M.E.S. College of Engineering, Pune
Mechanical Engineering Department
Course Outcomes

First Year Engineering

Course Code	Course Name

102003 **Systems In Mechanical Engineering**
CO1: Describe and compare the conversion of energy from renewable and non-renewable energy sources
CO2: Explain basic laws of thermodynamics, heat transfer and their applications
CO3: List down the types of road vehicles and their specifications

CO4: Illustrate various basic parts and transmission system of a road vehicle
CO5: Discuss several manufacturing processes and identify the suitable process
CO6: Explain various types of mechanism and its application

111006 **Workshop**
CO1: Familiar with safety norms to prevent any mishap in workshop.

CO2: Able to handle appropriate hand tool, cutting tool and machine tools to manufacture a job.
CO3: Able to understand the construction, working and functions of machine tools and their parts.
CO4: Able to know simple operations (Turning and Facing) on a centre lathe.

102012 **Engineering Graphics**
CO1: Draw the fundamental engineering objects using basic rules and able to construct the simple geometries.
CO2: Construct the various engineering curves using the drawing instruments.
CO3: Apply the concept of orthographic projection of an object to draw several 2D views and its sectional views for visualizing the physical state of the object.
CO4: Apply the visualization skill to draw a simple isometric projection from given orthographic views precisely using drawing equipment.
CO5: Draw the development of lateral surfaces for cut section of geometrical solids.
CO6: Draw fully-dimensioned 2D, 3D drawings using computer aided drafting tools

M.E.S. College of Engineering, Pune
Mechanical Engineering Department
Course Outcomes

Second Year Engineering

Course Code	Course Name

207002 **Engineering Mathematics – III**
- CO1: Solve higher order 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 similar engineering problems
- CO3: Apply statistical methods like correlation, regression analysis in analyzing, interpreting experimental data and probability theory in testing and quality control
- CO4: Apply 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

202041 **Manufacturing Process-I**
- CO1: Define and Explain various manufacturing processes such as casting, metal forming, joining, sheet metal working, lathe operations.
- CO2: Analyze different process parameters for different manufacturing processes such as casting process, metal forming process, sheet metal working and centre lathe.
- CO3: Solve numerical of different manufacturing processes such as casting process, metal forming process, sheet metal working and center lathe.

202042 **Computer Aided Machine Drawing**
- CO1: Create 2D sketches with geometrical and dimensional constraints
- CO2: Create Parametric 3D modelling of Machine Component
- CO3: Create assemblies of Mechanical Systems from 3D modeled mechanical components.
- CO4: Generate 2D production drawings of the parts and assembly with appropriate tolerances.

202043 **Thermodynamics**
- CO1: Remember and apply fundamental concepts of thermodynamics to understand science of thermodynamic system
- CO2: Derive expression for various thermodynamics processes to establish relation between different thermodynamic properties in consideration with Ideal gas equation and solve numerical to find different thermodynamics properties.
- CO3: Compare and estimate performance of various gas power cycle to identify difference between ideal and natural processes.
- CO4: Estimate performance of vapour (steam) power cycle and vapour compression cycle and use of steam table

CO5: Evaluate heat balance sheet for boiler to understand real life performance of steam boiler

CO6: Solve psychometric problems using psychometric charts.

202044   Material Science

CO1: Explain the defects in the materials affecting mechanical properties and summarize strengthening of metals by cold working and hot working

CO2: Determine the different properties of material by studying Destructive and Non-destructive testing.

CO3: Explain the concepts of corrosion ,prevention methods, and different surface modification methods

CO4: Prescribe proper metal, alloys, non-metals and powder metallurgical components for specific requirement/applications.

202051   Strength of Materials

CO1: DEFINE Various type of stresses developed on structural members subjected to tension, compression and direct shear

CO2: SOLVE Shear force and bending moment diagram for various type of transverse loading and support

CO3: COMPUTE the bending stresses using Flexural formula and shear stresses in

CO4: COMPUTE the slope and deflection at any location on a beam

CO5: CALCULATE torsional shear stresses in shaft and buckling of column using Euler's and Rankine's theory.

CO6: APPLY the concept of principle stresses and interpret with analytical and graphical methods for 2D structure with static loading and IDENTIFY the fundamental elements involved in the mechanical design of engineering structures failure, safety criterion

202045   Fluid Mechanics

CO1: Define Fundamental Properties Of Fluid And Discuss Fluid Statics

CO2: Explain Kinematics Of Flow Properties

CO3: Apply Euler's & Bernoulli's Equation For The Solution Of Fluids

CO4: Explain Concept Of Internal Flow And Explain Velocity Distribution For Laminar & Turbulent Flow

CO5: Determine Friction Losses Using Darcy-Weisbach Equation

CO6: Utilize Boundary Layer Concept To Determine Drag And Lift Force

202047   Soft Skills

CO1: Develop analytical perspective of self (SWOT) guiding the apsired achievement.

CO2: Demonstrate listening and com-prehending skills.

CO3: Demonstrate effective communica-tions skills in business environ-ment.

CO4: Write a professional resume for jobs and internships in the desired domain.
CO5: Develop the dexterity in assertion and articulation on different topics of discussion.
CO6: Develop an attitudinal and behav-ioral change for working in a team

202048   Theory of Machines – I
CO1: Explain various mechanism and its Application.
CO2: Evaluate static and dynamic force analysis of reciprocating engine mechanism.
CO3: Compute torque transmitting capacity of clutches, brakes and dynamometers.
CO4: Solve problem of velocity and acceleration analysis for simple mechanism by analytical method.
CO5: Draw velocity and acceleration diagram for simple mechanism by graphical method.

202049   Engineering Metallurgy
CO1: EXPLAIN formation of metals and alloys based on equilibrium diagrams and change in property due to microstructure.
CO2: DISTINGUISH between microscopic and macroscopic analysis of metals.
CO3: DIFFERENTIATE steels based on Iron -Iron carbide equilibrium diagram and micro-structure property relationship.
CO4: DETERMINE various heat treatment processes of steel based on applications.
CO5: DESCRIBE the designation of the steels and identify various types of steels
CO6: EXPLAIN and USE non ferrous metals and its alloys based on its composition and applications.

202050   Applied Thermodynamics
CO1: CLASSIFY Classify & Explain IC Engine with Valve Timing diagram. and CLASSIFY Compare fuel air cycle with air standard cycle.
CO2: EXPLAIN Explain different combustion stages of SI and CI engine and effect of different variable on combustion
CO3: DISCUSS Discuss different fuel supply system and effect of knocking and detonation on combustion in IC engines.
CO4: ESTIMATE Determine various performance parameters, characteristic curves, heat balance sheet for SI and CI Engine.
CO5: EXPLAIN Explain various auxillary systems of IC engine and exhaust emission norms.
CO6: DESCRIBE Describe construction, working of various types of reciprocating and rotary compressors with performance calculations of positive displacement compressors.

203152   Electrical and Electronics Engineering

CO1: Explain the construction and operation of DC Machines and 3-Phase Induction Motors.
CO2: Compute the performance parameters of DC Machines and 3- Phase Induction Motor
CO3: Develop the ability to select suitable DC Motors, 3- Phase Induction Motor and 1- Phase Motors for given applications.
CO4: Explain the difference between Microcontroller and Microprocessor.
CO5: Demonstrate the interfacing of LED and Stepper Motor using any IDE software

202053   Machine Shop – I
CO1: SUMMARIZE plastic moulding process and LIST the tools used
CO2: CREATE machine component like spur gear using different machining operations like turning & milling
CO3: OPERATE surface grinder to maintain accuracy within specified tolerance limit
CO4: USE power press to manufacture sheet metal component using processes like punching, forming, trimming

Third Year Engineering

Course Code	Course Name
302041	**Design of Machine Elements-I**

CO1: Design different machine elements like shaft, keys, cotter and knuckle joints, levers.
CO2: Determine finite and infinite life of machine elements subjected to fluctuating loads
CO3: Design threaded and welded joint for various loading and supporting conditions
CO4: Design power screws, C clamps & screw jack for various applications.
CO5: Design helical compression & tension springs for strength & stiffness

302042   Heat Transfer
CO1: Define various modes of heat transfer and governing laws of conduction, convection and radiation.
CO2: Apply heat conduction equation to thermal system with & without internal heat generation and transient heat conduction
CO3: Analyze heat transfer rate in natural and forced convection
CO4: Interpret heat transfer by radiation between objects with simple geometries
CO5: Analyze heat transfer equipment's and investigate the performance.

302043   Theory of Machines-II
CO1: Explain terminology, law, forces & various concepts of gear and use it to Solve the numerical.

CO2: Analyze speed and torque in different types of gear train using tabular or analytical method

CO3: Draw cam profile for various types of follower & follower motion.

CO4: Synthesize four bar and slider crank mechanism with analytical and graphical method

CO5: Analyze the gyroscopic couple & it's effect for stabilization of ship, aeroplane & four wheeler vehicle

302044   Turbo Machines

CO1: Define impulse momentum principle and working principle of turbo machines.

CO2: Determine performance of hydraulic turbines and draw the performance characteristics of Pelton wheel, Francis and Kaplan turbine.

CO3: Explain the working principle of steam turbine and governing of steam turbines.

CO4: Illustrate construction and working principle and evaluate the performance characteristics of energy consuming turbo machines

302045   Metrology and Quality Control

CO1: Classify, List and Use the accurate and precise instrument for inspection of geometric and dimensional measurement, standard used and errors in the measurement.

CO2: Design the inspection gauge and Able to analyse gear and thread metrology parameters

CO3: Operate comparators, interferometers during measurements and Outline advancement in metrological techniques like CMM, Machine vision system and Lasers.

CO4: Describe concept of quality, appropriate quality management system and improvement of quality deployment.

CO5: Analyse the processes of quality control using statistical quality control, acceptance sampling and improvement using total quality management tools

302046   Skill Development

CO1: Select appropriate tools and tackles used in machine assembly shop

CO2: Demonstrate assembly or disassembly skills

CO3: USE theoretical concepts about machine parts or components

CO4: Critique practical aspects of each component in assembly of machine

302047   Numerical Methods and Optimization

CO1: APPLY appropriate Numerical Methods to solve complex Mechanical Engineering problems.

CO2: CREATE mathematical models using appropriate numerical techniques.

CO3: DRAW flow chart and PREPARE computer program and validate results by using appropriate solver

CO4: SOLVE real life engineering problems using optimization techniques and numerical methods

302048   Design of Machine Elements-II
CO1: APPLY the principle of Spur gear design for industrial application and PREPARE a manufacturing drawing with concept of GD&T.
CO2: EXPLAIN and DESIGN Helical and Bevel Gear considering strength, loading and other gear design parameters
CO3: SELECT Rolling Contact Bearings from manufacturer's catalog for different speed, working Hrs., probability and load conditions.
CO4: APPLY procedure of worm gear design for various application considering strength, Loading and Heat criteria.
CO5: SUMMARIZE the design procedure of belt, rope and chain drive for different conditions and SELECT it from manufacturer's catalog
CO6: CLASSIFY and SELECT a Sliding contact bearing for Industrial application as per standard empirical relation and theories.

302049   Refrigeration and Air Conditioning
CO1: DEFINE Basic principles of Refrigeration and Air-Conditioning
CO2: APPLY Fundamental principles of Refrigeration and Air-Conditioning
CO3: SELECT Proper Refrigerants for different applications depending on their properties and environmental issues
CO4: DESIGN Vapor Compression Refrigeration and Air-Conditioning Systems using P-h and Psychometric Chart
CO5: ANALYSE Performance of Refrigeration and Air-conditioning systems

302050   Mechatronics
CO1: ANALYZE different type of sensors, Actuators and measurements systems.
CO2: EXPLAIN concept of transfer function, Block diagram reduction rules and SOLVE numerical on block diagram reduction
CO3: EXPLAIN principles of signal communication and interfacing of sensor/actuator with DAQ system.
CO4: EXPLAIN PLC system and its ladder programming and DISCUSS significance of PLC systems in industrial application
CO5: DESCRIBE system modeling and analysis in time domain and frequency domain
CO6: IDENTIFY control actions such as Proportional, integral and derivative and APPLY its significance in industrial applications

302051   Manufacturing Process-II
CO1: APPLY the knowledge of various manufacturing processes.
CO2: IDENTIFY various process parameters and their effect on processes.
CO3: POINT OUT application of modern machining.
CO4: DESIGN Jigs and Fixtures for variety of operations.

302052   Machine Shop-II
CO1: EXPLAIN Working of Lathe Machine, Drilling Machine, Milling Machine, Surface Grinding Machine and Taps
CO2: DEMONSTRATE CNC Programming to produce a program for given jobs
CO3: DRAW Proportionate drawing of drilling jig for a component
CO4: DRAW Process planning sheet for turning job.

302053   Seminar
CO1: Develop and promote presentation skills to communicate effectively with engineering community and society.
CO2: Utilizing technical resources for writing technical documents to explain modern engineering concept.
CO3: Apply principles of ethics and respect in interaction with others.

Final Year Engineering

Course Code	Course Name
402042	**CAD CAM Automation**

CO1: Apply homogenous transformation matrix for geometrical transformation of 2D CAD entities.
CO2: Predict mathematical model for analytical curves.
CO3: Critique performance of simple mechanical components or trusses using FEA (mathematical and software treatment).
CO4: Generate CNC program using appropriate manufacturing technique viz. turning, milling.
CO5: Understanding of various manufacturing techniques and develop competency in designing and developing products using rapid manufacturing technology.
CO6: Discuss role of components different robotic systems and their applications in manufacturing industries.

402043   Dynamics of Machinery
CO1: Explain Principle of Vibrations, Single degree freedom systems; Free & Forced Vibrations (UNDERSTAND) and Develop Analytical competency in solving single degree of freedom vibration problems. (ANALYZE)
CO2: Determine Mode shapes, Eigen values & Eigen vectors in Undamped Two Degree of Freedom systems(EVALUATE) and Determine Vibrations of Geared systems, Combined rectilinear and angular motion (EVALUATE)
CO3: Explain Basic Concept of Balancing, (UNDERSTAND) and Solve balancing problems of Rotating & Reciprocating masses of single & multi cylinder engines. (APPLY)

CO4: Explain various methods of vibration & noise measurement and their control for real life problem. (UNDERSTAND) and Measure vibrations & Noise, Noise & Vibration characteristics (EVALUATE)

402044 C   Elective I Heating Ventilation and Air Conditioning
CO1: Determine the performance parameters of trans-critical & ejector refrigeration systems
CO2: Estimate thermal performance of compressor, evaporator, condenser and cooling tower.
CO3: Explain importance of indoor and outdoor design conditions, IAQ, ventilation and air distribution system.
CO4: Estimate heat transmission through building walls using CLTD and decrement factor &time lag methods with energy-efficient and cost-effective measures for building envelope
CO5: Explain working of types of desiccant, evaporative, thermal storage, radiant cooling, clean room and heat pump air-conditioning systems.

402045 A   Elective II Automobile Engineering
CO1: Compare different vehicle layout and Discuss its component.
CO2: Explain the working principle of Drive Train, Steering System, Suspension System and its various components.
CO3: Explain the Performance Parameters of Vehicle and Determine power required for propulsion of vehicle.
CO4: Distinguish between Active Safety and Passive Safety and its importance.

402045 B   Elective II Operation Research
CO1: Formulate and solve Linear Programming Problem.
CO2: Solve transportation and assignment problem using optimization methods.
CO3: Solve linear problems by geme theory and replacement analysis.
CO4: Evaluate project details by CPM and PERT
CO5: Solve queing and sequencing problems.
CO6: Solve linear problems by dynamic programming

402045 C   Elective II Energy Audit and Management
CO1: Discuss: General aspects of Energy management, policy, action planning and environmental impact (India and world).
CO2: Compute: Energy Auditing and Energy conservation of Boiler and steam system, Furnace, DG sets, HVAC system, pumping system, Cooling tower and Compressed air system.
CO3: Illustrate: Costing of Utilities, Financial Analysis Techniques using simple payback, time value of money, NPV, ROI, IRR and sensitivity analysis.
CO4: Analyze: an energy performance assessment and efficiency improvement of Boilers, Furnaces, Heat exchangers, Fans and blowers, pumps, Compressors and HVAC systems thermal utilities

CO5: Determine: Energy efficiency of electrical utilities like electric motors, lighting systems etc.

CO6: Discuss : Cogeneration, Waste Heat recovery, CMD project and carbon credit calculations

402049 A Elective III Tribology

CO1: To provide the knowledge and importance of Tribology in design of machine elements.

CO2: To select proper grade lubricant for specific application.

CO3: To understand the principles and types of lubrication and lubrication regimes.

CO4: To introduce the concept of surface engineering and its importance in tribology.

402049 B Elective III Industrial Engineering

CO1: Define the concepts principles and framework of contents of Industrial Engineering

CO2: Explain different concepts involved in methods study content in different situations & the Industrial Engineering concept in the industrial environment

CO3: Explain different concepts involved in understanding of work content in different situations & the Industrial Engineering concept in the industrial environment

CO4: Develop various cost accounting and financial management practices widely applied in industries

CO5: Acquaint the students with different aspects of Production Planning and Control and Facility

CO6: Determine capability in integrating knowledge of design along with other aspects of value addition in the conceptualization and manufacturing stage of various products

402049 C Robotics

CO1: IDENTIFY Identify different type of robot configuration with relevant terminology.

CO2: SELECT Select suitable sensors, actuators and drives for robotic systems.

CO3: DISCUSS Understand kinematics in robotic systems.

CO4: DESIGN Design robot with desired motion with suitable trajectory planning.

CO5: SELECT Select appropriate robot programming for given application.

CO6: DISCUSS Understand need of IoT, machine learning, simulation in robotics.

402050 A Elective IV Advanced Manufacturing Processes

CO1: Justify the selection of special forming process for particular application

CO2: Justify the selection of advance joining process for particular application

CO3: Select the hybrid non-conventional manufacturing process for given application
CO4: Compare the various micro and nano fabrication techniques and it for given application
CO5: Explain the use of additive manufacturing in the product development
CO6: Categorize the various material characterization techniques

402050 B   Elective IV Solar & Wind Energy
CO1: DEFINE fundamentals of solar energy
CO2: EXPLAIN solar thermal systems and its applications
CO3: CLASSIFY solar photovoltaic and its applications
CO4: DIFFERENTIATE energy applications for domestic purpose
CO5: DESCRIBE fundamentals of wind energy
CO6: ANALYZE wind mill for domestic purpose

402050 C   Elective IV Product Design and Development
CO1: EXPLAIN Essential factors for product design
CO2: DESIGN Poduct as per customer needs and satisfaction
CO3: EXPLAIN Processes and concepts during product development
CO4: EXPLAIN Methods and processes of Forward and Reverse engineering
CO5: EXPLAIN various design processes as DFA,DFMEA, design for safety
CO6: EXPLAIN Understand the product life cycle and product data management