MECHANICAL ENGINEERING

COURSE CODE	15ME32 - MATERIAL SCIENCE
CO1	Describe the mechanical properties of metals, their alloys and various modes of failure.
CO2	Understand the microstructures of ferrous and non-ferrous materials to mechanical properties.
CO3	Explain the processes of heat treatment of various alloys.
CO4	Understand the properties and potentialities of various materials available and material selection procedures.
CO5	Know about composite materials and their processing as well as applications.
COURSE CODE	15ME33- BASIC THERMODYNAMICS
CO1	Explain thermodynamic systems, properties, Zeroth law of thermodynamics, temperature scales and energy interactions.
CO2	Determine heat, work, internal energy, enthalpy for flow & non flow process using First and Second Law of Thermodynamics.
CO3	Interpret behaviour of pure substances and its applications to practical problems.
CO4	Determine change in internal energy, change in enthalpy and change in entropy using TD relations for ideal gases.
CO5	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 CODE	15ME34 - MECHANICS OF MATERIALS
CO1	Understand simple, compound, thermal stresses and strains their relations, Poisson's ratio, Hooke's law, mechanical properties including elastic constants and their relations.
CO2	Determine stresses, strains and deformations in bars with varying circular and rectangular cross-sections subjected to normal and temperature loads.
CO3	Determine plane stress, principal stress, maximum shear stress and their orientations using analytical method and Mohr's circle.
CO4	Determine the dimensions of structural members including beams, bars and rods using Energy methods and also stress distribution in thick and thin cylinders.
CO5	Draw SFD and BMD for different beams including cantilever beams, simply supported beams and overhanging beams subjected to UDL, UVL, Point loads and couples.
CO6	Determine dimensions, bending stress, shear stress and its distribution in beams of circular, rectangular, symmetrical I and T sections subjected to point loads and UDL.
CO7	Determine slopes and deflections at various points on beams subjected to UDL, UVL, Point loads and couples.
CO8	Determine the dimensions of shafts based on torsional strength, rigidity and flexibility and also elastic stability of columns using Rankin's and Euler's theory.
COURSE CODE	15ME35B - MACHINE TOOLS & OPERATIONS
CO1	Explain the construction & specification of various machine tools.
CO2	Describe various machining processes pertaining to relative motions between tool & work piece
CO3	Discuss different cutting tool materials, tool nomenclature & surface finish
CO4	Apply mechanics of machining process to evaluate machining time
CO5	Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.

COURSE CODE	15ME36A / 46A - COMPUTER AIDED MACHINE DRAWING
CO1	Sections of pyramids, prisms, cubes, cones and cylinders resting on their bases in 2D.
CO2	Orthographic views of machine parts with and without sectioning in 2D.
CO3	Sectional views for threads with terminologies of ISO Metric, BSW, square and acme, sellers and American standard threads in 2D.
CO4	Hexagonal and square headed bolt and nut with washer, stud bolts with nut and lock nut, flanged nut, slotted nut, taper and split pin for locking counter sunk head screw, grub screw, Allen screw assemblies in 2D.
CO5	Parallel key, Taper key, and Woodruff Key as per the ISO standards in 2D.
CO6	single and double riveted lap joints, butt joints with single/double cover straps, cotter and knuckle joint for two rods in 2D.
CO7	Sketch split muff, protected type flanged, pin type flexible, Oldham's and universal couplings in 2D.
CO8	assemblies from the part drawings with limits ,fits and tolerance given for Plummer block, Ram bottom safety valve, I.C. Engine connecting rod, Screw Jack, Tailstock of lathe, Machine Vice and Lathe square tool post in 2D and 3D.
COURSE CODE	15ME36B/46B - MECHANICAL MEASUREMENTS & METROLOGY
CO1	Understand the objectives of metrology, methods of measurement, selection of measuring instruments, standards of measurement and calibration of end bars.
CO2	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.
CO3	Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design.
CO4	Understand the principle of Johnson Mikrokator, sigma comparator, dial indicator, LVDT, back pressure gauges, Solex comparators and Zeiss Ultra Optimeter.
CO5	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.
CO6	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.
CO7	Understand laser interferometers and Coordinate measuring machines.
CO8	Explain measurement systems, transducers, intermediate modifying devices and terminating devices.
CO9	Describe functioning of force, torque, pressure, strain and temperature measuring devices.
COURSE CODE	15MEL37A/47A - MATERIALS TESTING LAB
CO1	Acquire experimentation skills in the field of material testing
CO2	Develop theoretical 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	Know how to improve structure/behavior of materials for various industrial applications
COURSE CODE	15MEL38B - MACHINE SHOP

CO1	Perform turning , facing , knurling , thread cutting, tapering , eccentric turning and allied operations.
CO2	Perform keyways / slots , grooves etc using shaper.
CO3	Perform gear tooth cutting using milling machine.
CO4	Understand the formation of cutting tool parameters of single point cutting tool using bench grinder / tool and cutter grinder.
CO5	Understand Surface Milling/Slot Milling.
CO6	Demonstrate precautions and safety norms followed in Machine Shop.
CO7	Exhibit interpersonal skills towards working in a team.
COURSE CODE	**15ME42 - KINEMATICS OF MACHINES**
CO1	Familiarize with mechanisms and motion analysis of mechanisms
CO2	Understand methods of mechanism motion analysis and their characteristics
CO3	Analyse motion of planar mechanisms, gears, gear trains and cams.
COURSE CODE	**15ME43 - APPLIED THERMODYNAMICS**
CO1	Apply thermodynamic concepts to analyze the performance of gas power cycles including propulsion systems.
CO2	Evaluate the performance of steam turbine components
CO3	Understand combustion of fuels and combustion processes in I C engines including alternate fuels and pollution effect on environment
CO4	Apply thermodynamic concepts to analyze turbo machines
CO5	Determine performance parameters of refrigeration and air-conditioning systems.
CO6	Understand the principles and applications of refrigeration systems.
CO7	Analyze air-conditioning processes using the principles of psychrometry and Evaluate cooling and heating loads in an air-conditioning system
CO8	Understand the working, applications, relevance of air and identify methods for performance improvement.
COURSE CODE	**15ME44 - FLUID MECHANICS**
CO1	Identify and calculate the key fluid properties used in the analysis of fluid behavior.
CO2	Understand and apply the principles of pressure, buoyancy and floatation
CO3	Apply the knowledge of fluid statics, kinematics and dynamics while addressing problems of mechanical and chemical engineering
CO4	Understand and apply the principles of fluid kinematics and dynamics.
CO5	Understand the concept of boundary layer in fluid flow and apply dimensional analysis to form dimensionless numbers in terms of input output variables.
CO6	Understand the basic concept of compressible flow and CFD
COURSE CODE	**15ME45A - METAL CASTING AND WELDING**
CO1	Describe the casting process, preparation of Green, Core, dry sand molds and Sweep, Shell, Investment and plaster molds.
CO2	Explain the Pattern, Core, Gating, Riser system and Jolt, Squeeze, Sand Slinger Molding Machines.
CO3	Compare the Gas fired pit, Resistance, Coreless, Electrical and Cupola Metal Furnaces.
CO4	Compare the Gravity, Pressure die, Centrifugal, Squeeze, slush and Continuous Metal mold castings.

CO5	Explain the Solidification process and Casting of Non-Ferrous Metals.
CO6	Describe the Metal Arc, TIG, MIG, Submerged and Atomic Hydrogen Welding processes used in manufacturing.
CO7	Explain the Resistance spot, Seam, Butt , Projection, Friction, Explosive, Thermit, Laser and Electron Beam Special type of welding process used in manufacturing. U PO1
CO8	Describe the Metallurgical aspects in Welding and inspectionmethods for the quality assurance of components made of casting andjoining process. U PO1
COURSE CODE	**15MEL47A / MEL47B - MECHANICAL MEASUREMENT & METROLOGY LABORATORY**
CO1	To calibrate pressure gauge, thermocouple, LVDT, load cell, micrometer.
CO2	To measure angle using Sine Center/ Sine Bar/ Bevel Protractor, alignment using Autocollimator/ Roller set.
CO3	To demonstrate measurements using Optical Projector/Tool maker microscope, Optical flats.
CO4	To measure cutting tool forces using Lathe/Drill tool dynamometer.
CO5	To measure Screw thread parameters using 2-Wire or 3-Wire method, gear tooth profile using gear tooth vernier/Gear tooth micrometer.
CO6	To measure surface roughness using Tally Surf/ Mechanical Comparator.
COURSE CODE	**15MEL48A / MEL48B - FOUNDRY & FORGING**
CO1	Demonstrate various skills of sand preparation, molding.
CO2	Demonstrate various skills of forging operations
CO3	Work as a team keeping up ethical principles.
COURSE CODE	**15ME51 - MANAGEMENT AND ENGINEERING ECONOMICS**
CO1	Understand needs, functions, roles, scope and evolution of Management
CO2	Understand importance, purpose of Planning and hierarchy of planning and also analyze its types
CO3	Discuss Decision making, Organizing, Staffing, Directing and Controlling
CO4	Select the best economic model from various available alternatives
CO5	Understand various interest rate methods and implement the suitable one.
CO6	Estimate various depreciation values of commodities
CO7	Prepare the project reports effectively.
COURSE CODE	**15ME52 - DYNAMICS OF MACHINERY**
CO1	Determine the forces and couples for static and dynamic conditions of four bar and slider crank mechanisms to keep the system in equilibrium.
CO2	Determine magnitude and angular position of balancing masses under static and dynamic condition of rotating masses in same and different planes.
CO3	Determine unbalanced primary, secondary forces and couples in single and multi-cylinder engine.
CO4	Determine sensitiveness, isochronism, effort and power of porter and hartnell governors
CO5	Determine gyroscopic couple and effects related to 2, 4 wheeler, plane disc, ship and aeroplanes.
CO6	Understand types of vibration, SHM and methods of finding natural frequencies of simple mechanical systems.
CO7	Determine equation of motion, natural frequency, damping factor, logarithmic decrement of damped free vibration (SDOF) systems

CO8	Determine the natural frequency, force and motion transmissibility of single degree freedom systems.
CO9	Determine equation of motion of rotating and reciprocating unbalance systems, magnification factor, and transmissibility of forced vibration (SDOF) systems.
COURSE CODE	**15ME53 - TURBO MACHINES**
CO1	Able to give precise definition of turbo machinery
CO2	Identify various types of turbo machinery
CO3	Apply the Euler's equation for turbo machinery to analyse energy transfer in turbo machines
CO4	Understand the principle of operation of pumps, fans, compressors and turbines.
CO5	Perform the preliminary design of turbo machines (pumps, rotary compressors and turbines)
CO6	Analyze the performance of turbo machinery.
COURSE CODE	**15ME54 - DESIGN OF MACHINE ELEMENTS - 1**
CO1	Describe the design process, choose materials.
CO2	Apply the codes and standards in design process.
CO3	Analyze the behaviour of machine components under static, impact, fatigue loading using failure theories.
CO4	Design shafts, joints, couplings
CO5	Design of riveted and welded joints
CO6	Design of threaded fasteners and power screws
COURSE CODE	**15ME553 - HUMAN RESOURCE MANAGEMENT**
CO1	Understand the importance, functions and principles Human Resource Management and process of Job analysis
CO2	Summarize the objectives of Human Resource planning, Recruitment and selection process
CO3	Understand the process involved in Placement, Training and development activities
CO4	Understand the characteristics of an effective appraisal system and compensation planning.
CO5	Understand the issues related to employee welfare, grievances and discipline.
COURSE CODE	**15ME562 - ENERGY ENVIRONMENT**
CO1	Summarize the basic concepts of energy, its distribution and general Scenario
CO2	Explain different energy storage systems, energy management, audit and economic analysis.
CO3	Summarize the environment eco system and its need for awareness
CO4	Identify the various types of environment pollution and their effects.
CO5	Discuss the social issues of the environment with associated acts
COURSE CODE	**15MEL57 - FLUID MECHANICS & MACHINERY LAB**
CO1	Perform experiments to determine the coefficient of discharge of flow measuring devices
CO2	Conduct experiments on hydraulic turbines and pumps to draw characteristics
CO3	Test basic performance parameters of hydraulic turbines and pumps and execute the knowledge in real life situations
CO4	Determine the energy flow pattern through the hydraulic turbines and pumps
CO5	Exhibit his competency towards preventive maintenance of hydraulic machines
COURSE CODE	**15MEL58 - ENERGY LAB**

CO1	Perform experiments to determine the properties of fuels and oils
CO2	Conduct experiments on engines and draw characteristics.
CO3	Test basic performance parameters of I.C. Engine and implement the knowledge in industry.
CO4	Identify exhaust emission, factors affecting them and report the remedies.
CO5	Determine the energy flow pattern through the I C Engine
CO6	Exhibit his competency towards preventive maintenance of IC engines
COURSE CODE	**15ME61-FINITE ELEMENT METHOD**
CO1	Understand the concepts behind formulation methods in FEM.
CO2	Identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.
CO3	Develop element characteristic equation and generation of global equation.
CO4	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 CODE	**15ME62-COMPUTER INTEGRATED MANUFACTURING**
CO1	Able to define Automation, CIM, CAD, CAM and explain the 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 flow lines to reduce down time and enhance productivity.
CO4	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.
CO5	Visualize and appreciate the modern trends in Manufacturing like additive manufacturing, Industry 4.0 and applications of Internet of Things leading to Smart Manufacturing
COURSE CODE	**15ME63-HEAT TRANSFER**
CO1	Compute temperature distribution in steady-state and unsteady-state heat conduction
CO2	Understand and interpret heat transfer through extended surfaces.
CO3	Interpret and compute forced and free convective heat transfer.
CO4	Explain the principles of radiation heat transfer and understand the numerical formula for heat conduction problems.
CO5	Design heat exchangers using LMTD and NTU methods.
COURSE CODE	**15ME64-DESIGN OF MACHINE ELEMENTS-II**
CO1	Apply engineering design tools to product design.
CO2	Design mechanical systems involving springs, belts and pulleys.
CO3	Design different types of gears and simple gear boxes for different applications.
CO4	Design brakes and clutches.
CO5	Design hydrodynamic bearings for different applications.
CO6	Select Anti friction bearings for different applications using the manufacturers, catalogue.
CO7	Develop proficiency to generate production drawings using CAD software.
CO8	Become good design engineers through learning the art of working in a team

COURSE CODE	15ME653-METAL FORMING
CO1	Able to understand the concept of different metal forming process.
CO2	Able to approach metal forming processes both analytically and numerically
CO3	Able to design metal forming processes
CO4	Able to develop approaches and solutions to analyze metal forming processes and the associated problems and flaws

COURSE CODE	15ME664-TOTAL QUALITY MANAGEMENT
CO1	Explain the various approaches of TQM
CO2	Infer the customer perception of quality
CO3	Analyze customer needs and perceptions to design feedback systems.
CO4	Apply statistical tools for continuous improvement of systems
CO5	Apply the tools and technique for effective implementation of TQM.

COURSE CODE	15MEL67-HEAT TRANSFER LAB
CO1	Conduct experiments to determine convective heat transfer coefficient for free and forced convection and correlate with theoretical values.
CO2	Estimate the effective thermal resistance in composite slabs and efficiency in pin-fin
CO3	Determine surface emissivity of a test plate
CO4	Estimate performance of a refrigerator and effectiveness of fin
CO5	Calculate temperature distribution of study and transient heat conduction through plane wall, cylinder and fin using numerical approach.

COURSE CODE	15MEL68-MODELING & ANALYSIS LAB
CO1	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.
CO2	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.
CO3	Analyze the given problem by applying basic principle to solve and demonstrate 1D and 2D heat transfer with conduction and convection boundary conditions.
CO4	Carry out dynamic analysis and finding natural frequencies for various boundary conditions and also analyze with forcing function.

COURSE CODE	15ME71- ENERGY ENGINEERNG
CO1	Summarize the basic concepts of thermal energy systems,
CO2	Identify renewable energy sources and their utilization.
CO3	Understand the basic concepts of solar radiation and analyze the working of thermal systems.
CO4	Understand principles of energy conversion from alternate sources including geothermal, ocean, biomass, biogas.
CO5	Understand the concepts and applications of fuel cells, thermoelectric coMHD generator.
CO6	Identify methods of energy storage for specific applications

COURSE CODE	15ME72-FLUID POWER SYSTEMS

CO1	Identify and analyse the functional requirements of a flfor a given application.
CO2	Visualize how a hydraulic/pneumatic circuit will work to accomplish the function.
CO3	Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application
CO4	Select and size the different components of the circuit
CO5	Develop a comprehensive circuit diagram by integrating the components selected forthe given application.
COURSE CODE	**15ME73- CONTROL ENGINEERING**
CO1	Recognize control system and its types , control actions
CO2	Determine the system governing equations for physical models(Electrical, Thermal, Mechanical, Electro Mechanical)
CO3	Calculate the gain of the system using block diagram and signal flow graph
CO4	Illustrate the response of 1st and 2nd order systems
CO5	Determine the stability of transfer functions in complex domain and frequency domain
CO6	Employ state equations to study the controllability and observability
COURSE CODE	**15ME742-TRIBOLOGY**
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 bearingfor 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 CODE	**15ME754 - MECHATRONICS**
CO1	Illustrate various components of Mechatronics systems.
CO2	Assess various control systems used in automation.
CO3	Develop mechanical, hydraulic, pneumatic and electrical control systems.
COURSE CODE	**15MEL76 - DESIGN LABORATORY**
CO1	To understand the working principles of machine elements such as Governors, Gyroscopes etc.,
CO2	To identify forces and couples in rotating mechanical system components.
CO3	To identify vibrations in machine elements and design appropriate damping methods and to determine the critical speed of a rotating shaft
CO4	To measure strain in various machine elements using strain gauges.
CO5	To determine the minimum film thickness, load carrying capacity, frictional torque and pressure distribution of journal bearing.
CO6	To determine strain induced in a structural member using the principle of photo-elasticity.
COURSE CODE	**15MEL77 - CNC LABORATORY**
CO1	Generate CNC Lathe part program for Turning, Facing, Chamfering, Grooving, Step turning, Taper turning, Circular interpolation etc.
CO2	Generate CNC Mill Part programming for Point to point motions, Line motions, Circular

	interpolation, Contour motion, Pocket milling- circular, rectangular, Mirror commands etc.
CO3	Use Canned Cycles for Drilling, Peck drilling, Boring, Tapping, Turning, Facing, Taper turning Thread cutting etc.
CO4	Simulate Tool Path for different Machining operations of small components using CNC Lathe & CNC Milling Machine.
CO5	Use high end CAM packages for machining complex parts; use state of art cutting tools and related cutting parameters; optimize cycle time
CO6	Understand & write programs for Robot control; understand the operating principles of hydraulics, pneumatics and electro pneumatic systems. Apply this knowledge to automate & improve efficiency of manufacturing.