K S INSTITUTE OF TECHNOLOGY, BENGALURU

DEPARTMENT OF EMCHANICAL ENGINEERING

COURSE OUTCOME FOR 2019-23 Batch

Course: Engineering Mathematics – III (18MAT31)	
CO1	Utilize Numerical techniques for various finite difference technique problems
CO2	Make use of Fourier series to analyze wave forms of periodic functions
CO3	Identify statistical methods to find correlation and regression lines, also numerical methods to solve transcendental equations.
CO4	Obtain the Fourier and Z - transforms to analyze wave forms of non periodic functions
CO5	Construct Greens, divergence and Stokes theorems for various engineering applications

Course: Mechanics Of Materials (18ME32)	
CO1	Utilize the concept of mechanics to solve the art of state problems on stress & strain
CO2	Make use of the concept of stress and strain to solve compound stress and cylinder problems.
CO3	Construct Shear Force and Bending Moment model of beam application and solve for its stresses
CO4	Utilization of pure torsion & column equations in structural application
CO5	Select theory of failure & strain energy equation for solving engineering problems

Course: Basic Thermodynamics (18ME33)	
CO1	**Identify** thermodynamic systems, properties, Zeroth law of thermodynamics, temperature scales, work and heat interactions.
CO2	**Determine** heat, work, internal energy, enthalpy for flow & non flow process using First and Second Law of Thermodynamics.
CO3	**Calculate** change in internal energy, change in enthalpy, change in entropy, efficiency and cop for Reversible and irreversible process.
CO4	**Make use of** the behaviour of pure substances and its applications to practical problems. compare the Availability and Irreversibility.
CO5	**Evaluate** the properties of ideal ,real gases and air- water mixture.

Course: Material Science (18ME34)	
CO1	**Interpret** the basic concepts of crystal structure, concepts of diffusion, mechanical behavior of materials and various modes of failure.
CO2	**Classify** solid solutions, interpret equilibrium phase diagrams of ferrous and nonferrous alloys and mechanism of solidification.
CO3	**Relate** suitable heat-treatment process to achieve desired properties of metals and alloys
CO4	**Interpret** the properties and applications of various materials like ceramics, plastics and Smart materials.
CO5	**Identify** various composite materials and their processing as well as applications.

Course: Subject: METAL CUTTING AND FORMING (18ME35A)	
CO1	**Interpret** the basic concepts of crystal structure, concepts of diffusion, mechanical behavior of materials and various modes of failure.
CO2	**Classify** solid solutions, interpret equilibrium phase diagrams of ferrous and nonferrous alloys and mechanism of solidification.
CO3	**Relate** suitable heat-treatment process to achieve desired properties of metals and alloys
CO4	**Interpret** the properties and applications of various materials like ceramics, plastics and Smart materials.
CO5	**Identify** various composite materials and their processing as well as applications.

Course: COMPUTER AIDED MACHINE DRAWING (18ME36A)	
CO1	Develop the sectional views of the solids and Draw the orthographic views of the machine components by using CAD software.
CO2	Build the 2D views and 3D drawings of simple machine parts/ Threaded fasteners.
CO3	Construct the views of machine elements including keys, Couplings and joints.
CO4	Inspect Limits, Fits, Tolerances and level of surface finish of machine elements.
CO5	Create 2D and 3D models by standard CAD software with manufacturing considerations.

Course: MATERIALS TESTING LAB (18MEL37A)	
CO1	**Understand** & acquire experimentation skills in the field of material testing.
CO2	**Understanding** of the mechanical properties of materials by performing experiments.
CO3	Apply the knowledge to analyze a material failure and determine the failure inducing agent/s.
CO4	Apply the knowledge of testing methods in related areas.
CO5	Evaluate how to improve structure/behaviour of materials for various industrial applications.

Course: Workshop and Machine Shop Practice (18MEL38A)	
CO1	Perform turning, facing, knurling, thread cutting, tapering, eccentric turning and allied operations, Perform keyways / slots, grooves etc using shaper
CO2	Perform gear tooth cutting using milling machine.
CO3	Understand the formation of cutting tool parameters of single point cutting tool using bench grinder / tool and cutter grinder
CO4	Understand Surface Milling/Slot Milling.
CO5	Exhibit interpersonal skills towards working in a team.

Subject :ENGG. MATHEMATICS – IV (18MAT41)	
CO1	Apply Numerical methods to obtain the solution of fist order and first degree differential equations.
CO2	Make use of probability theory on discrete and continuous random variables to obtain the solution of problems on different distributions and joint probability distribution.

CO3	Identify the problems on sampling distribution and on markov chains in attempting the engineering problems for feasible random events.
CO4	Utilize the Bessel's and Legendre functions for the problems arising in engineering fields.
CO5	Construct the analytic functions. Calculate residues and poles of complex potentials in flow problems.

Course: Applied Thermodynamics (18ME42)	
CO1	**Identify** the basic thermodynamic cycles like otto,Diesel, Dual and gas turbine cycles applied in IC engine and gas turbine Applications .
CO2	**Apply** Basic thermo dynamic cycles used in the steam power plants for power productions based on Rankine cycle .
CO3	**Build** combustion parameters for correct heat combustion for given air fuel ratio, efficiency calculations along with performance and testing of IC Engines.
CO4	**Construct** refrigeration systems based on various refrigeration cycles along with air conditioning systems .
CO5	**Make use of** the basic formulations for reciprocating compressors and steam nozzles for efficiency and effect of friction. .

Course: Fluid Mechanics (18ME43)	
CO1	Identify the need of the fluid properties used for the analysis of fluid behavior.
CO2	Utilize the knowledge of kinematics and dynamics while addressing problems of fluid flow. Make use of the principles of bernoulli's theorem to derive an expression for discharge of different flow measuring devices
CO3	Derive an expression for loss of head due to friction in pipes and also an equation of hagen poiseille's for laminar flow through pipe and parallel plates.
CO4	Analyze the development of boundary layer due to the flow over a flat plate and further identify the difference between lift and drag forces for both compressible and incompressible fluid flow.
CO5	Solve the industrial related gas turbine and engines problems using the basic concept of compressible flow and CFD.

Course: KINEMATICS OF MACHINERY (18ME44)	
CO1	**Understanding** the basic terminology of planar mechanisms and their motion study.
CO2	**Model** displacement diagrams for followers with various types of motions and Cam profile drawing for various followers.
CO3	**Evaluating** the transmission of power by application of various gears and gear trains.
CO4	**Constructing** velocity and acceleration diagrams for planar mechanisms by Graphical method
CO5	**Inspect** velocity and acceleration of planar mechanisms by complex algebra method and kinematic synthesis of four bar and slider crank kinematic chain

Course: Metal Casting and Welding (18ME45B)	
CO1	Classify the casting process, different moulding techniques, pattern, Core, and Gating, Riser system and Molding Machines.

CO2	Explain working and parameters of different furnaces and the different casting Techniques.
CO3	Illustrate about the Solidification process in and Casting of ferrous and Non-Ferrous Metals.
CO4	Make use of the knowledge of the welding process used in manufacturing.
CO5	Make use of the Metallurgical aspects in Welding and inspection Methods for the quality assurance of components made of casting and joining process in the manufacturing industry.

Course: Mechanical Measurements and Metrology (18ME46B)	
CO1	**Explain** the basic concepts of metrology, standards of measurement and working principles of different comparators.
CO2	**Select** the limits of size, fits, geometric and position tolerances, gauges and their design and calibration process of instruments such as slip gauges, sine bar, sine center and Autocollimator.
CO3	**Interpret** the nomenclature and measuring methods of screw threads and gears.
CO4	**Illustrate** the measurement systems, transducers, intermediate modifying devices and terminating devices.
CO5	**Summarize** the functioning of force, torque, pressure, strain and temperature measuring devices.

Course: Mechanical Measurements and Metrology lab (18ME47B)	
CO1	Explain calibration of pressure gauge, thermocouple, LVDT, load cell and micrometer
CO2	Find angle using Sine Center/ Sine Bar/ Bevel Protractor, alignment using Autocollimator/ Roller set.
CO3	Obtainmeasurements using Optical Projector/Tool maker microscope, Optical flats.
CO4	Determine cutting tool forces using Lathe/Drill tool dynamometer.
CO5	Find Screw thread parameters using 2-Wire or 3-Wire method, gear tooth profile using gear tooth vernier/Gear tooth micrometer.

Course: FOUNDRY AND FORGING LAB (18ME48B)	
CO1	**Analyze** and optimize foundry sand, core sand to a particular application.
CO2	**Build** moulds with or without patterns.
CO3	**Understand** casting of ferrous and non-ferrous objects.
CO4	**Develop** skills in making forging models manually and also with the use of power hammers.

Course: Management and Economics (18ME51)	
CO1	**Explain** the concepts of management and understand the importance of planning, organizing, staffing, directing and controlling in the development of organization.
CO2	**Understand** comprehensive concepts of engineering and economics and identify the alternative uses of limited resources to select the prefered course of action for decision makers.

CO3	**Apply** suitable organizational structure, motivation theories with sound communication tools.
CO4	**Solve** compound interest factors, different economic models such as PWC, FWC, AEC & Rate of return in the process of decision making.
CO5	Calculate the total cost of the products and depreciation of assets using different methods.

Course : DESIGN OF MACHINE ELEMENTS -I (18ME52)	
CO1	Understand the design process, material selection, codes & standards, behaviour of component under impact and cyclic loading
CO2	Determine the stresses induced in a component due to eccentric, torsional impact and reversed bending loads and fatigue loads.
CO3	Determine dimensions of couplings, keys and the corresponding stress developed.
CO4	Design and analyze the riveted joints and welded brackets under transverse and parallel welds.
CO5	Analyze the stresses developed in Joints, threaded fasteners and power screw under static and dynamic loads.

Course: DYNAMICS OF MACHINERY (18ME53)	
CO1	Establish the characteristics of centrifugal governors and gyroscopic effect on ships, aeroplanes & vehicles
CO2	Utilize the concept of balancing in rotating and reciprocating parts of machinery.
CO3	Analyze the effect of static and dynamic equilibrium of forces in planar mechanisms.
CO4	Understand the concept of SHM and determine natural frequencies in un-damped free vibrations of single degree freedom systems
CO5	Inspect the nature of damped free vibrations and Forced vibration of single degree freedom systems.

Course: Turbo machines (18ME54)	
CO1	**Illustrate** the need of dimensional analysis, specific speed, degree of reaction, utilization factor to classify the turbo machines
CO2	**Explain** the working of steam turbine, hydraulic turbine and centrifugal pump based on fluid inlet and exit conditions
CO3	**Make use of** the dimensionless parameter, degree of reaction and fluid inlet and exit directions for **identifying** the type of turbo machine
CO4	**Select** a suitable hydraulic turbine for the analysis based on head, energy input, specific speed and quantity of fluid flowing and **identify** the effect of compounding in steam turbines
CO5	**Identify** the difference between single and multi-stage centrifugal pumps and compressors

Course: Fluid Power Engineering (18ME55)	
CO1	Identify the components of fluid power system (Hydraulic & Pneumatic) with different types of fluids for industrial applications
CO2	Select the types of pumps and actuators for various applications

CO3	Distinguish the types of control valves used in fluid power system with circuit design
CO4	Compare the pneumatic control valves with the hydraulic system
CO5	Examine an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application

Course: Fluid Power Engineering (18ME55)	
CO1	Understand the fundamental basis and nature of operation management techniques for the manufacturing Industry and also to assess a range of strategies for improving the efficiency and effectiveness oforganizational operations
CO2	Analyze the appropriateness and applicability of a range of operations management systems/models in decision making and forecasting techniques.
CO3	Evaluate various facility alternatives and their capacity decisions and sequencing techniques in operations management environment.
CO4	Summarize Aggregate Planning & Master Scheduling methods by graphical, charting techniques and mathematical techniques as applied to product and process industries.
CO5	Assess the operational issues between Industry, vendor and customer by using Material Requirement Planning (MRP), Purchasing and Supply Chain Management (SCM).

Course: FLUID MECHANICS AND MACHINES LABORATORY (18MEL57)	
CO1	Estimate the coefficient of friction and head losses in pipes and forces developed by impact of jet on vanes
CO2	Experiment with different types of flow measuring devices.
CO3	Evaluate performance of power generating fluid machines
CO4	Evaluate performance of power absorbing fluid machines
CO5	Evaluate the performance of Reciprocating compressor and air blower

Course: ENERGY LABORATORY (18MEL58)

CO1	**Experiment with** different fuels to measure its properties like flash point, fire point and calorific value
CO2	**Determine** viscosity of different grades of oil at various temperatures using say bolt and redwood viscometer
CO3	Construct actual port timing and valve timing diagram for 4-stroke engine to identify the valve overlap
CO4	**Evaluate** the results of tests on single cylinder four stroke petrol engines and diesel engine and analyze performance curves
CO5	**Determine** the emission values of diesel and petrol engines using gas analyzer inserted into exhaust pipe of engine

Course: Finite Element Method (18ME61)	
CO1	Identify the basic procedures implemented in FEM along with reduction of execution time and memory requirements for given engineering problem
CO2	Construct the basic algorithms or numerical procedures to solve simple bar and truss problems subjected to axial loading

CO3	Make use of finite element matrix to solve lateral and torsional loaded members confined to regular shapes
CO4	Construct the fundamental numerical procedures required to solve thermal and fluid flow problems confined to simple loading conditions
CO5	Establish a relation between mass and stiffness matrix to solve dynamic problems along with axisymmetric ring elements

Course : DESIGN OF MACHINE ELEMENTS -II (18ME62)	
CO1	**Apply** design principles for the design of mechanical systems involving springs, belts, pulleys, and wire ropes.
CO2	**Make use of** beam analysis to design the different gear systems like spur & helical gears
CO3	**Evaluate** the efficiency of the Bevel & worm gears drives for relevant applications:
CO4	**Apply** the Design Principles for the design of Brakes & Clutches.
CO5	**Apply** design concepts of hydrodynamic bearings for different applications and select Anti friction bearings for different applications using the manufacturers, catalogue.

Course : Heat Transfer (18ME63)	
CO1	Illustrate the three modes of heat transfer and interpret conduction heat transfer equations for slab or cylinders or spheres in both steady and unsteady states
CO2	Explain the various correlations for force, free convection, radiation, condensation and heat exchangers.
CO3	Make us of thermal resistance concept to solve numerical on slabs, cylinders, fins in steady state and infinite, semi-infinite solids in unsteady state.
CO4	Examine the type of correlation to be used suitably so as to analyse convection heat transfer for various applications and Boiling and condensation
CO5	Analyse the methods, to find the exit temperature of fluid and size of heat exchangers, also radiation heat transfer rate from black bodies, real surface and thermal shield.

Course: Non-Traditional Machining (18ME641)

CO1	**Explain** the needs, advantages, limitations and applications of non-traditional machining process viz; USM, AJM, WJM, ECM, CHM, EDM, PAM, LBM, and EBM.
CO2	**Compare** the various traditional and non-traditional machining processes and **Classify** and select the various non-traditional machining processes based on nature of energy employed.
CO3	**Explain** the constructional features of USM, AJM, WJM, ECM, CHM, EDM, PAM, LBM, and EBM.
CO4	**Explain** the working principle of USM, AJM, WJM, ECM, CHM, EDM, PAM, LBM, and EBM.
CO5	**Make use of** process characteristics and parameters to **analyze** the performance of USM, AJM, WJM, ECM, CHM, EDM, PAM, LBM, and EBM.

Course: Computer Aided Modeling and Analysis Lab (18MEL66)

CO1	Understand the basic concepts of representation of engineering problems in to one dimensional modeling and analysis.
CO2	Solve truss problems using one dimensional concept
CO3	Solve bending moment and shear force representation for various loading cases. Solve rectangular plate with a circular hole problem under uni-axial loading.
CO4	Solve thermal problems using one dimensional and two-dimensional FEA concepts
CO5	Solve Dynamic problems through one dimensional FEA concept.

Course: HEAT TRANSFER LABORATORY (18MEL67)	
CO1	Perform experiments to **determine** the thermal conductivity of a metal rod
CO2	**Estimate** the effective thermal resistance in composite slabs and efficiency in pin-fin
CO3	Conduct experiments to **determine** convective heat transfer coefficient for free and forced convection and correlate with theoretical values
CO4	**Determine** surface emissivity of a test plate and Steffan Boltzman Constant
CO5	**Determine** LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers**,** Estimate performance of a Vapour Compression Refrigeration.

Course: MINI PROJECT (18MEMP68)	
CO1	Practice acquired knowledge within the chosen area of technology for project development.
CO2	Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
CO3	Reproduce, improve and refine technical aspects for engineering projects by applying theknowledge of design/solve complex engineering problems by the usage of modern tools.
CO4	Work as an individual or in a team in development of technical projects.
CO5	Communicate and report effectively project related activities and findings.

Course: Control Engineering (18ME71)	
CO1	Explain concepts of loop systems and different types of controllers.
CO2	Construct mathematical models to understand transfer function of mechanical, electrical and hydraulic control systems with block diagrams and SFG.
CO3	Build the concept of transient and steady state system and solve frequency response analysis.
CO4	Solve Bode plots and Root locus plots for frequency response analysis.
CO5	Develop state equation of linear continuous data for controllability and observability.

Course: COMPUTER AIDED DESIGN AND MANUFACTURING (18ME72)	
CO1	Define automation, CIM,CAD,CAM& explain differences between these concepts. Solve simple problems of transformations of entities on computer screen.
CO2	Explain the basics of automated manufacturing industries through mathematical models and analyze different types of automated flow lines
CO3	Analyze the automated flowlines to reduce time and enhance productivity
CO4	Explain the use of different computer applications in manufacturing and able to prepare part program for simple jobs on CNCand Robot Programming

CO5	Visualize and appreciate the modern trends in manufacturing like additive manufacturing industry 4.0 and applications of IOT leading to smart manufacturing.

Course: Additive Manufacturing (18ME741)	
CO1	Understanding the Additive Manufacturing process, Systems drives and actuators used in it
CO2	Discussing the Polymerization and Powder Metallurgy process and the importance of Nanotechnology
CO3	Summarizing the characterisation techniques used in Powder Metallurgy process
CO4	Explaining the characterisation techniques used on Nanomaterials
CO5	Acquiring Knowledge on CNC and Automation

Course: Computer Integrated Manufacturing Lab (18MEL76)	
CO1	**Explain** the concepts of Computer Integrated manufacturing and Classify NC,CNC and DNC systems.
CO2	**Develop** manual part programs to perform milling, drilling and turning operations in design, simulation and manufacturing.
CO3	**Analyze** the Simulation of Tool Path for different Machining operations of small components using CNC Lathe & CNC Milling Machine.
CO4	**Identify** the concepts of flexible manufacturing systems like Automatic storage and Retrieval system and utilize Robot programming language for simple operations such as pick and place, stacking objects using teach pendent and off line programming.
CO5	**Apply** the knowledge of pneumatics and hydraulics to demonstrate the related experiments.

Course: DESIGN LABORATORY (18MEL77)	
CO1	To determine the natural frequency, logarithmic decrement, damping ratio and damping coefficient in a SDOF systems subjected to longitudinal and torsional vibrations.
CO2	To construct force and couple polygons to balance the rotating masses.
CO3	To utilize the principles of photo elasticity and determine the fringe constant and stress concentration of photo elastic materials subject to different loads.
CO4	To calculate equilibrium speed, sensitiveness, power and effort of Porter and Hartnell Governor.
CO5	To obtain Pressure distribution in Journal bearing and find the critical speed of a rotating shaft.

Course: PROJECT PHASE I (18MEP78)	
CO1	Review the research literature,identify and analyze the complex engineering problems, formulate the sustainable conclusions or solutions using the basic principles of applied mathematics,science and engineering
CO2	Design proper methodology to derive the solutions for the existing or anticipated complex engineering problems in concern with the issues of public health ,safety societal, cultural and environmental areas.

CO3	Practice and establish the professional engineering methodology for sustainable development in the society to address the complex engineering problems associated with societal and environmental factors.
CO4	Form internal & external group to work together as a team in the project under consideration under multi disciplinary settings.
CO5	Communicate effectively addressing the complex engineering activities with documentation reports and proper presentation tools.

Course: Energy Engineering (18ME81)	
CO1	**Summarize** the basic concepts of Thermal energy systems, Diesel power plant, Hydel power plant, renewable energy sources and their utilization.
CO2	**Understand** the basic concepts of solar energy, Green energy, zero energy and energy from alternate sources.
CO3	**Apply** the basic concepts for Thermal and Hydel power plant
CO4	**Make use of the** basic concepts solar and wind energy to analyse it
CO5	**Identify** the concepts and applications of Bio mass energy, Green energy and zero energy.

Course: Tribology(18ME822)	
CO1	Understand the fundamentals of tribology and associated parameters
CO2	Apply concepts of tribology for the performance analysis and design of components experiencing relative motion
CO3	Analyse the requirements and design hydrodynamic journal and plane slider bearings for a given application
CO4	Select proper bearing materials and lubricants for a given tribological application
CO5	Apply the principles of surface engineering for different applications of tribology

Course: PROJECT PHASE II (18MEP83)	
CO1	Review the research literature,identify and analyze the complex engineering problems, formulate the sustainable conclusions or solutions using the basic principles of applied mathematics,science and engineering
CO2	Design proper methodology to derive the solutions for the existing or anticipated complex engineering problems in concern with the issues of public health ,safety societal, cultural and environmental areas.
CO3	Practice and establish the professional engineering methodology for sustainable development in the society to address the complex engineering problems associated with societal and environmental factors.
CO4	Form internal & external group to work together as a team in the project under consideration under multi disciplinary settings.
CO5	Communicate effectively addressing the complex engineering activities with documentation reports and proper presentation tools.

Course: TECHNICAL SEMINAR (18MES84)	
CO1	Reviewing of advanced or recent technologies in the field of mechanical engineering
CO2	Investigate and study the literature of recent technologies from various sources

CO3	Skill to write detailed technical report describing the gained knowledge
CO4	Enhances the effective communication and presentation skill.

INTERNSHIP/PROFESSIONAL PRACTICE (18ME85)	
CO1	Apply modern techniques, resources, engineering and IT tools while addressing complex engineering problems.
CO2	Demonstrate the contextual knowledge to access societal, health, safety and cultural issues normally encountered in industries.
CO3	Contribute through engineering solutions for the sustainable development in societal and environmental context and exercise professional ethics, norms, standards and responsibilities in engineering practice.
CO4	Effectively work as a team member as well as a leader while demonstrating the knowledge of project management, finance handling and other management practices in a multidisciplinary environment.
CO5	Demonstrate the knowledge of documentation, report writing, effective presentation, receiving and delivering clear instructions in the professional environment and recognize the need & have preparation ability to engage in independent & life- long learning facing the challenges of technological changes.

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