



DEPARTMENT OF MECHANICAL ENGINEERING

2015 SCHEME

SUBJECT: MATHEMATICS III

SUBJECT CODE: 15MAT31

CO#	Course Outcomes
CO : 1	Know the use of periodic signals and Fourier series to analyze circuits and system communications.
CO : 2	Explain the general linear system theory for continuous-time signals and digital signal processing using the Fourier Transform and z-transform.
CO : 3	Employ appropriate numerical methods to solve algebraic and transcendental equations.
CO : 4	The numerical methods are highly useful when the analytical/theoretical approach to the problems are either unavailable or highly difficult.
CO : 5	Apply Green's Theorem, Divergence Theorem and Stokes' theorem in various applications in the field of electro-magnetic and gravitational fields and fluid flow problems. Determine the extremals of functionals and solve the simple problems of the calculus of variations.

SUBJECT: MATERIAL SCIENCE

SUBJECT CODE: 15ME32

CO#	Course Outcomes
CO : 1	Understand the atomic structure, crystalline structure of solids and defects in it
CO : 2	Understand the mechanical behaviour of structure materials
CO : 3	Understand different composite materials and its processing and applications
CO : 4	Understand the various heat treatment process and its applications
CO : 5	Understand the formation of alloys, solidification process and phases present in cast metals

SUBJECT: BAISC THERMODYNAMICS

SUBJECT CODE: 15ME33

CO#	Course Outcomes
CO : 1	Explain thermodynamic systems, properties, Zeroth law of thermodynamics, temperature scales and energy interactions.
CO : 2	Determine heat, work, internal energy, enthalpy for flow & non flow process using First and Second Law of Thermodynamics.

CO : 3	Interpret behavior of pure substances and its applications to practical problems.
CO : 4	Determine change in internal energy, change in enthalpy and change in entropy using TD relations for ideal gases.
CO : 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

SUBJECT: MECHANICS OF MATERIALS

SUBJECT CODE: 15ME34

CO#	Course Outcomes
CO : 1	Understand stresses and strains, their relations, Hooke's law, Mechanical properties and determine stresses, strains and deformations in bars with varying and composite cross-sections subjected to normal and temperature loads
CO : 2	Understand the cylinders, study the stress distribution in cylinders, and determine plane, principal stress, maximum shear stress and their orientations using analytical method and Mohr's circle
CO : 3	Determine dimensions, stresses and deflections at various points for different beams subjected to different types of loads and draw SFD and BMD for the same
CO : 4	Determine the dimensions of the shafts based on torsional strength, rigidity and flexibility and also elastic stability of columns using Rankine's and Euler's theory
CO : 5	Determine the dimensions of structural members using Energy methods and also study the different types of theories of failure

SUBJECT: METAL CASTING AND WELDING

SUBJECT CODE: 15ME35A/45A

CO#	Course Outcomes
CO : 1	Describe the casting process, preparation of Green, Core, dry sand molds and Sweep, Shell, Investment and plaster molds.
CO : 2	Explain the Pattern, Core, Gating, Riser system and Jolt, Squeeze, Sand Slinger Molding Machines.
CO : 3	Compare the Gas fired pit, Resistance, Coreless, Electrica and cupola furnaces. compare the Gravity, Pressure die, Centrifugal, Squeeze, slush and Continuous Metal mold
CO : 4	Explain the soldification process and casting of non ferrous metals. The metal arc,MIG,TIG,submerdged and automatic hydogen welding process used in manufacturing
CO : 5	Expain the resistance spot,seam,butt,projection,frictionexplosive,thermit,laser and electron weding process

SUBJECT: MACHINE TOOLS AND OPERATIONS

SUBJECT CODE: 15ME35B/45B

CO#	Course Outcomes
CO : 1	Explain the construction & specification of various machine tools.
CO : 2	Describe various machining processes pertaining to relative motions between tool &work piece
CO : 3	Discuss different cutting tool materials, tool nomenclature & surface finish

CO : 4	Apply mechanics of machining process to evaluate machining time
CO : 5	Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.

SUBJECT: COMPUTER AIDED MACHINE DRAWING

SUBJECT CODE: 15ME36A/46A

CO#	Course Outcomes
CO : 1	To include understanding of the theory of projection and make drawing using orthographic projections and sectional views
CO : 2	To familiarize the students with Indian standards on drawing sheets
CO : 3	To impart knowledge of thread forms and keys
CO : 4	Design and modulate the types of joints and riveted joints
CO : 5	to make the students understand and interpret drawings of machine components to prepare assembly drawings both manually and using standard CAD package.

SUBJECT: MECHANICAL MEASUREMENTS AND METROLOGY

SUBJECT CODE: 15ME36B/46B

CO#	Course Outcomes
CO : 1	Build the slip gauges using M87 & M112 set with the basics of Metrology, Standards
CO : 2	Design the plug gauges & Ring gauge with the basics of Limits, Fits & Tolerances
CO : 3	Understand Screw thread and gear tooth parameters, lasers and CMM
CO : 4	Analyze the working of generalised measurement system and types of transducers
CO : 5	Describe functioning of Force, Torque, Pressure, Strain and temperature measuring device

SUBJECT: MATERIAL TESTING LAB

SUBJECT CODE: 15ME37A/47A

CO#	Course Outcomes
CO : 1	Students will be able to demonstrate the knowledge and skills to conduct and analyzing the results w.r.t. Hardness testing, Tensile testing, Shear, Compression, Bending test, Fracture testing, Fatigue testing and Impact testing
CO : 2	Students will be able to get the basic knowledge about the methods to enhance the properties of the material from heat treatment process
CO : 3	Students will be able to study the wear characteristics of ferrous, non-ferrous and composite materials for different parameters
CO : 4	Students will able to get the practical knowledge about Non-destructive testing

SUBJECT: MECHANICAL MEASUREMENTS AND METROLOGY LAB SUBJECT CODE: 15ME37B/47B

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

SUBJECT: FOUNDRY AND FORGING LAB**SUBJECT CODE: 15ME38A/48A**

CO#	Course Outcomes
CO : 1	To analyse Shear Strength, Compression strength and tensile strength using universal sand testing machines and Industrial applications where the hot gases escapes from the moulding sand when molten metal starts solidifying in contact with moisture present in the sand and also to analyse defects like blow holes in the casting.
CO : 2	Preparation of moulds using two moulding boxes using various types of patterns or without patterns and also finishing of mould cavities
CO : 3	The production of various shapes of forged models from the given specimen by using various forged technique like stretching, bending, drawing and upsetting operations. Also to aim at getting accuracy in the given model.

SUBJECT: MACHINE SHOP**SUBJECT CODE: 15ME38B/48B**

CO#	Course Outcomes
CO : 1	Will be able to demonstrate the various skills of Turning, facing, knurling, thread cutting
CO : 2	Will be able to operate lathe machine, milling machine, shaping machines safely
CO : 3	Will be able to work effectively with the others as a team
CO : 4	Conduct themselves ethically and responsibly in machine shop.

SUBJECT: ENGINEERING MATHEMATICS-IV**SUBJECT CODE: 15MAT41**

CO#	Course Outcomes
CO : 1	Solve first and second order ordinary differential equations arising in flow problem using single step and multistep numerical methods.
CO : 2	Solve problems of quantum mechanics, hydrodynamics and heat conduction by employing Bessel's function relating to cylindrical polar coordinate systems and Legendre's polynomials relating to spherical polar coordinate systems.
CO : 3	Understand the analyticity, potential fields, residues and poles of complex potentials in field theory and electromagnetic theory. Describe conformal and bilinear transformation arising in aerofoil theory, fluid flow visualization and image processing.
CO : 4	Solve problems on probability distributions relating to digital signal processing, information theory and optimization concepts of stability of design and structural engineering.
CO : 5	Draw the validity of the hypothesis proposed for the given sampling distribution in accepting or rejecting the hypothesis. Determine joint probability distributions and stochastic matrix connected with the multivariable correlation problems for feasible random events. Define transition probability matrix of a Markov chain and solve problems related to discrete parameter random process.

SUBJECT: KINEMATICS OF MACHINERY**SUBJECT CODE: 15ME42**

CO#	Course Outcomes
CO : 1	Identify the mechanisms and method of mechanisms, study motion analysis of mechanisms
CO : 2	Study motion of mechanisms by graphical and instantaneous center method
CO : 3	Study motion of mechanisms by analytical method
CO : 4	Study motion of spur gears and gear trains
CO : 5	Study cam profiles and motion of cams for different followers.

SUBJECT: APPLIED THERMODYNAMICS**SUBJECT CODE: 15ME43**

CO#	Course Outcomes
CO : 1	Apply the thermodynamics concepts to analyze the performance of gas power cycles including propulsion systems.
CO : 2	understand combustion of fuels and combustion process in IC engines including alternate fuels and pollution effect on environment
CO : 3	Evaluate the performance of steam turbine components
CO : 4	Apply the thermodynamics concepts to analyze the refrigeration and psychrometric chart.
CO : 5	Analyze the compressor systems and their performance parameter

SUBJECT: FLUID MECHANICS**SUBJECT CODE: 15ME44**

CO#	Course Outcomes
CO : 1	Identify and calculate the key fluid properties used in the analysis of fluid behavior, understand and apply the principles of pressure, buoyancy and floatation.
CO : 2	Understand and apply the principles of fluid kinematics and dynamics.
CO : 3	Understand the various types of laminar and turbulent flows and study the different types of energy losses through the pipes with different equations and diagrams.
CO : 4	To discuss the main properties of laminar and turbulent pipe flow and appreciate their differences and the concept of boundary layer theory and understand the concept of dynamic similarity and how To apply it to experimental modeling.
CO : 5	To appreciate the consequences of compressibility in gas flow and understand the effects of friction and heat transfer on compressible flows and to know the importance of computational fluid dynamics.

SUBJECT: MANAGEMENT AND ENGINEERING ECONOMIC**SUBJECT CODE: 15ME51**

CO#	Course Outcomes
CO : 1	Understand needs, functions, roles, scope and evaluation of Management and importance and planning.
CO : 2	Discuss the decision making, organizing, staffing, Directing and controlling
CO : 3	Estimate various depreciation values of commodities and selling price of an object and various interest methods
CO : 4	Analyze the best economics model from various available alternatives
CO : 5	Evalute various depreciation of commodities

SUBJECT: DYNAMICS OF MACHINERY**SUBJECT CODE: 15ME52**

CO#	Course Outcomes
CO : 1	To gain the knowledge of static and dynamic equilibrium conditions of mechanisms subjected forces and couple, with and without friction and Analyze the mechanisms for static and dynamic equilibrium
CO : 2	To understand the balancing principles of rotating and reciprocating masses
CO : 3	To understand the conceptual principles of governors and gyroscopes
CO : 4	To understand vibrations characteristics of single degree of freedom systems.
CO : 5	Characterize the single degree of freedom system subjected to free and forced vibrations with and without damping.

SUBJECT: TURBO MACHINES**SUBJECT CODE: 15ME53**

CO#	Course Outcomes
CO : 1	Understand the turbomachine, parts, comparison and application of thermodynamics with efficiency terms
CO : 2	Understand and analyze the energy transfer in turbomachines and analysis of turbomachines
CO : 3	Understand and apply the concepts of single and multi stage turbine, Reaction turbine
CO : 4	Understand the different hydraulic turbines and apply the concepts of velocity triangles.
CO : 5	Understand and apply the concepts of centrifugal pumps, centrifugal compressors and axial flow compressors their pressure & velocity developed.

SUBJECT: DESIGN OF MACHINE ELEMENTS-I**SUBJECT CODE: 15ME54**

CO#	Course Outcomes
CO : 1	Describe the design process, choose materials, apply the codes and standards in design process. Analyze the behavior of machine components under static loading
CO : 2	Design of machine elements subjected to impact and fatigue loads
CO : 3	Design of shafts, joints, keys and couplings
CO : 4	Design of riveted and welded joints
CO : 5	Design of threaded fasteners and power screws

SUBJECT: NON TRADITIONAL MACHINING**SUBJECT CODE: 15ME554**

CO#	Course Outcomes
CO : 1	Understand the compare traditional and non traditional machining
CO : 2	Understand the constructional features, performance parameters, processes
CO : 3	Identify the need of chemical and electro chemical machining processes
CO : 4	Understand the constructional features of the equipment, process, parameters, characteristic, applications, advantages and limitations of edm and pam
CO : 5	Understand the lbm equipment, lbm parameters, and characteristics. Ebm equipment and mechanism of metal removal.

SUBJECT: ENERGY AND ENVIRONMENT**SUBJECT CODE: 15ME562**

CO#	Course Outcomes
CO : 1	Summarize the basic concepts of energy, its distribution and General Scenario.
CO : 2	Explain different energy storage systems, energy management, audit and economic analysis.
CO : 3	Summarize the environment eco system and its need for awareness.
CO : 4	Identify the various types of environment pollution and their effects.
CO : 5	Discuss the social issues of the environment with associated acts.

SUBJECT:FLUID MECHANICS & MACHINES LAB**SUBJECT CODE: 15MEL57**

CO#	Course Outcomes
CO : 1	Perform experiments to determine the coefficient of discharge of flow measuring devices and friction through pipes.
CO : 2	Conduct experiments on hydraulic turbines and pumps to draw characteristics.
CO : 3	Conduct performance test on a two stage Reciprocating Air Compressor

SUBJECT:ENERGY LAB**SUBJECT CODE: 15MEL58**

CO#	Course Outcomes
CO : 1	Apply the knowledge to characterize the fuel by its properties like Flash, Fire Point, Viscosity by performing various experiments.
CO : 2	Analyze the engine performance using the concept of thermodynamics
CO : 3	Estimate the calorific value of solid, liquid and Gaseous fluids.

SUBJECT: FINITE ELEMENT ANALYSIS**SUBJECT CODE: 15ME61**

CO#	Course Outcomes
CO : 1	To learn basic principles of finite element analysis procedure
CO : 2	To learn the theory and characteristics of finite elements that represent engineering structures
CO : 3	To learn and apply finite element solutions to structural, thermal
CO : 4	To learn and apply finite element solutions to structural, dynamic problems.
CO : 5	To learn and apply fem solutions engineering problems to develop tht knowledge and skills needed to effectively evaluate fea.

CO#	Course Outcomes
CO : 1	Analyze various types of automation and production concepts
CO : 2	Analyze various automated flow lines and line balancing problem
CO : 3	Apply computer aided process planning, MRP, and computer integrated production management system,
CO : 4	Prepare part programs for simple jobs on CNC machine tools and robot programming.
CO : 5	Visualize and appreciate the modern trends in Manufacturing like additive manufacturing, Industry 4.0 and applications of Internet of Things leading to Smart Manufacturing.

CO#	Course Outcomes
CO : 1	Apply the different modes of heat transfer and compute temperature distribution in steady and unsteady states of heat conduction.
CO : 2	Interpret heat transfer through extended surfaces and analyze the unsteady state heat transfer.
CO : 3	Illustrate the principles of radiation heat transfer and solve the numerical formula for heat conduction problems.
CO : 4	Interpret and compute forced and free convective heat transfer.
CO : 5	Analyze heat exchange using LMTD and NTU methods and demonstrate the phenomenon of heat transfer with phase change.

CO#	Course Outcomes
CO : 1	Students will be able to solve the problems related to curved beams and cylinders.
CO : 2	Students will be able to design mechanical systems involving springs, belts and pulleys.
CO : 3	Students will be able to design Spur and Helical gears for different applications.
CO : 4	Students will be able to design clutches and brakes for different applications.
CO : 5	Students will be able to design hydrodynamic bearings for different applications

CO#	Course Outcomes
CO : 1	Able to apply the concept of engine & cooling system to automobiles
CO : 2	Able to select the appropriate transmission and braking systems for automobiles
CO : 3	Able to plan & design the steering and suspension systems
CO : 4	To select different types of fuels and injection systems for engines
CO : 5	To evaluate the cause of automobile emissions, its effects on environment and methods to reduce the emissions.

CO#	Course Outcomes
CO : 1	Explain the various approaches of TQM
CO : 2	Infer the customer perception of Quality
CO : 3	Analyze customer needs and perceptions to design feedback systems.
CO : 4	Apply Statistical tools for Continuous Improvement Process
CO : 5	Apply tools and Techniques for effective implementation of TQM

CO#	Course Outcomes
CO : 1	Understand the basics of biomass conversion Technologies and factors affecting Biogas generation
CO : 2	Describe the components of a Nuclear reactor and types of Nuclear Reactors.
CO : 3	Describe the working and basic components of Diesel Engine Power plants and Hydroelectric power plants.
CO : 4	Describe the working ad basic components of steam Power Plants.
CO : 5	Understand harnessing of various types of Renewable Energies like Solar, Wind, Tidal, OTEC and Geothermal.

SUBJECT:FLUID POWER SYSTEM**SUBJECT CODE: 15ME72**

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

SUBJECT:CONTROL ENGINEERING**SUBJECT CODE: 15ME73**

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

SUBJECT:TRIBOLOGY**SUBJECT CODE: 15ME742**

CO#	Course Outcomes
CO : 1	Understand the fundamentals of tribology and associated parameters.
CO : 2	Apply concepts of tribology for the performance analysis and design of components experiencing relative motion.
CO : 3	Analyse the requirements and design hydrodynamic journal and plane slider bearings for a given application.
CO : 4	Select proper bearing materials and lubricants for a given tribological application.
CO : 5	Apply the principles of surface engineering for different applications of tribology.

CO#	Course Outcomes
CO : 1	Understand the meaning, definitions, scope, need, phases and techniques of operations research.
CO : 2	Formulate as L.P.P and derive optimal solutions to linear programming problems by graphical method, Simplex method, Big-M method and Dual Simplex method.
CO : 3	Formulate as Transportation and Assignment problems and derive optimum solutions for transportation, Assignment and travelling salesman problems
CO : 4	Construct networkdiagrams and determine critical path, floats for deterministic and PERT networks including crashing of Networks.. Solve waiting line problems for M/M/1 and M/M/K queuing models. 6.
CO : 5	Determine minimum processing times for sequencing of n jobs-2 machines, n jobs-3machines,n jobs-m machinesand 2 jobs-n machines using Johnson's algorithm.Solve problems on game theory for pure and mixed strategy under competitive environment.

CO#	Course Outcomes
CO : 1	Explain the various strategies of PLM and Product Data Management
CO : 2	Describe decomposition of product design and model simulation
CO : 3	Apply the concept of New Product Development and its structuring
CO : 4	Analyze the technological forecasting and the tools in the innovation.
CO : 5	Apply the virtual product development and model analysis



DEPARTMENT OF MECHANICAL ENGINEERING

2017 SCHEME

SUBJECT: MATHEMATICS III

SUBJECT CODE: 17MAT31

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CO : 1	Know the use of periodic signals and Fourier series to analyze circuits and system communications.
CO : 2	Explain the general linear system theory for continuous-time signals and digital signal processing using the Fourier Transform and z-transform.
CO : 3	Employ appropriate numerical methods to solve algebraic and transcendental equations.
CO : 4	The numerical methods are highly useful when the analytical/theoretical approach to the problems are either unavailable or highly difficult.
CO : 5	Apply Green's Theorem, Divergence Theorem and Stokes' theorem in various applications in the field of electro-magnetic and gravitational fields and fluid flow problems. Determine the extremals of functionals and solve the simple problems of the calculus of variations.

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CO : 5	Determine the dimensions of structural members using Energy methods and also study the different types of theories of failure

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CO : 1	Describe the casting process, preparation of Green, Core, dry sand molds and Sweep, Shell, Investment and plaster molds.
CO : 2	Explain the Pattern, Core, Gating, Riser system and Jolt, Squeeze, Sand Slinger Molding Machines.
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CO : 3	Evaluate the performance of steam turbine components
CO : 4	Apply the thermodynamics concepts to analyze the refrigeration and psychrometric chart.
CO : 5	Analyze the compressor systems and their performance parameter

CO#	Course Outcomes
CO : 1	Identify and calculate the key fluid properties used in the analysis of fluid behavior, understand and apply the principles of pressure, buoyancy and floatation.
CO : 2	Understand and apply the principles of fluid kinematics and dynamics.
CO : 3	Understand the various types of laminar and turbulent flows and study the different types of energy losses through the pipes with different equations and diagrams.
CO : 4	To discuss the main properties of laminar and turbulent pipe flow and appreciate their differences and the concept of boundary layer theory and understand the concept of dynamic similarity and how To apply it to experimental modeling.
CO : 5	To appreciate the consequences of compressibility in gas flow and understand the effects of friction and heat transfer on compressible flows and to know the importance of computational fluid dynamics.

CO#	Course Outcomes
CO : 1	Explain the development of management and the role it plays at different levels in an organization.
CO : 2	Understand the necessity of good leadership, communication and coordination for establishing effective control in an organization.
CO : 3	Understand engineering economics demand supply and its importance in economics decision making and problem solving
CO : 4	Calculate present worth, annual worth and IRR for different alternatives in economic decision making.
CO : 5	Understand the procedure involved in estimation of cost for a simple component, product costing and depreciation, its methods.

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

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

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

SUBJECT: NON TRADITIONAL MACHINING**SUBJECT CODE: 17ME554**

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

SUBJECT: ENERGY AND ENVIRONMENT**SUBJECT CODE: 17ME562**

CO#	Course Outcomes
CO : 1	Summarize the basic concepts of energy, its distribution and general Scenario
CO : 2	Explain different energy storage systems, energy management, audit and economic analysis.
CO : 3	Summarize the environment eco system and its need for awareness.
CO : 4	Identify the various types of environment pollution and their effects.
CO : 5	Discuss the social issues of the environment with associated acts

SUBJECT: FLUID MECHANICS & MACHINERY LAB**SUBJECT CODE: 17ME57**

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

CO#	Course Outcomes
CO : 1	Understand the concepts behind formulation methods in FEM.
CO : 2	Identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements
CO : 3	Develop element characteristic equation and generation of global equation.
CO : 4	Able to apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer
CO : 5	Able to apply fluid flow, axisymmetric and dynamic problems and solve them displacements, stress and strains induced

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

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

SUBJECT: DESIGN OF MACHINE ELEMENTS II**SUBJECT CODE: 17ME64**

CO#	Course Outcomes
CO : 1	Apply engineering design tools to product design.
CO : 2	Design mechanical systems involving springs,belts and pulleys.
CO : 3	Design different types of gears and simple gear boxes for different applications.
CO : 4	Design brakes and clutches.
CO : 5	Design hydrodynamic bearings for different applications. And Select Anti friction bearings for different applications using the manufacturers, catalogue

SUBJECT: METAL FORMING**SUBJECT CODE: 17ME653**

CO#	Course Outcomes
CO : 1	Able to understandthe concept of different metal forming process
CO : 2	Able to approach metal forming processes both analytically and numerically
CO : 3	Able to design metal forming processes
CO : 4	Able to develop approaches and solutions to analyze metal forming processes and the associated problems and flaws.

SUBJECT: AUTOMOBILE ENGINEERING**SUBJECT CODE: 17ME655**

CO#	Course Outcomes
CO : 1	To identify the different parts of an automobile and it's working
CO : 2	To understand the working of transmission and braking systems
CO : 3	To comprehend the working of steering and suspension systems
CO : 4	To learn various types of fuels and injection systems
CO : 5	To know the cause of automobile emissions,its effects on environment and methods to reduce the emissions

CO#	Course Outcomes
CO : 1	Explain the various approaches of TQM
CO : 2	Infer the customer perception of quality
CO : 3	Analyze customer needs and perceptions to design feedback systems.
CO : 4	Apply statistical tools for continuous improvement of systems
CO : 5	Apply the tools and technique for effective implementation of TQM.

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

CO#	Course Outcomes
CO : 1	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 different- loading conditions.
CO : 2	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.
CO : 3	Analyze the given problem by applying basic principle to solve and demonstrate 1D and 2D heat transfer with conduction and convection boundary conditions.
CO : 4	Carry out dynamic analysis and finding natural frequencies for various boundary conditions and also analyze with forcing function

SUBJECT: ENERGY ENGINEERING**SUBJECT CODE: 17ME71**

CO#	Course Outcomes
CO : 1	Summarize the basic concepts of thermal energy systems
CO : 2	Identify renewable energy sources and their utilization.
CO : 3	Understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.
CO : 4	Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas.
CO : 5	Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator and Identify methods of energy storage for specific applications

SUBJECT: FLUID POWER SYSTEMS**SUBJECT CODE: 17ME72**

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

SUBJECT: CONTROL ENGINEERING**SUBJECT CODE: 17ME73**

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

SUBJECT: TRIBOLOGY**SUBJECT CODE: 17ME742**

CO#	Course Outcomes
CO : 1	Understand the fundamentals of tribology and associated parameters
CO : 2	Apply concepts of tribology for the performance analysis and design of components experiencing relative motion..
CO : 3	Analyse the requirements and design hydrodynamic journal and plane slider bearings for a given application.
CO : 4	Select proper bearing materials and lubricants for a given tribological application.
CO : 5	Apply the principles of surface engineering for different applications of tribology

SUBJECT: SMART MATERIALS and MEMS**SUBJECT CODE: 17ME745**

CO#	Course Outcomes
CO : 1	Describe the methods of controlling vibration using smart systems and fabrication methods of MEMS.
CO : 2	Explain the principle concepts of Smart materials, structures, Fibre optics, ER & MR Fluids, Biomimetics and MEMS with principles of working..
CO : 3	Analyze the properties of smart structures, MEMS, with the applications and select suitable procedure for fabrication
CO : 4	Summarize the methods and uses of Micro fabrications, Biomimetics, types of polymers used in MEMS, Fibre optics, piezoelectric sensing and actuation

SUBJECT: MECHATRONICS**SUBJECT CODE: 17ME753**

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

SUBJECT: DESIGN LABORATORY**SUBJECT CODE: 17MEL76**

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

	distribution of journal bearing..
CO : 5	To determine strain induced in a structural member using the principle of photo-elasticity

SUBJECT: COMPUTER INTEGRATED MANUFACTURING LAB

SUBJECT CODE: 17MEL77

CO#	Course Outcomes
CO : 1	Generate CNC Lathe part program for Turning, Facing, Chamfering, Grooving, Step turning, Taper turning, Circular interpolation
CO : 2	Generate CNC Mill Part programming for Point to point motions, Line motions, Circular interpolation, Contour motion, Pocket milling- circular, rectangular, Mirror commands etc.
CO : 3	Use Canned Cycles for Drilling, Peck drilling, Boring, Tapping, Turning, Facing, Taper turning Thread cutting etc.
CO : 4	Simulate Tool Path for different Machining operations of small components using CNC Lathe & CNC Milling Machine.
CO : 5	Use high end CAM packages for machining complex parts; use state of art cutting tools and related cutting parameters; optimize cycle time; set up and cut part on.

SUBJECT: OPERATIONS RESEARCH

SUBJECT CODE: 17ME81

CO#	Course Outcomes
CO : 1	Understand the meaning, definitions, scope, need, phases and techniques of operations research.
CO : 2	Formulate as L.P.P and derive optimal solutions to linear programming problems by graphical method, Simplex method, Big-M method and Dual Simplex method.
CO : 3	Formulate as Transportation and Assignment problems and derive optimum solutions for transportation, Assignment and travelling salesman problems.
CO : 4	Solve waiting line problems for M/M/1 and M/M/K queuing models and Construct network diagrams and determine critical path, floats for deterministic and PERT networks including crashing of Networks.
CO : 5	Determine minimum processing times for sequencing of n jobs-2 machines, n jobs-3 machines, n jobs-m machines and 2 jobs-n machines using Johnson's algorithm.

SUBJECT: PRODUCT LIFE CYCLE MANAGEMENT

SUBJECT CODE: 17ME835

CO#	Course Outcomes
CO : 1	Explain the various strategies of PLM and Product Data Management
CO : 2	Describe decomposition of product design and model simulation
CO : 3	Apply the concept of New Product Development and its structuring
CO : 4	Analyze the technological forecasting and the tools in the innovation.
CO : 5	Apply the virtual product development and model analysis



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SUBJECT: TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES

SUBJECT CODE: 18MAT31

CO#	Course Outcomes
CO : 1	Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering
CO : 2	Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory
CO : 3	Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
CO : 4	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
CO : 5	Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

SUBJECT: MECHANICS OF MATERIALS

SUBJECT CODE: 18ME32

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

SUBJECT: BAISC THERMODYNAMICS**SUBJECT CODE: 18ME33**

CO#	Course Outcomes
CO : 1	Explain fundamentals of thermodynamics and evaluate energy interactions across the boundary of thermodynamic systems.
CO : 2	Evaluate the feasibility of cyclic and non-cyclic processes using 2nd law of thermodynamics.
CO : 3	Apply the knowledge of entropy, reversibility and irreversibility to solve numerical problems and apply 1st law of thermodynamics to closed and open systems and determine quantity of energy transfers and change in properties
CO : 4	Interpret the behavior of pure substances and its application in practical problems
CO : 5	Recognize differences between ideal and real gases and evaluate thermodynamic properties of ideal and real gas mixtures using various relations.

SUBJECT: MATERIAL SCIENCE**SUBJECT CODE: 18ME34**

CO#	Course Outcomes
CO : 1	Understand the mechanical properties of metals and their alloys various materials available and material selection procedures.
CO : 2	Analyze the various modes of failure and understand the microstructures of ferrous and nonferrous materials.
CO : 3	Describe the processes of heat treatment of various alloys.
CO : 4	Acquire the Knowledge of composite materials and their production process as well as applications.
CO : 5	Understand the properties and potentialities of various materials available and material selection procedures.

SUBJECT: METAL CUTTING AND FORMING**SUBJECT CODE: 18ME35A/45A**

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

CO#	Course Outcomes
CO : 1	Describe the casting process and prepare different types of cast products.
CO : 2	Acquire knowledge on Pattern, Core, Gating, Riser system and to use Jolt, Squeeze, Sand Slinger moulding machines.
CO : 3	Compare the Gas fired pit, Resistance, Coreless, Electrical and Cupola Metal Furnaces
CO : 4	Compare the Gravity, Pressure die, Centrifugal, Squeeze, slush and Continuous Metal mold castings.
CO : 5	Understand the Solidification process and Casting of Non-Ferrous Metals
CO: 6	Describe the Metal Arc, TIG, MIG, Submerged and Atomic Hydrogen Welding processes etc. used in manufacturing. CO7: Describe methods for the quality assurance of components made of casting and joining process
CO:7	Describe methods for the quality assurance of components made of casting and joining process

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

CO#	Course Outcomes
CO : 1	Understand the objectives of metrology, methods of measurement, standards of measurement & various measurement parameters.
CO : 2	Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design
CO : 3	Understand the working principle of different types of comparators. CO3: Describe measurement of major & minor diameter, pitch, angle and effective diameter of screw threads
CO : 4	Explain measurement systems, transducers, intermediate modifying devices and terminating devices
CO : 5	Describe functioning of force, torque, pressure, strain and temperature measuring devices.

SUBJECT: MATERIAL TESTING LAB**SUBJECT CODE: 18ME37A/47A**

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

SUBJECT: MECHANICAL MEASUREMENTS AND METROLOGY LAB SUBJECT CODE: 18ME37B/47B

CO#	Course Outcomes
CO : 1	Understand Calibration of pressure gauge, thermocouple, LVDT, load cell, micrometre.
CO : 2	Apply concepts of Measurement of angle using Sine Centre/ Sine Bar/ Bevel Protractor, alignment using Autocollimator/ Roller set
CO : 3	Demonstrate measurements using Optical Projector/Tool maker microscope, Optical flats
CO : 4	Analyse tool forces using Lathe/Drill tool dynamometer.
CO : 5	Analyse Screw thread parameters using 2-Wire or 3-Wire method, gear tooth profile using gear tooth Vernier/Gear tooth micrometre
CO : 3	Understand the concepts of measurement of surface roughness.

SUBJECT: WORKSHOP AND MACHINE SHOP PRACTICE**SUBJECT CODE: 18ME38A/48A**

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

SUBJECT: FOUNDRY, FORGING AND WELDING LAB**SUBJECT CODE: 18MEL38B/48B**

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

SUBJECT: CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW (CPC) SUBJECT CODE: 18CPC39/49

CO#	Course Outcomes
CO : 1	Have constitutional knowledge and legal literacy.
CO : 2	Understand Engineering and Professional ethics and responsibilities of Engineers. □
CO : 3	Understand the the cybercrimes and cyber laws for cyber safety measures. Question

**SUBJECT: COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS
SUBJECT CODE: 18MAT41**

CO#	Course Outcomes
CO : 1	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
CO : 2	Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
CO : 3	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field
CO : 4	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
CO : 5	Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

SUBJECT: APPLIED THERMODYNAMICS**SUBJECT CODE: 18ME42**

CO#	Course Outcomes
CO : 1	Apply thermodynamic concepts to analyze the performance of gas power cycles.
CO : 2	Apply thermodynamic concepts to analyze the performance of vapour power cycles.
CO : 3	Understand combustion of fuels and performance of I C engines.
CO : 4	Understand the principles and applications of refrigeration systems.

CO : 5	Apply Thermodynamic concepts to determine performance parameters of refrigeration and airconditioning systems.
CO : 6	Understand the working principle of Air compressors and Steam nozzles, applications, relevance of air and identify methods for performance improvement

SUBJECT: FLUID MECHANICS

SUBJECT CODE: 18ME43

CO#	Course Outcomes
CO : 1	Identify and calculate the key fluid properties used in the analysis of fluid behavior.
CO : 2	Explain the principles of pressure, buoyancy and floatation
CO : 3	Apply the knowledge of fluid statics, kinematics and dynamics while addressing problems of mechanical and chemical engineering.
CO : 4	Describe the principles of fluid kinematics and dynamics.
CO : 5	Explain the concept of boundary layer in fluid flow and apply dimensional analysis to form dimensionless numbers in terms of input output variables.
CO : 6	Illustrate and explain the basic concept of compressible flow and CFD

SUBJECT: KINEMATICS OF MACHINES

SUBJECT CODE: 18ME44

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

SUBJECT: METAL CUTTING AND FORMING

SUBJECT CODE: 18ME35A/45A

CO#	Course Outcomes
CO : 1	Explain the construction & specification of various machine tools.
CO : 2	Discuss different cutting tool materials, tool nomenclature & surface finish.
CO : 3	Apply mechanics of machining process to evaluate machining time.
CO : 4	Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.

CO : 5	Understand the concepts of different metal forming processes
CO : 6	Apply the concepts of design of sheet metal dies to design different dies for simple sheet metal components.