



HKBK COLLEGE OF ENGINEERING, Bengaluru, Karnataka
DEPARTMENT OF MECHANICAL ENGINEERING

Course outcome (Undergraduate Course outcome) for 2018 Scheme

Course Name: Elements of Mechanical Engineering

Sub code: 18 EME 15/25

CO	Course Outcomes
1.	Various Energy sources, Boilers, Prime movers such as turbines and IC engines, refrigeration and air-conditioning systems
2.	Metal removal process using Lathe, drilling, Milling Robotics and Automation
3.	. Fair understanding of application and usage of various engineering materials

Course Name: ENGINEERING GRAPHICS

Sub code: 18EGDL 15/25

CO	Course Outcomes
1.	Students will be able to demonstrate the usage of CAD software.
2.	Students will be able to visualize and draw Orthographic projections, Sections of solids and Isometric views of solids.
3.	Students are evaluated for their ability in applying various concepts to solve

Course Name: MATERIAL SCIENCE

Sub code: 18ME34

CO	Course Outcomes
1.	Describe the mechanical properties of metals, their alloys and various modes of failure.
2.	Understand the microstructures of ferrous and non-ferrous materials to mechanical properties.
3.	Explain the processes of heat treatment of various alloys.
4.	Understand the properties and potentialities of various materials available and material selection procedures.
5.	Know about composite materials and their processing as well as applications.

Course Name: BASIC THERMODYNAMICS**Sub code: 18ME33**

CO	Course Outcomes
1.	Explain thermodynamic systems, properties, Zeroth law of thermodynamics, temperature scales and energy interactions
2.	Determine heat, work, internal energy, enthalpy for flow & non flow process using First and Second Law of Thermodynamics.
3.	Interpret behavior of pure substances and its applications to practical problems.
4.	Determine change in internal energy, change in enthalpy and change in entropy using TD relations for ideal gases
5.	Calculate Thermodynamics properties of real gases at all ranges of pressure, temperatures using modified equation of state including Vander Waals equation, Redlich Wong equation and Beattie-Bridgeman equation

Course Name: **Mechanics of Materials** Sub code: 18ME32

CO	Course Outcomes
1.	Understand simple, compound, thermal stresses and strains their relations and strain energy
2.	Analyse structural members for stresses, strains and deformations.
3.	Analyse the structural members subjected to bending and shear loads.
4.	Analyse shafts subjected to twisting loads.
5.	:Analyse the short columns for stability

Course Name: METAL CUTTING AND FORMING**Sub Code: 18ME35A**

CO	Course Outcomes
1.	Explain the construction & specification of various machine tools.
2.	Discuss different cutting tool materials, tool nomenclature & surface finish.
3.	Apply mechanics of machining process to evaluate machining time.
4.	Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.
5.	Understand the concepts of different metal forming processes
6.	Apply the concepts of design of sheet metal dies to design different dies for simple sheet metal components

Course Name: Computer Aided Machine Drawing**Sub Code: 18ME36A**

CO	Course Outcomes
1.	Identify the national and international standards pertaining to machine drawing.
2.	Understand the importance of the linking functional and visualization aspects in the preparation of the part drawings
3.	Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies.
4.	Interpret the Machining and surface finish symbols on the component drawings.
5.	Preparation of the part or assembly drawings as per the conventions.

Course Name: MATERIALS TESTING LAB**Sub Code: 18MEL37A**

CO	Course Outcomes
1.	Acquire experimentation skills in the field of material testing.
2.	2.Develop theoretical understanding of the mechanical properties of materials by performing experiments.
3.	Apply the knowledge to analyze a material failure and determine the failure inducing agent/s.
4.	Apply the knowledge of testing methods in related areas.
5.	Know how to improve structure/behavior of materials for various industrial applications.

Course Name: WORKSHOP AND MACHINE SHOP PRACTICE**Sub Code: 18MEL38A**

CO	Course Outcomes
1.	To read working drawings, understand operational symbols and execute machining operations.
2.	Prepare fitting models according to drawings using hand tools- V-block, marking gauge, files, hack
3.	Understand integral parts of lathe, shaping and milling machines and various accessories and attachments used.
4.	Select cutting parameters like cutting speed, feed, depth of cut, and tooling for various machining operations.
5.	Perform cylindrical turning operations such as plain turning, taper turning, step turning, thread Cutting, facing, knurling, internal thread cutting, eccentric turning and estimate cutting time
6.	Perform machining operations such as plain shaping, inclined shaping, keyway cutting, Indexing and Gear cutting and estimate cutting time.

Course Name: MANAGEMENT AND ECONOMICS**Sub Code: 18ME51**

CO	Course Outcomes
1.	Understand needs, functions, roles, scope and evolution of Management
2.	Understand importance, purpose of Planning and hierarchy of planning and also analyze
3.	Discuss Decision making, Organizing, Staffing, Directing and Controlling
4.	Select the best economic model from various available alternatives
5.	Understand various interest rate methods and implement the suitable one.
6.	Estimate various depreciation values of commodities
7.	Prepare the project reports effectively

Course Name: DESIGN OF MACHINEELEMENTS-I**Sub Code: 18ME52**

CO	Course Outcomes
1.	Describe the design process, choose materials.
2.	Apply the codes and standards in design process.
3.	. Analyze the behavior of machine components under static, impact, fatigue loading using failure theories.
4.	Design shafts, joints, couplings.
5.	Design of riveted and welded joints.
6.	Design of threaded fasteners and power screws

Course Name: FLUID POWER ENGINEERING**Sub Code: 18ME55**

CO	Course Outcomes
1.	: Identify and analyse the functional requirements of a fluid power transmission system for a given application
2.	Visualize how a hydraulic/pneumatic circuit will work to accomplish the function.
3.	Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro- pneumatics for a given application.
4.	Select and size the different components of the circuit.
5.	Develop a comprehensive circuit diagram by integrating the components selected for the given application.

Course Name: Dynamics of Machinery**Sub Code: 18ME53**

CO	Course Outcomes
1.	Determine the forces and couples for static and dynamic conditions of four bar and slider crank mechanisms to keep the system in equilibrium.
2.	Determine magnitude and angular position of balancing masses under static and dynamic condition of rotating masses in same and different planes.
3.	Determine unbalanced primary, secondary forces and couples in single and multi-cylinder engine
4.	Determine sensitiveness, isochronism, effort and power of porter and hartnell governors.
5.	Determine gyroscopic couple and effects related to 2, 4 wheeler, plane disc, ship and aeroplanes.
6.	Understand types of vibration, SHM and methods of finding natural frequencies of simple mechanical systems
7.	Determine equation of motion, natural frequency, damping factor, logarithmic decrement of damped free vibration (SDOF) systems.
8.	Determine the natural frequency, force and motion transmissibility of single degree freedom systems.
9.	Determine equation of motion of rotating and reciprocating unbalance systems, Magnification factor, and transmissibility of forced vibration (SDOF) systems.

Course Name: TURBO MACHINES**Sub Code: 18ME54**

CO	Course Outcomes
1.	Cable to give precise definition of turbomachinery
2.	Identify various types of turbo machinery
3.	Apply the Euler's equation for turbomachinery to analyse energy transfer in turbomachines
4.	Understand the principle of operation of pumps, fans, compressors and turbines.
5.	CO5 Perform the preliminary design of turbomachines (pumps, rotary compressors and turbines)
6.	Analyze the performance of turbo machinery

Course Name: OPERATIONS MANAGEMENT**Sub Code: 18ME56**

CO	Course Outcomes
1.	Explain the concept and scope of operations management in a business context
2.	:Recognize the role of Operations management among various business functions and its role in the organizations' strategic planning and gaining competitive advantage.
3.	Analyze the appropriateness and applicability of a range of operations management systems/models indecision making.
4.	Assess a range of strategies for improving the efficiency and effectiveness of organizational operations.
5.	Evaluate a selection of frameworks used in the design and delivery of operations

Course Name: OPERATIONS MANAGEMENT**Sub Code: 18MEL57**

CO	Course Outcomes
1.	Perform experiments to determine the coefficient of discharge of flow measuring devices.
2.	Conduct experiments on hydraulic turbines and pumps to draw characteristics.
3.	Test basic performance parameters of hydraulic turbines and pumps and execute theknowledge in real life situations.
4.	Determine the energy flow pattern through the hydraulic turbines and pumps
5.	Exhibit his competency towards preventive maintenance of hydraulic machines

Course Name: ENERGY CONVERSION LABORATORY**Sub Code: 18MEL58**

CO	Course Outcomes
1.	Perform experiments to determine the properties of fuels and oils.
2.	Conduct experiments on engines and draw characteristics.
3.	Test basic performance parameters of I.C. Engine and implement the knowledge in industry.
4.	Identify exhaust emission, factors affecting them and report the remedies.
5.	Determine the energy flow pattern through the I C Engine
6.	Exhibit his competency towards preventive maintenance of IC engines.

Course Name: MECHANICAL MEASUREMENT AND METROLOGY**Sub Code: 18ME46B**

CO	Course Outcomes
1.	Understand the objectives of metrology, methods of measurement, selection of measuring instruments, standards of measurement and calibration of end bars
2.	Describe slip gauges, wringing of slip gauges and building of slip gauges, angle measurement using sine bar, sine center, angle gauges, optical instruments and straightness measurement using Autocollimator
3.	Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design. U
4.	Understand the principle of Johnson Mikrokator, sigma comparator, dial indicator, LVDT, back pressure gauges, Solex comparators and Zeiss Ultra Optimeter
5.	Describe measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2 – wire, 3 – wire methods, screw thread gauges and tool maker's microscope.
6.	Explain measurement of tooth thickness using constant chord method, addendum comparator methods and base tangent method, composite error using gear roll tester and measurement of pitch, concentricity, run out and involute profile
7.	Understand laser interferometers and Coordinate measuring machines
8.	Explain measurement systems, transducers, intermediate modifying devices and terminating devices.
9.	Describe functioning of force, torque, pressure, strain and temperature measuring devices

Course Name: Applied Thermodynamics**Sub Code: 18ME42**

CO	Course Outcomes
1.	Apply thermodynamic concepts to analyze the performance of gas power cycles.
2.	Apply thermodynamic concepts to analyze the performance of vapour power cycles.
3.	Understand combustion of fuels and performance of I C engines.
4.	Understand the principles and applications of refrigeration systems.
5.	Apply Thermodynamic concepts to determine performance parameters of refrigeration and air conditioning systems.
6.	Understand the working principle of Air compressors and Steam nozzles, applications, relevance of air and identify methods for performance improvement.

Course Name: Kinematics of Machines**Sub Code: 18ME44**

CO	Course Outcomes
1.	Knowledge of mechanisms and their motion.
2.	Understand the inversions of four bar mechanisms
3.	Analyse the velocity, acceleration of links and joints of mechanisms.
4.	Analysis of cam follower motion for the motion specifications.
5.	Understand the working of the spur gears.
6.	Analyse the gear trains speed ratio and torque.

Course Name: METAL CASTING AND WELDING**Sub Code: 18ME45B**

CO	Course Outcomes
1.	Describe the casting process and prepare different types of cast products.
2.	Acquire knowledge on Pattern, Core, Gating, Riser system and to use Jolt, Squeeze, Sand Slingermoulding machines.
3.	Compare the Gas fired pit, Resistance, Coreless, Electrical and Cupola Metal Furnaces.
4.	Compare the Gravity, Pressure die, Centrifugal, Squeeze, slush and Continuous Metal mouldcastings.
5.	Understand the Solidification process and Casting of Non-Ferrous Metals.
6.	Describe the Metal Arc, TIG, MIG, Submerged and Atomic Hydrogen Welding processes etc. used in manufacturing.
7.	Describe methods for the quality assurance of components made of casting and joining process

Course Name: FLUID MECHANICS**Sub Code: 18ME43**

CO	Course Outcomes
1.	Identify and calculate the key fluid properties used in the analysis of fluid behavior.
2.	Explain the principles of pressure, buoyancy and floatation
3.	Apply the knowledge of fluid statics, kinematics and dynamics while addressing problems of mechanical and chemical engineering.
4.	Describe the principles of fluid kinematics and dynamics. Explain the concept of boundary layer in fluid flow and apply dimensional analysis to form dimensionless numbers in terms of input output variables.
5.	Illustrate and explain the basic concept of compressible flow and CFD

Course Name: MECHANICAL MEASUREMENTS AND METROLOGY LABORATORY**Sub Code: 18MEL47B**

CO	Course Outcomes
1.	To calibrate pressure gauge, thermocouple, LVDT, load cell, micrometer.
2.	To measure angle using Sine Center/ Sine Bar/ Bevel Protractor, alignment using Autocollimator/ Roller set.
3.	To demonstrate measurements using Optical Projector/Tool maker microscope, Optical flats.
4.	To measure cutting tool forces using Lathe/Drill tool dynamometer.
5.	To measure Screw thread parameters using 2-Wire or 3-Wire method, gear tooth profile using gear tooth vernier/Gear tooth micrometer.
6.	To measure surface roughness using Tally Surf/ Mechanical Comparator.

Course Name: FOUNDRY, FORGING AND WELDING LAB**Sub Code: 18MEL48B**

CO	Course Outcomes
1.	Demonstrate various skills in preparation of molding sand for conducting tensile, shear and compression tests using Universal sand testing machine.
2.	Demonstrate skills in determining permeability, clay content and Grain Fineness Number of basesands.
3.	Demonstrate skills in preparation of forging models involving upsetting, drawing and bending operations.

Course Name: NON CONVENTIONAL ENERGY SOURCES

Sub Code: 18ME651

CO	Course Outcomes
1.	Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations.
2.	Know the need of renewable energy resources, historical and latest developments
3.	Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation, drying, cooking etc.
4.	Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.
5.	Understand the concept of Biomass energy resources and their classification, types of biogas Plants applications
6.	Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations.
7.	Acquire the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications

Course Name: Design of Machine Elements II

Sub Code: 18ME62

CO	Course Outcomes
1.	To understand various elements involved in a mechanical system.
2.	To analyze various forces acting on the elements of a mechanical system and design them using appropriate techniques, codes, and standards.
3.	To select transmission elements like gears, belts, pulleys, bearings from the manufacturers' catalogue.
4.	To design completely a mechanical system integrating machine elements.
5.	To produce assembly and working drawings of various mechanical systems involving machine elements like belts, pulleys, gears, springs, bearings, clutches and brakes.

Course Name: **Heat Transfer** Sub Code: 18ME63

CO	Course Outcomes
1.	Understand the basic modes of heat transfer.
2.	Compute temperature distribution in steady-state and unsteady-state heat conduction
3.	Understand and interpret heat transfer through extended surfaces.
4.	Interpret and compute forced and free convective heat transfer.
5.	Explain the principles of radiation heat transfer and understand the numerical formula for heat conduction problems.
6.	Design heat exchangers using LMTD and NTU methods

Course Name: Finite Element Methods**Sub Code: 18ME61**

CO	Course Outcomes
1.	Understand the concepts behind formulation methods in FEM.
2.	Identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.
3.	Develop element characteristic equation and generation of global equation.
4.	Able to apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axi symmetric and dynamic problems and solve them displacements, stress and strains induced.

Course Name: **NON-TRADITIONAL MACHINING** Sub Code: 18ME641

CO	Course Outcomes
1.	: Understand the compare traditional and non-traditional machining process and recognize the need for Non- traditional machining process.
2.	Understand the constructional features, performance parameters, process characteristics, applications, advantages and limitations of USM, AJM and WJM.
3.	Identify the need of Chemical and electro-chemical machining process along with the constructional features, process parameters, process characteristics, applications, advantages and limitations.
4.	Understand the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM & PAM.
5.	Understand the LBM equipment, LBM parameters, and characteristics. EBM equipment and mechanism of metal removal, applications, advantages and limitations LBM & EBM.

Course Name: SUPPLY CHAIN MANAGEMENT**Sub Code: 18ME653**

CO	Course Outcomes
1.	Understand the framework and scope of supply chain management.
2.	: Build and manage a competitive supply chain using strategies, models, techniques and information technology.
3.	Plan the demand, inventory and supply and optimize supply chain network.
4.	Understand the emerging trends and impact of IT on Supply chain.

Course Name: **HEAT TRANSFER LABORATORY** Sub Code: 18MEL67

CO	Course Outcomes
1.	Perform experiments to determine the thermal conductivity of a metal rod
2.	Conduct experiments to determine convective heat transfer coefficient for free and forced convection and correlate with theoretical values.
3.	Estimate the effective thermal resistance in composite slabs and efficiency in pin-fin Determine surface emissivity of a test plate
4.	Estimate performance of a refrigerator and effectiveness of fin
5.	Calculate temperature distribution of steady and transient heat conduction through plane wall, cylinder and fin using numerical approach.

Course Name: COMPUTER AIDED MODELING AND ANALYSIS LABORATORY**Sub Code:** 18MEL66

CO	Course Outcomes
1.	Demonstrate the basic features of an analysis package.
2.	Use the modern tools to formulate the problem, and able to create geometry, descritize, apply boundary condition to solve problems of bars, truss, beams, plate to find stress with differentloading conditions.
3.	Demonstrate the deflection of beams subjected to point, uniformly distributed and varying loads further to use the available results to draw shear force and bending moment diagrams.
4.	Analyze the given problem by applying basic principle to solve and demonstrate 1D and 2D heat transfer with conduction and convection boundary conditions.
5.	Carry out dynamic analysis and finding natural frequencies for various boundary conditions and also analyze with forcing function

Course Name: AUTOMATION & ROBOTICS**Sub Code:** 18ME732

CO	Course Outcomes
1.	: Translate and simulate a real time activity using modern tools and discuss the Benefits of automation.
2.	Identify suitable automation hardware for the given application.
3.	: Recommend appropriate modelling and simulation tool for the given manufacturing Application
4.	Explain the basic principles of Robotic technology, configurations, control and Programming of Robots.
5.	Explain the basic principles of programming and apply it for typical Pick & place, Loading & unloadingand palletizing applications

Course Name: COMPUTER AIDED DESIGN AND MANUFACTURING**Sub Code:** 18ME72

CO	Course Outcomes
1.	: Define Automation, CIM, CAD, CAM and explain the differences between these concepts. Solvesimple problems of transformations of entities on computer screen
2.	Explain the basics of automated manufacturing industries through mathematical models and analyzedifferent types of automated flow lines.
3.	Analyse the automated flow linestoreduce time and enhance productivity.
4.	Explain the use of different computer applications in manufacturing, and able to prepare part programsforsimple jobs on CNC machine tools and robot programming.
5.	Visualize and appreciate the modern trends in Manufacturing like additive manufacturing, Industry 4.0and applications of Internet of Things leading to Smart Manufacturing

Course Name: CONTROL ENGINEERING**Sub Code:** 18ME71

CO	Course Outcomes
1.	Recognize control system and its types , control actions
2.	Determine the system governing equations for physical models(Electrical, Thermal,
3.	Calculate the gain of the system using block diagram and signal flow graph
4.	Illustrate the response of 1st and 2nd order systems
5.	Determine the stability of transfer functions in complex domain and frequency domain
6.	Employ state equations to study the controllability and observability

Course Name: ENERGY AND ENVIRONMENT

Sub Code: 18ME751

CO	Course Outcomes
1.	Understand energy scenario, energy sources and their utilization.
2.	Understand various methods of energy storage, energy management and economic analysis.
3.	Analyse the awareness about environment and eco system.
4.	Understand the environment pollution along with social issues and acts.

Course Name: MECHATRONICS

Sub Code: 18ME744

CO	Course Outcomes
1.	. Illustrate various components of Mechatronics systems.
2.	Assess various control systems used in automation.
3.	Develop mechanical, hydraulic, pneumatic and electrical control systems.

Course Name: DESIGN LABORATORY

Sub Code: 18MEL77

CO	Course Outcomes
1.	To understand the working principles of machine elements such as Governors, Gyroscopes etc.,
2.	. To identify forces and couples in rotating mechanical system components.
3.	To identify vibrations in machine elements and design appropriate damping methods and to determine the critical speed of a rotating shaft.
4.	To measure strain in various machine elements using strain gauges.
5.	To determine the minimum film thickness, load carrying capacity, frictional torque and pressure distribution of journal bearing.
6.	To determine strain induced in a structural member using the principle of photo-elasticity.

Course Name: COMPUTER AIDED MANUFACTURINGLAB

Sub Code: 18MEL76

CO	Course Outcomes
1.	To expose the students to the techniques of CNC programming and cutting tool path generation through CNC simulation software by using G-Codes and M-codes.
2.	To educate the students on the usage of CAM packages.
3.	To make the students understand the importance of automation in industries through exposure to FMS, Robotics, and Hydraulics and Pneumatics.

Course Name: ENERGY ENGINEERING

Sub Code: 18ME81

CO	Course Outcomes
1.	Understand the construction and working of steam generators and their accessories.
2.	Identify renewable energy sources and their utilization.
3.	Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, nuclear, hydel and tidal.

Course Name: NON-DESTRUCTIVE TESTING AND EVALUATION

Sub Code: 18ME823

CO	Course Outcomes
1.	Classify various non-destructive testing methods.
2.	Check different metals and alloys by visual inspection method.
3.	Explain and perform non-destructive tests like: Liquid penetrant test, Magnetic particle test, Ultrasonic test, X-ray and Gamma ray radiography, Leak Test, Eddy current test.
4.	Identify defects using relevant NDT methods.
5.	Differentiate various defect types and select the appropriate NDT methods for better evaluation.