credits: 3:0:0

Course Objective:
• To familiarize the students about functioning of CNC machine tool from the control point of view.

Course Outcomes:
• Ability to design control systems for CNC machine tool

Introduction to CNC systems, Coordinate systems of CNC machines, Economics. CNC programming- Interpolation, feed, tool and spindle functions (G-codes). CNC drives- Hydraulic systems, servo and stepping motors, response analysis, Feedback devices and counter. CNC Interpolation - Hardware interpolators- DDA integrator, linear, circular, complete interpolators, Software interpolators, Tustin method, NURBS and polynomial interpolators, Acceleration and deceleration control techniques. CNC control loops, PID control, servo controller, gain tuning, feed forward control, Mathematical analysis of control loops. CNC Architecture - Numerical control kernel- types, PLC, programming, languages, Human-Machine Interface functions, structure, Introduction to Open CNC architecture.

Reference Books:

14ME3035 SOLAR THERMAL ENERGY CONVERSION

Credits 3:0:0

Course Objective
• To impart knowledge on solar thermal systems

Course Outcome
Ability to
• estimate the solar radiation on horizontal and tilted surfaces
• analyze the performance of different solar collectors
• select the right type of solar collector for an application
• design solar heating and cooling systems.

Reflecting Surfaces and transparent materials, Selective Surfaces: Ideal coating characteristics; Anti-reflective coating, Solar radiations, Thermal analysis of Solar Collectors, Solar Energy storage - Heliostats; Solar power plant; Solar furnaces - Solar water heating systems, Solar space heating and cooling system, Solar pond, Solar applications, solar vapour absorption refrigeration system, solar desiccant cooling.

Reference Books

14ME3036 BIOMASS ENERGY

Credits 3:0:0

Course Objective
To impart knowledge on
• thermal biomass conversion and biological pathways.
• power generation techniques.
• Design, Selection, Construction and Operation of Biogas Plants.

Course Outcome
Ability to
• develop thermal biomass conversion systems.
• apply Pyrolysis, Gasification and Liquefaction and fermentation processes
• Communicate effectively about issues in environmental aspects for bio energy conversion and also to design the biogas plants.


References Books
14ME3037 QUALITY CONCEPTS IN DESIGN

Credits 3:0:0

Course Objective:
To impart knowledge on
- the basic concepts in Total quality Management
- the Taguchi methods for robust design

Course Outcome
- Ability to apply the six sigma concepts in industries.
- Ability to apply TQM and SPC in Industries
- Ability to conduct experiments and evolve solutions.
- Ability to improve the reliability of the systems


Reference Books:

14ME3038 RENEWABLE ENERGY SOURCES

Credits: 3:0:0

Course objective:
- To impart knowledge on various renewable energy sources and functioning of non-conventional power plants

Course outcome:
- Ability to design various non-conventional energy power plants
- Ability to select suitable non-conventional energy resources under specific conditions and for specific applications.


Reference books:
2. Rai G.D, ‘Non-conventional energy sources”, Khanna Publishers, New Delhi, Reprint 2011
14ME3039 EXPERIMENTAL STRESS ANALYSIS

Credits: 3:0:0

Course Objective:
- To impart knowledge on applied stress and strain involved in solid mechanics.
- To impart knowledge on the relation between theory of mechanics and experimental stress and strain analysis

Course Outcome:
Ability to:
- Work with devices used while carrying out experimental stress and strain analysis
- Analyze experimental stress and strain data and interpret the results.

Reference Books
3. Sadhu singh, Experimental stress analysis, Khanna publishers, 2009

14ME3040 ENGINEERING FRACTURE MECHANICS

Credits: 3:0:0

Course Objective:
To impart knowledge on
- stress and strain field around a crack in a body for different fracture modes
- factors governing crack growth, crack arrest and fatigue.
- the applications of fracture mechanics.

Course Outcome:
Ability to
- estimate stress and strain field around a crack.
- estimate the fracture toughness value of a material for various fracture modes.
- provide solution to prevent crack growth and fatigue failures


References:

14ME3041 APPLIED MECHATRONICS

Credits 3:0:0

Course Objectives:
- To provide the students with the Mechatronics principles and applications.
- To explore architecture of intelligence machines.
- To provide students with the necessary skills, motivation and training to work and communicate with confidence in interdisciplinary areas.

Course Outcomes:
Ability to
- utilize principles of Mechatronics for design industrial and domestic applications.
- select proper sensor and actuator for a given application
- develop intelligent automated system and manufacturing data base system


References Books
3. Ogata Katsuhiko , ‘Modern Control Engineering’, Printice Hall of India , 2005
14ME3042 AUTOMATION IN MANUFACTURING

Credits 3:0:0

Course Objectives:
To impart knowledge on
- basic principles of automation, tool transfer and implementation of automated flow line.
- design aspects and analysis of material handling system.
- ways of improving line balance and solving line balancing problems.

Course Outcomes:
Ability to
- implement the concepts of a productive system in automation.
- apply the knowledge of automated flow lines for industrial and other applications.
- design and analysis of material handling systems for automated assembly lines.
- balance automated assembly lines.


Reference Books

14ME4001 - FRICTION STIR WELDING AND PROCESSING TECHNOLOGY

Credits: 3:1:0

Course objective:
- To help learners gain a more complete understanding of various aspects of solid state welding process and in particular Friction stir welding/processing

Course outcome:
- Ability to weld mechanical structures while minimizing negative impact to the environment


Reference Books:

14ME4002 APPLIED THERMAL ENGINEERING AND EXPERIMENTAL METHODS

Credits: 3:1:0

Course Objective:
- To impart the fundamentals of heat transfer, exergy analysis and optimization techniques for various energy systems.

Course Outcome:
- Ability to apply the knowledge in analyzing the heat transfer performance of thermal systems, also will be conversant with measurement techniques, data acquisition and processing.


Reference Books:

14ME4003 SMART MATERIALS AND VIBRATION CONTROL

Credits: 3:1:0

Course Objective:
To impart
- the fundamentals of smart materials and its devices
- the development of smart structures and products
- knowledge and motivation in the design, analysis and manufacturing of smart structures
- the importance of vibration control and the methods to control it using smart materials

Course Outcome:
Ability to
- understand the physical principles underlying the behavior of smart materials

Smart Sensors- Smart Transducers- Measurement Methods- Signal Conditioning Devices- Calibration Methods-Passive, Semi-Active and Active Control- Feedback and Feed forward Control Strategies.

Design-Analysis-Manufacturing of smart materials-Application issues involved in integrating smart materials with signal processing and control capabilities.


Techniques for Vibration control- Vibration source isolation using electro/magneto rheological fluids- Distributed Control Strategy - Control of Plate Vibration.

Reference Books:
1. A.V. Srinivasan, Smart Structures: Analysis and Design, Cambridge University Press,
6. Clarence W desilva, “vibration Damping Control and design, CRC Press, Taylor and Francis Group, 2005

14ME4004 CONTROL SYSTEM ENGINEERING

Credits: 3:1:0

Course Objective:
To impart
- The basic concepts of control system and stability
- Understanding about design and specifications of control systems
- Knowledge about stability criteria

Course Outcome:
Ability to
- Represent control systems block statements.
- Be familiar with about Block diagrams, stability of control systems and stability criterion.
- Acquire ideas concerning analysis and components of control systems.

Time domain specifications-types of test inputs-I and II order systems-response-generalized error series-steady state error-frequency domain specifications-polar-plot-bode plot.
Concepts of state variables and state model - Concepts of controllability and observability- Design of DCS with deadbeat response- sampled data control system with deadbeat response -full and reduced order observer, output feedback design.
Servomotor-stepper motor-synchro–resolver-amplidyne-planar motor--Passive Compliances
References Books: