Program Outcomes: -

1. **Engineering Knowledge:** An ability to apply knowledge of computing, mathematics, science and engineering fundamentals in understanding complex mechanical systems.
2. **Problem Analysis:** An ability to identify and analyzed the complex engineering problems and provide solutions by using principles of engineering science, mathematics and computational / numerical methods.
3. **Design/ Development of solutions:** An ability to design solutions for thermal, hydraulic & machining systems and design components and processes that meet the specified needs with appropriate consideration for safety, societal and environmental aspects.
4. **Conduct investigation of complex problems:** An ability to investigate solutions of complex problems by conducting experiments, simulating, computing and analyzing data to provide valid findings and conclusions.
5. **Modern tool usage:** An ability to use modern engineering tools and technologies necessary for obtaining quick, economical and accurate solutions of engineering problems and understanding their limitations.
6. **The engineer and society:** An ability to analyze the local and global impact of mechanical systems on individuals, organizations and society.
7. **Environment and sustainability:** An ability to understand the environmental issues and provide the solutions for sustainable development of the system.
8. **Ethics:** An ability to understand professional and ethical responsibility through soft skill development.
9. **Individual and team work:** An ability to function effectively as an individual or as a team member to accomplish the goal.
10. **Communication:** An ability to communicate effectively at technical and management levels using both written and oral communication.
11. **Project management and finance:** An ability to apply technical and management skills to develop one's own work as a member and leader in a team to manage projects and in multidisciplinary environments.
12. **Lifelong learning:** Recognize the need of industry and develop ability to keep up-to-date with contemporary technologies through lifelong learning.

Program Specific Outcomes:

1. An ability to apply the principle to fabrication, test and documentation of mechanical system and process
2. To develop ability to design, development, implementation of more advanced mechanical systems or process
3. Be prepared to work professionally in either thermal or mechanical system areas.

SE 2012 Pattern

Course Title: Engineering Mathematics 3
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Solve higher order linear differential equations and apply to modeling and analyzing mass spring systems.
CO2	Apply Laplace transform and Fourier transform techniques to solve differential equations involved in Vibration theory, Heat transfer and related engineering applications.
CO3	Apply statistical methods like correlation, regression analysis in analyzing, interpreting experimental data and probability theory in testing and quality control.
CO4	Perform vector differentiation and integration, analyze the vector fields and apply to fluid flow problems.
CO5	Solve various partial differential equations such as wave equation, one and two dimensional heat flow equations.

Course Title: Manufacturing Processes I
Course Outcomes (CO's):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Understand and analyze foundry practices like pattern making, mould making and explain various casting process.
CO2	Understand and analyze Rolling, Forging, Extrusion and Drawing processes.
CO3	Understand and explain different plastic processing methods along with applications
CO4	Understand and explain different joining process along with applications.
CO5	Understand and analyze different sheet metal working processes.
CO6	Understand and explain the constructional details, working of lathe machine with analysis of machining parameters.

Course Title: Computer Aided Machine Drawing
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Understand the importance of CAD in the light of allied technologies such as CAM, CAE, FEA, CFD and PLM.
CO2	Understand the significance of parametric technology and its application in 2D sketching.
CO3	Implement parametric feature-based modeling in developing 3D machine components model.
CO4	Develop an ability to create 3D assemblies of Mechanical Systems.
CO5	Able to communicate between Design and Manufacturing using 2D drawings.

Course Title: Thermodynamics

Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Apply thermodynamics terminology and concepts appropriately to different processes, devices applications.
CO2	Calculate Entropy changes in process & heat, work and other important thermodynamic properties for various ideal gas processes.
CO3	Estimate the performance of power plants and their components using thermodynamic cycles & availability in each case.
CO4	Analyze the condition of steam and performance of thermodynamics vapor and refrigeration cycles by using steam table & refrigerant chart.
CO5	Illustrate the concept of steam generators & Evaluate the performance of boilers
CO6	Estimate various properties of Psychrometry and sketch the processes on Psychrometry chart

Course Title: Material Science

Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Explain Material properties, crystal structure and allied concepts including planes and directions.
CO2	Explain the defects in the materials affecting mechanical properties and summarize strengthening of materials by cold working and hot working.
CO3	Identify the different properties of material by studying destructive and non-destructive testing.
CO4	Describe the concepts of corrosion, prevention methods, and different surface modification methods.
CO5	Identify and explain importance of surface modification techniques.
CO6	Explain Basic steps in powder metallurgy, various methods of powder production and its applications.

Course Title: Fluid Mechanics

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Describe and determine various properties of fluid for operating conditions encountered in fluid engineering problems
CO2	Determine total pressure and couple exerted by static fluid on plan and curved surfaces encountered in dam structures and stability of floating objects.
CO3	Describe various types of flow and their physics and determine velocity, acceleration stream function and velocity potential at any point in a flow field to recognize conditions of possibilities of fluid flow.
CO4	Discuss physics and the governing equations associated with laminar and turbulent flows to analyse and design flow measuring devices and pipe flow systems
CO5	Discuss physics of laminar and turbulent flows in external flow to determine drag and lift forces on surfaces of stationary and moving objects
CO6	Develop mathematical correlation for complex flow phenomenon in terms of dimensionless parameters.

Course Title: Theory of Machines I

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Identify the given mechanism and compute the degrees of freedom.
CO2	Analyze the slider crank mechanism for static and dynamic force.
CO3	Calculate the torque /power in clutches, brakes and dynamometers using friction theory.
CO4	Determine velocity and acceleration of mechanisms by vector and complex algebra methods
CO5	Analyze velocity and acceleration of mechanisms graphically.

Course Title: Engineering Metallurgy

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO 1	Explain different alloy systems and apply phase rule.
CO 2	Distinguish between macro and microscopy.
CO 3	Describe iron-iron carbide equilibrium diagram, classify and identify applications of steels and cast iron.
CO 4	Understand heat treatment for steels and analyse its effect on various properties.
CO 5	Describe the effect of alloying element and heat treatment on alloy steels.
CO 6	Illustrate the importance of non-ferrous alloys in engineering applications.

Course Title: Applied Thermodynamics

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Classify various types of Engines, Compare Air standard, Fuel Air and Actual cycles and elaborate various losses in real cycles
CO2	Understandmixture preparation mechanisms and Stages of Combustion in S. I. Engines, Theory of Detonation, Pre-ignition and factors affecting detonation.
CO3	Understand Fuel Supply system, Stages of Combustion in CI Engines, Theory of Detonation in CI Engines and Comparison of SI and CI Combustion and Knocking and factors affecting it, Criteria for good combustion chamber and types.
CO4	Perform Testing of I. C. Engines and analyze its performance
CO5	Describe construction and working of various I. C. Engine systems, and categorize various exhaust-non exhaust emissions, their control and emission norms.
CO6	Understand theory of positive displacement compressor and analyze performance.

Course Title: Strength of Materials

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Apply stress strain concept to calculate deformation in axially loaded members.
CO2	Calculate and Construct shear force and bending moment diagram for various types of beams with different loading conditions.
CO3	Calculate bending and shear stress in beam for various cross sections and loading.
CO4	Formulate equation and calculate maximum slope and deflection of beams for varying end conditions.
CO5	Apply Torsion and buckling theory to calculate safe load.
CO6	Evaluate normal and shear stresses acting on oblique plane graphically as well as analytically and apply theories of failure to determine F.O.S for different materials.

Course Title: Electrical and Electronics Engineering

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Develop the capability to identify and select suitable DC motor / induction motor / special purpose motor and its speed control method for given industrial application.
CO2	Program Arduino IDE using conditional statements.
CO3	Interfacing sensors with Arduino IDE

TE 2012 Pattern

Course Title: Design of Machine Elements –I

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Identify failure modes for mechanical elements and design of machine elements based on strength.
CO2	Design Shafts, Keys and Coupling for industrial applications.
CO3	Design machine elements subjected to fluctuating loads.
CO4	Design Power Screws for various applications.
CO5	Design fasteners and welded joints subjected to different loading conditions.
CO6	Design various springs for strength and stiffness.

Course Title: Heat Transfer

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Identify the various modes of heat transfer and implement/apply the basic heat conduction equations for steady one dimensional thermal system.
CO2	Formulate governing equation for constant cross sectional area fin and recognize the fundamentals of thermal insulation
CO3	Estimate solutions for transient heat conduction in simple geometries
CO4	Describe fundaments of convective heat transfer and evaluate heat transfer coefficient in natural and forced convection
CO5	State the fundaments of radiation Heat Transfer and Interpret heat transfer by radiation between objects with simple geometries.
CO6	Illustrate fundaments of condensation, boiling heat transfer and evaluate heat exchanger performance by using LMTD and NTU-effectiveness

Course Title: TOM II

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Understand the fundamentals of gear theory which will be the prerequisite for the gear design
CO2	Analyze forces acting on Spur, Helical, Bevel, Worm and Worm gear
CO3	Analyze speed and torque in epicyclic gear trains
CO4	Construct cam profile for different follower motions and describe advance cam curves
CO5	Describe synthesis of four bar mechanism analytically and graphically
CO6	Express step-less regulation transmission and analyze gyroscopic couple and its effect on aero planes, ships and Automobiles

Course Title: Metrology and Quality Control

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Understand the methods of measurement, selection of measuring instruments / standards of measurement, carryout data collection and its analysis.
CO2	Explain tolerance, limits of size, fits, geometric and position tolerances and gauge design
CO3	Understand and use/apply Quality Control Techniques/ Statistical Tools appropriately
CO4	Develop an ability of problem solving and decision making by identifying and analyzing the cause for variation and recommend suitable corrective actions for quality improvement.

Course Title: Hydraulics and Pneumatics

Course Outcomes (CO's):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Describe the basic principles of fluid power and positive displacement hydraulic pumps
CO2	Illustrate the working principles, applications of hydraulic actuators, power units and accessories
CO3	Explain the working principles, applications of fluid power control devices
CO4	Interpret the working of industrial hydraulics circuits, methods of contamination control
CO5	Describe the Components, Control Valves and Circuits of Pneumatics
CO6	Select the appropriate components required for hydraulic and pneumatic systems

Course Title: Numerical Methods & Optimization

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Explain the errors obtained in the numerical solution of problems and determine the root of algebraic, Transcendental equations.
CO2	Solve Simultaneous equations and Differential equations.
CO3	Optimize the solution of real life engineering problem using modern optimization techniques
CO4	Apply basic curve fitting principles, statistical concepts and numerical integration to solve engineering problems.
CO5	Develop algorithm for solution procedure and to write a code in computer programming language

Course Title: Design of Machine Elements –II

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Understand and apply principles of gear design to spur gears and industrial spur gear boxes.
CO2	To become proficient in Design of Helical and Bevel Gear
CO3	To develop capability to analyze Rolling contact bearing and its selection from manufacturer's Catalogue.
CO4	To learn a skill to design worm gear box for various industrial applications.
CO5	To inculcate an ability to design belt drives and selection of belt, rope and chain drives.
CO6	To achieve an expertise in design of Sliding contact bearing in industrial applications.

Course Title: Turbo Machines

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Classify different types of turbo machines & apply impulse momentum to different plate profiles.
CO2	Design, and analyze performance of Pelton wheel
CO3	Design and analyze performance of Reaction turbine and effect of draft tube
CO4	Evaluate energy conversion in steam nozzle, differentiate velocity diagrams of Impulse and Reaction turbine and analyze its performance
CO5	Design components of centrifugal pump and analyze its performance
CO6	Analyze performance of centrifugal and axial flow compressor

Course Title: MECHATRONICS

Course Outcomes (CO):

Course outcome (CO)	Statement At the end of the course, student will be able to
CO1	Recognition of key elements of mechatronics system and its representation in terms of block diagram
CO2	Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O
CO3	Interfacing of Sensors, Actuators using appropriate DAQ micro-controller
CO4	Analysis of system model (for control application) Time and Frequency domain
CO5	Implementation of PID and PLC controller on real time basis.

Course Title: MANUFATCURING PROCESS –II

Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Student should be able to apply the knowledge of various manufacturing processes.
CO2	Student should be able to identify various process parameters and their effect on processes.
CO3	Student should be able to figure out application of modern machining.
CO4	Students should get the knowledge of Jigs and Fixtures for variety of operations.

Course Title: SEMINAR

Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Inculcate motivation for topic of interest and develop a thought process for technical presentation.
CO2	To make students familiar with intellectual properties and literature survey.
CO3	The students will be able to deliver well-organized technical presentations at conferences and other symposia.

BE 2012 Pattern

Course Title: Refrigeration & Air Conditioning

Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Illustrate the fundamental principles and applications of refrigerants, refrigeration and air conditioning systems.
CO2	Analyze the performance of simple vapor compression refrigeration and various types of vapor absorption system.
CO3	Analyze the performance of multiple evaporator vapor compression refrigeration system and explain cryogenics.
CO4	Analyze the air conditioning system using principles of psychrometry and their processes.
CO5	Evaluate cooling load for air conditioning systems used for various applications and explain components of refrigeration systems.
CO6	Design simple air duct system and discuss various components of air handling units.

Course Title: CAD CAM & Automation
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Apply homogeneous transformation to 2D/3D dimensional CAD entities.
CO2	Analyze analytical & synthetic curves, surfaces and solid.
CO3	Understand fundamentals of finite element method, & determine stress, strain, and displacement in simple mechanical components like spring, bar, truss.
CO4	Develop CNC part program for turning/milling.
CO5	Explain suitable rapid prototyping methods for engineering problems.
CO6	Understand different automation strategies and fundamentals of robotics.

Course Title: Dynamics of Machinery
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Estimate natural frequency for single DOF undamped & damped free vibratory systems.
CO2	Determine response to forced vibrations due to harmonic excitation.
CO3	Estimate natural frequencies, mode shapes for 2 DOF undamped free vibratory systems.
CO4	Apply balancing techniques for static and dynamic balancing of multi cylinder engines.
CO5	Describe vibration measuring instruments along with vibration control methods.
CO6	Explain noise, its measurement & noise reduction techniques.

Course Title: Elective I- ENERGY AUDIT AND MANAGEMENT
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Carry out energy audit of their residence/ society / college.
CO2	Carry out electric tariff calculation for any installation.
CO3	Manage the peak load and power factor of any installation.
CO4	Suggest different methods to optimize the energy consumption for any process and develop ecofriendly methods.
CO5	Adopt new methods to improve overall efficiency of system e.g. co-generation, non-conventional methods of energy production.

Course Title: Elective II- Operations Research
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Execute the LLP using Two Phase Method and Decision Theory to solve problems.
CO2	Evaluate the existing utilization of the resources and propose a better solution using transportation models.
CO3	Analyze the conflicting situations and evaluate the optimal strategy using Game Theory and replacement analysis.
CO4	Implement the project management techniques like CPM, PERT, Crashing Analysis and Monte-Carlo Simulation method.
CO5	Evaluate the waiting time, idle time and process time using Queuing and Sequencing Models.
CO6	Optimize multi stage decision making problems using Integer Programming and Dynamic Programming.

Course Title: Project 1
Course Outcomes (CO's):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Find out the gap between existing mechanical systems and develop new creative new mechanical system.
CO2	Learn about the literature review.
CO3	Get the experience to handle various tools, tackles and machines.

Course Title: Power Plant Engineering
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	To study the power generation scenario, the components of thermal power plant, improved Rankin cycle, Cogeneration cycle
CO2	To understand details of steam condensing plant, analysis of condenser, the an environmental impacts of thermal power plant, method to reduce various pollution from thermal power plant
CO3	To study layout, component details of hydroelectric power plant, hydrology and elements, types of nuclear power plant
CO4	To understand components; layout of diesel power plant , components; different cycles; methods to improve thermal efficiency of gas power plant
CO5	To study the working principle , construction of power generation from non-conventional sources of energy
CO6	To learn the different instrumentation in power plant and basics of economics of power generation.

Course Title: Mechanical System Design
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Understand the difference between component level design and system level design.
CO2	Design various mechanical systems like pressure vessels, machine tool gear boxes, material handling systems, etc. for the specifications stated/formulated.
CO3	Learn optimum design principles and apply it to mechanical components.
CO4	Handle system level projects from concept to product.

Course Title: Elective I- ENERGY AUDIT AND MANAGEMENT
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Carry out energy audit of their residence/ society / college.
CO2	Carry out electric tariff calculation for any installation.
CO3	Manage the peak load and power factor of any installation.
CO4	Suggest different methods to optimize the energy consumption for any process and develop ecofriendly methods.
CO5	Adopt new methods to improve overall efficiency of system e.g. co-generation, non-conventional methods of energy production.

Course Title: Elective I- Tribology
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	The course will enable the students to know the importance of Tribology in Industry
CO2	The course will enable the students to know the basic concepts of Friction, Wear, Lubrications and their measurements.
CO3	Identify the performance of different types of bearings and analytical analysis thereof.
CO4	Apply the principles of surface engineering for different applications of tribology.

Course Title: Elective II- Operations Research
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Execute the LLP using Two Phase Method and Decision Theory to solve problems.
CO2	Evaluate the existing utilization of the resources and propose a better solution using transportation models.
CO3	Analyze the conflicting situations and evaluate the optimal strategy using Game Theory and replacement analysis.
CO4	Implement the project management techniques like CPM, PERT, Crashing Analysis and Monte-Carlo Simulation method.
CO5	Evaluate the waiting time, idle time and process time using Queuing and Sequencing Models.
CO6	Optimize multi stage decision making problems using Integer Programming and Dynamic Programming.

Course Title: Elective II- Product Design and Development
Course Outcomes (CO's):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Understand essential factors for product design
CO2	Design product as per customer needs and satisfaction
CO3	Understand Processes and concepts during product development
CO4	Understand methods and processes of Forward and Reverse engineering
CO5	Carry various design processes as DFA, DFMEA, design for safety
CO6	Understand the product life cycle and product data management

Course Title: Elective III- Refrigeration and Air Conditioning Equipment Design
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Determine the performance parameters of trans-critical & ejector refrigeration systems
CO2	Estimate thermal performance of compressor, evaporator, condenser and cooling tower.
CO3	Describe refrigerant piping design, capacity & safety controls and balancing of vapour compressor system.
CO4	Explain importance of indoor and outdoor design conditions, IAQ, ventilation and air distribution system.
CO5	Estimate heat transmission through building walls using CLTD and decrement factor &time lag methods with energy-efficient and cost-effective measures for building envelope.
CO6	Explain working of types of desiccant, evaporative, thermal storage, radiant cooling, clean room and heat pump air-conditioning systems.

Course Title: Elective III- Industrial Engineering
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Apply the Industrial Engineering concept.
CO2	Understand, analyze and implement different concepts involved in method study.
CO3	Design and Develop different aspects of work system and facilities.
CO4	Understand and Apply Industrial safety standards, financial management practices.
CO5	Undertake project work based on modeling & simulation area.

Course Title: Elective III- Robotics
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Identify different type of robot configuration with relevant terminology.
CO2	Select suitable sensors, actuators and drives for robotic systems.
CO3	Understand kinematics in robotic systems.
CO4	Design robot with desired motion with suitable trajectory planning.
CO5	Select appropriate robot programming for given application.
CO6	Understand need of IOT, machine learning, simulation in robotics.

Course Title: Elective IV- FINITE ELEMENT ANALYSIS
Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	Explain types of analysis and procedure for Finite Element Analysis through its fundamental concepts, different approaches.
CO2	Formulate 1D element stiffness matrices & load vector from various approaches and determine displacements & stresses of mechanical engineering problem.
CO3	Develop 2D element stiffness matrices & load vector from various approaches and determine displacements & stresses of mechanical engineering problem.
CO4	Explain higher order elements and solve numerical integration for engineering problem.
CO5	Analyze 1D steady state heat transfer problems and evaluate temperature distribution for various modes of heat transfer.
CO6	Determine natural frequency & mode shapes for undamped free vibration engineering problem

Course Title: Elective IV- COMPUTATIONAL FLUID DYNAMICS

Course Outcomes (CO):

Course outcome (CO)	Statement
	At the end of the course, student will be able to
CO1	**Analyse** and model fluid flow and heat transfer problem
CO2	**Apply** numerical technique to discretize and solve governing differential equation for two dimension heat conduction equation
CO3	**Solve** basic advection and convection diffusion equations and understands the role in fluid flow and heat transfer
CO4	**Evaluate** flow parameters in internal and external flow using simple algorithm
CO5	**Discuss** basic introduction to turbulent flow model