Program	**Mechanical Engineering**

Program Outcome (POs)

PO 1	**Engineering Knowledge** – Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solutions of complex problems.
PO 2	**Problem Analysis** – Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of solutions** – Design solutions for complex engineering problems and design system components or processes that meet the specified need with appropriate considerations for public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigation of complex problems** – Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusion.
PO 5	**Modern tool usage** – Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of limitations.
PO 6	**The Engineer and society** – Apply reasoning informed by the contextual knowledge to assess societal, health, safety legal and cultural issues and consequent responsibilities relevant to professional engineering practice.
PO 7	**Environment and Sustainability** – Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need of sustainable development.
PO 8	**Ethics-** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PO 9	**Individual and Team work –** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication** – Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentation, give and receive clear instructions.
PO 11	**Project Management and Finance** – Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life Long Learning** – Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadcast context of technological change.

Program Specific Outcomes (PSOs)

PSO 1	Apply knowledge in analysis, design, survey, testing and construction of civil engineering structures along with knowledge of mathematics, basic science and soft skill to solve complex civil engineering problems.
PSO 2	Understand economic, environmental, societal, health and safety factors involved in Civil Engineering.
PSO 3	Develop skill for continuous self-learning and research in civil engineering to fulfil the needs of society, ethically.

(Academic Coordinator) **(HOD)**

Suman Ramesh Tulsiani Technical Campus Faculty of Engineering
Department of Mechanical Engineering
Course Outcome (Batch 2019-23)

	Academic Year 2019-20 First Year (Semester I)
107001	**Engineering Mathematics I**
C101.1	Mean value theorems and its generalizations leading to Taylors and Maclaurin's series useful in the analysis of engineering problems.
C101.2	the Fourier series representation and harmonic analysis for design and analysis of periodic continuous and discrete systems.
C101.3	to deal withderivative of functions of several variables that are essential in various branches of Engineering.
C101.4	To apply the concept of Jacobian to find partial derivative of implicit function and functional dependence. Use of partial derivatives in estimating error and approximation and finding extreme values of the function.
C101.5	the essential tool of matrices and linear algebra in a comprehensive manner for analysis of system of linear equations, finding linear and orthogonal transformations, Eigen values and Eigen vectors applicable to engineering problems
107002	**Engineering Physics**
C102.1	Develop understanding of interference, diffraction and polarization; connect it to few engineering applications.
C102.2	Learn basics of lasers and optical fibers and their use in some applications.
C102.3	Understand concepts and principles in quantum mechanics. Relate them to some applications.
C102.4	Understand theory of semiconductors and their applications in some semiconductor devices.
C102.5	Summarize basics of magnetism and superconductivity. Explore few of their technological applications.
C102.6	Comprehend use of concepts of physics for Non Destructive Testing. Learn some properties of nanomaterials and their application.

102003	**Systems in Mechanical Engineering**
C103.1	Describe and compare the conversion of energy from renewable and non-renewable energy sources
C103.2	Explain basic laws of thermodynamics, heat transfer and their applications
C103.3	List down the types of road vehicles and their specifications
C103.4	Illustrate various basic parts and transmission system of a road vehicle
C103.5	Discuss several manufacturing processes and identify the suitable process
C103.6	Explain various types of mechanism and its application
103004	**Basic Electrical Engineering**
C104.1	Differentiate between electrical and magnetic circuits and derive mathematical relation for self and mutual inductance along with coupling effect.
C104.2	Calculate series, parallel and composite capacitor as well as characteristics parameters of alternating quantity and phasor arithmetic
C104.3	Derive expression for impedance, current, power in series and parallel RLC circuit with AC supply along with phasor diagram.
C104.4	Relate phase and line electrical quantities in polyphase networks, demonstrate the operation of single phase transformer and calculate efficiency and regulation at different loading conditions
C104.5	Apply and analyze the resistive circuits using star-delta conversion KVL, KCL and different network theorems under DC supply.
C104.6	Evaluate work, power, energy relations and suggest various batteries for different applications, concept of charging and discharging and depth of charge.
110005	**Programming and Problem Solving**
C105.1	Inculcate and apply various skills in problem solving.
C105.2	Choose most appropriate programming constructs and features to solve the problems in diversified domains.
C105.3	Got the concept of Field survey and Aerial survey and able to solve Levelling problems.

C105.4	Demonstrate significant experience with the Python program development environment.
111006	**Workshop Practice**
C106.1	Familiar with safety norms to prevent any mishap in workshop.
C106.2	Able to handle appropriate hand tool, cutting tool and machine tools to manufacture a job.
C106.3	Able to understand the construction, working and functions of machine tools and their parts.
C106.4	Able to know simple operations (Turning and Facing) on a centre lathe.
101006	**Environmental Studies**
107.1	Demonstrate an integrative approach to environmental issues with a focus on sustainability.
107.2	Explain and identify the role of the organism in energy transfers in different ecosystems.
107.3	Distinguish between and provide examples of renewable and nonrenewable resources & analyze personal consumption of resources.
107.4	Identify key threats to biodiversity and develop appropriate policy options for conserving biodiversity in different settings.
	First Year (Semester II)
107008	**Engineering Mathematics II**
C108.1	the effective mathematical tools for solutions of first order differential equations that model physical processes such as Newton's law of cooling, electrical circuit, rectilinear motion, mass spring systems, heat transfer etc.
C108.2	advanced integration techniques such as Reduction formulae, Beta functions, Gamma functions, Differentiation under integral sign and Error functions needed in evaluating multiple integrals and their applications.
C108.3	to trace the curve for a given equation and measure arc length of various curves.

C108.4	the concepts of solid geometry using equations of sphere, cone and cylinder in a comprehensive manner.
C108.5	evaluation of multiple integrals and its application to find area bounded by curves, volume bounded by surfaces, Centre of gravity and Moment of inertia.
107009	**Engineering Chemistry**
C109.1	Apply the different methodologies for analysis of water and techniques involved in softening of water as commodity.
C109.2	Select appropriate electro-technique and method of material analysis.
C109.3	Demonstrate the knowledge of advanced engineering materials for various engineering applications.
C109.4	Analyze fuel and suggest use of alternative fuels.
C109.5	Identify chemical compounds based on their structure.
C109.6	Explain causes of corrosion and methods for minimizing corrosion.
104010:	**Basic Electronics Engineering**
C110.1	Explain the working of P-N junction diode and its circuits.
C110.2	Identify types of diodes and plot their characteristics and also can compare BJT with MOSFET
C110.3	Build and test analog circuits using OPAMP and digital circuits using universal/basic gates and Flip flops
C110.4	Use different electronics measuring instruments to measure various electrical parameters.
C110.5	Select sensors for specific applications.
C110.6	Describe basic principles of communication systems.
101011	**Engineering Mechanics**
C111.1	Determine resultant of various force systems
C111.2	Determine centroid, moment of inertia and solve problems related to friction
C111.3	Determine reactions of beams, calculate forces in cables using principles of equilibrium

C111.4	Solve trusses, frames for finding member forces and apply principles of equilibrium to forces in space
C111.5	Calculate position, velocity and acceleration of particle using principles of kinematics
C111.6	Calculate position, velocity and acceleration of particle using principles of kinetics and Work, Power, Energy
102012	**Engineering Graphics**
C112.1	Draw the fundamental engineering objects using basic rules and able to construct the simple geometries.
C112.2	Construct the various engineering curves using the drawing instruments.
C112.3	Apply the concept of orthographic projection of an object to draw several 2D views and its sectional views for visualizing the physical state of the object.
C112.4	Apply the visualization skill to draw a simple isometric projection from given orthographic views precisely using drawing equipment.
C112.5	Draw the development of lateral surfaces for cut section of geometrical solids.
C112.6	Draw fully-dimensioned 2D, 3D drawings using computer aided drafting tools.
110013	**Project Based Learning**
C113.1	Project based learning will increase their capacity and learning through shared cognition.
C113.2	Students able to draw on lessons from several disciplines and apply them in practical way.
C113.3	Learning by doing approach in PBL will promote long-term retention of material and replicable skill, as well as improve teachers' and students' attitudes towards learning.
101014	**Environmental Studies-II**
C114.1	Have an understanding of environmental pollution and the science behind those problems and potential solutions.
C114.2	Have knowledge of various acts and laws and will be able to identify the industries that are violating these rules.

C114.3	Assess the impact of ever increasing human population on the biosphere: social, economic issues and role of humans in conservation of natural resources
C114.4	Learn skills required to research and analyze environmental issues scientifically and learn how to use those skills in applied situations such as careers that may involve environmental problems and/or issues.
	Academic Year 2020-21 Second Year (Semester III)
202042	**Solid Mechanics**
C 201.1	To acquire basic knowledge of stress, strain due to various types of loading.
C 201.2	To draw Shear Force and Bending Moment Diagram for transverse loading.
C 201.3	To determine Bending, Shear stress, Slope and Deflection on Beam.
C 201.4	To solve problems of Torsional shear stress for shaft and Buckling for the column.
C 201.5	To apply the concept of Principal Stresses and Theories of Failure.
C 201.6	6. To utilize the concepts of Solid Mechanics on application based combined mode of loading
202042	**Solid Modeling and Drafting**
C 202.1	UNDERSTAND basic concepts of CAD system, need and scope in Product Lifecycle Management
C 202.2	UTILIZE knowledge of curves and surfacing features and methods to create complex solid geometry
C 202.3	CONSTRUCT solid models, assemblies using various modeling techniques & PERFORM mass property analysis, including creating and using a coordinate system
C 202.4	APPLY geometric transformations to simple 2D geometries
C 202.5	USE CAD model data for various CAD based engineering applications viz. production drawings, 3D printing, FEA, CFD, MBD, CAE, CAM, etc.
C 202.6	USE PMI & MBD approach for communication
202043	**Engineering Thermodynamics**
C203.1	Describe the basics of thermodynamics with heat and work interaction.

C203.2	Apply laws of thermodynamics to steady flow and non-flow processes.
C203.3	Apply entropy, available and non available energy for an open and closed system.
C203.4	Determine the properties of steam and their effect on performance of vapour power cycle.
C203.5	Analyse the fuel combustion process and products of combustion.
C203.6	Select various instrumentations required for safe and efficient operation of steam generator.
202044	**Engineering Materials and Metallurgy**
C204.1	COMPARE crystal structures and ASSESS different lattice parameters.
C204.2	CORRELATE crystal structures and imperfections in crystals with mechanical behaviour of materials.
C204.3	DIFFERENTIATE and DETERMINE mechanical properties using destructive and nondestructive testing of materials.
C204.4	IDENTIFY & ESTIMATE different parameters of the system viz., phases, variables, component, grains, grain boundary, and degree of freedom. etc.
C204.5	ANALYSE effect of alloying element & heat treatment on properties of ferrous & nonferrous alloy.
C204.6	SELECT appropriate materials for various applications.
203156	**Electrical and Electronics Engineering**
C205.1	APPLY programming concepts to UNDERSTAND role of Microprocessor and Microcontroller in embedded systems
C205.2	DEVELOP interfacing of different types of sensors and other hardware devices with Atmega328 based Arduino Board
C205.3	UNDERSTAND the operation of DC motor, its speed control methods and braking
C205.4	DISTINGUISH between types of three phase induction motor and its characteristic features
C205.5	EXPLAIN about emerging technology of Electric Vehicle (EV) and its modular subsystems
C205.6	CHOOSE energy storage devices and electrical drives for EVs

202045	**Geometric Dimensioning and Tolerancing Lab**
C206.1	SELECT appropriate IS and ASME standards for drawing
C206.2	READ & ANALYSE variety of industrial drawings.
C206.3	APPLY geometric and dimensional tolerance, surface finish symbols in drawing.
C206.4	EVALUATE dimensional tolerance based on type of fit, etc.
C206.5	SELECT an appropriate manufacturing process using DFM, DFA, etc.
202046	**Audit Course III**
C207.1	Encourage studenst to register for atleat one course through NPTEL and SWAYAM plateform
C207.2	Develop the soft skills and personality development among the students
	Second Year (Semester IV)
207002	**Engineering Mathematics - III**
C208.1	SOLVE higher order linear differential equations and its applications to model and analyze mass spring systems.
C208.2	APPLY Integral transform techniques such as Laplace transform and Fourier transform to solve differential equations involved in vibration theory, heat transfer and related mechanical engineering applications.
C208.3	APPLY Statistical methods like correlation, regression in analyzing and interpreting experimental data applicable to reliability engineering and probability theory in testing and quality control.
C208.4	PERFORM Vector differentiation & integration, analyze the vector fields and APPLY to fluid flow problems.
C208.5	SOLVE Partial differential equations such as wave equation, one and two dimensional heat flow equations.
C208.6	Solve various partial differential equations such as wave Equation, one and two dimensional heat flow equations.
202047	**Kinematics of Machinery**
C209.1	APPLY kinematic analysis to simple mechanisms

C209.2	ANALYZE velocity and acceleration in mechanisms by vector and graphical method
C209.3	SYNTHESIZE a four bar mechanism with analytical and graphical methods
C209.4	APPLY fundamentals of gear theory as a prerequisite for gear design
C209.5	CONSTRUCT cam profile for given follower motion
202048	**Applied Thermodynamics**
C210.1	DETERMINE COP of refrigeration system and ANALYZE psychrometric processes.
C210.2	DISCUSS basics of engine terminology,air standard, fuel air and actual cycles.
C210.3	IDENTIFY factors affecting the combustion performance of SI and CI engines.
C210.4	DETERMINE performance parameters of IC Engines and emission control.
C210.5	EXPLAIN working of various IC Engine systems and use of alternative fuels.
C210.6	CALCULATE performance of single and multi stage reciprocating compressors and DISCUSS rotary positive displacement compressors
202049	**Fluid Mechanics**
C211.1	DETERMINE various properties of fluid
C211.2	APPLY the laws of fluid statics and concepts of buoyancy
C211.3	IDENTIFY types of fluid flow and terms associated in fluid kinematics
C211.4	APPLY principles of fluid dynamics to laminar flow
C211.5	ESTIMATE friction and minor losses in internal flows and DETERMINE boundary layer formation over an external surface
C211.6	CONSTRUCT mathematical correlation considering dimensionless parameters, also ABLE to predict the performance of prototype using model laws
202050	**Manufacturing Processes**
C212.1	SELECT appropriate moulding, core making and melting practice and estimate pouring time, solidification rate and DESIGN riser size and location for sand casting process

C212.2	UNDERSTAND mechanism of metal forming techniques and CALCULATE load required for flat rolling
C212.3	DEMONSTRATE press working operations and APPLY the basic principles to DESIGN dies and tools for forming and shearing operations
C212.4	CLASSIFY and EXPLAIN different welding processes and EVALUATE welding characteristics
C212.5	DIFFERENTIATE thermoplastics and thermosetting and EXPLAIN polymer processing techniques
C212.6	UNDERSTAND the principle of manufacturing of fibre-reinforce composites and metal matrix composites
202051	**Machine Shop**
C213.1	PERFORM welding using TIG/ MIG/ Resistance/Gas welding technique
C213.2	MAKE Fibre-reinforced Composites by hand lay-up process or spray lay-up techniques
C213.3	PERFORM cylindrical/surface grinding operation and CALCULATE its machining time
C213.4	DETERMINE number of indexing movements required and acquire skills to PRODUCE a spur gear on a horizontal milling machine
C213.5	PREPARE industry visit report
C213.6	UNDERSTAND procedure of plastic processing
202052	**Project Based Learning - II**
C 214.1	IDENTIFY the real-world problem (possibly of interdisciplinary nature) through a rigorous literature survey and formulate / set relevant aims and objectives.
C 214.2	ANALYZE the results and arrive at valid conclusions.
C 214.3	PROPOSE a suitable solution based on the fundamentals of mechanical engineering by possibly integration of previously acquired knowledge.
C 214.4	CONTRIBUTE to society through proposed solutions by strictly following professional ethics and safety measures.
C 214.5	USE of technology in proposed work and demonstrate learning in oral and written form.

C 214.6	DEVELOP ability to work as an individual and as a team member.

Academic Year 2021-22 Third Year (Semester V)	
302041	**Numerical and Statistical Methods**
C301.1	SOLVE system of equations using direct and iterative numerical methods.
C301.2	ESTIMATE solutions for differential equations using numerical techniques.
C301.3	DEVELOP solution for engineering applications with numerical integration.
C301.4	DESIGN and CREATE a model using a curve fitting and regression analysis.
C301.5	APPLY statistical Technique for quantitative data analysis.
C301.6	DEMONSTRATE the data, using the concepts of probability and linear algebra.
302042	**: Heat and Mass Transfer**
C302.1	ANALYZE & APPLY the modes of heat transfer equations for one dimensional thermal system.
C302.2	DESIGN a thermal system considering fins, thermal insulation and & Transient heat conduction.
C302.3	EVALUATE the heat transfer rate in natural and forced convection & validate with experimentation results.
C302.4	INTERPRET heat transfer by radiation between objects with simple geometries, for black and grey surfaces.
C302.5	ABILITY to analyze the rate of mass transfer using Fick's Law of Diffusion and understands mass diffusion in different coordinate systems.
C302.6	DESIGN & ANALYSIS of heat transfer equipments and investigation of its performance.
302043:	**Design of Machine Elements**
C303.1	DESIGN AND ANALYZE the cotter and knuckle Joints, levers and components subjected to eccentric loading.
C303.2	DESIGN shafts, keys and couplings under static loading conditions.

C303.3	ANALYZE different stresses in power screws and APPLY those in the procedure to design screw jack.
C303.4	EVALUATE dimensions of machine components under fluctuating loads.
C303.5	EVALUATE & INTERPRET the stress developed on the different type of welded and threaded joints.
C303.6	APPLY the design and development procedure for different types of springs.
302044:	**Mechatronics**
C304.1	DEFINE key elements of mechatronics, principle of sensor and its characteristics.
C304.2	UTILIZE concept of signal processing and MAKE use of interfacing systems such as ADC, DAC, Digital I/O.
C304.3	DETERMINE the transfer function by using block diagram reduction technique.
C304.4	EVALUATE Poles and Zero, frequency domain parameter for mathematical modeling for mechanical system.
C304.5	APPLY the concept of different controller modes to an industrial application.
C304.6	DEVELOP the ladder programming for industrial application.
302045-A	**Advanced Forming & Joining Processes**
C305A.1	ANALYSE the effect of friction in metal forming deep drawing and IDENTIFICATIONof surface defects and their remedies in deep drawing operations
C305A.2	ASSESS the parameters for special forming operation and SELECT appropriate specialforming operation for particular applications
C305A.3	ANALYSE the effect of HAZ on microstructure and mechanical properties of materials
C305A.4	CLASSIFY various solid state welding process and SELECT suitable welding processesfor particular applications
C305A.5	CLASSIFY various advanced welding process and SELECT suitable welding processesfor particular applications.
C305A.6	INTERPRET the principles of sustainable manufacturing and its role in manufacturingindustry.

302045-B	**Machining Science & Technology**
C305B.1	DEFINE metal cutting principles and mechanics of metal cutting and tool life.
C305B.2	DESCRIBE features of gear and thread manufacturing processes.
C305B.3	SELECT appropriate grinding wheel and demonstrate the various surface finishing processes.
C305B.4	SELECT appropriate jigs/fixtures and to draw the process plan for a given component.
C305B.5	SELECT & EVALUATE various parameters of process planning.
C305B.6	GENERATE CNC program for Turning / Milling processes and generate tool path using CAM software.
302046:	**Digital Manufacturing Laboratory**
C306.1	DEVELOP a component using conventional machines, CNC machines and Additive Manufacturing Techniques.
C306.2	ANALYZE cutting tool parameters for machining given job.
C306.3	DEMONSTRATE simulation of manufacturing process using Digital Manufacturing Tools.
C306.4	SELECT and DESIGN jigs and Fixtures for a given component.
C306.5	DEMONESTRATE different parameters for CNC retrofitting and reconditioning.
302047:	**Skill Development**
C307.1	APPLY& DEMONSTRATE procedure of assembly & disassembly of various machines.
C307.2	DESIGN & DEVELOP a working/model of machine parts or any new product.
C307.3	EVALUATE fault with diagnosis on the machines, machine tools and home appliances.
C307.4	IDENTIFY & DEMONSTRATE the various activities performed in an industry such as maintenance, design of components, material selection.
Third Year (Semester VI)	
302049:	**Artificial Intelligence & Machine Learning**

C309.1	DEMONSTRATE fundamentals of artificial intelligence and machine learning.
C309.2	APPLY feature extraction and selection techniques.
C309.3	APPLY machine learning algorithms for classification and regression problems.
C309.4	DEVISE AND DEVELOP a machine learning model using various steps.
C309.5	EXPLAIN concepts of reinforced and deep learning.
C309.6	SIMULATE machine learning model in mechanical engineering problems.
302050:	**Computer Aided Engineering**
C310.1	DEFINE the use of CAE tools and DESCRIBE the significance of shape functions in finite element formulations.
C310.2	APPLY the various meshing techniques for better evaluation of approximate results.
C310.3	APPLY material properties and boundary condition to SOLVE 1-D and 2-D element stiffness matrices to obtain nodal or elemental solution.
C310.4	ANALYZE and APPLY various numerical methods for different types of analysis.
C310.5	EVALUATE and SOLVE non-linear and dynamic analysis problems by analyzing the results obtained from analytical and computational method.
C310.6	GENERATE the results in the form of contour plot by the USE of CAE tools.
302051:	**Design of Transmission Systems**
C311.1	APPLY the principle of Spur & Helical gear design for industrial application and PREPARE a manufacturing drawing with the concepts of GD&T.
C311.2	EXPLAIN and DESIGN Bevel & Worm gear considering design parameters as per design standards.
C311.3	SELECT&DESIGN Rolling and Sliding Contact Bearings from manufacturer's catalogue for a typical application considering suitable design parameters.
C311.4	DEFINE and DESIGN various types of Clutches, Brakes, used in automobile.
C311.5	APPLY various concept to DESIGN Machine Tool Gear box, for different applications
C311.6	ELABORATE various modes of operation, degree of hybridization and allied terms associated with hybrid electric vehicles.

302052-A	**Composite Materials**
C312A.1	DEFINE & COMPARE composites with traditional materials.erials for various applications.
C312A.2	IDENTIFY & ESTIMATE different parameters of the Polymer Matrix Composite
C312A.3	CATEGORISE and APPLY Metal Matrix Process from possessions landscape.
C312A.4	DETERMINE volume/weight fraction and strength of Composites.
C312A.5	SELECT appropriate testing and inspection method for composite materials.
C312A.6	SELECT composites materials for various applications.
302052-B: Surface Engineering	
C312B.1	DEFINE the basic's principle & mechanism of surface degradation.
C312B.2	ANALYSE & SELECT correct corrosion prevention techniques for a different service condition.
C312B.3	DEMONSTRATE the role of surface engineering of materials to modify/improve the surface properties.
C312B.4	SELECT the suitable surface heat treatments to improve the surface properties.
C312B.5	APPLY the surface modification technique to modify surface properties.
C312B.6	ANALYSE & EVALUTE various surface coating defects using various testing/characterization method.
302053: Measurement Laboratory	
C313.1	EVALUATE causes of errors in Vernier calipers, micrometers by performing experiments in standard metrological conditions, noting deviations at actual and by plotting cause and effect diagram, to reduce uncertainty in measurement.
C313.2	ANALYZE strain measurement parameters by taking modulus of elasticity in consideration to acknowledge its usage in failure detection and force variations.
C313.3	EXAMINE surface Textures, surface finish using equipment's like Talysurf and analyze surface finish requirements of metrological equipment's like gauges, jaws of vernier calipers, micrometers, magnifying glasses of height gauge and more, to optimize surface finish accuracy requirements and cost of measurement.

C313.4	MEASURE the dimensional accuracy using Comparator and limit gauges and appraise their usage in actual measurement or comparison with standards set to reduce measurement lead time.
C313.5	PERFORM Testing of Flow rate, speed and temperature measurements and their effect on performance in machines and mechanisms like hydraulic or pneumatic trainers, lathe machine etc. to increase repeatability and reproducibility.
C313.6	COMPILE the information of opportunities of entrepreneurships/business in various sectors of metrology like calibrations, testing, coordinate and laser metrology etc in an industry visit report.
302054: Fluid Power & Control Laboratory	
C314.1	DEFINE working principle of components used in hydraulic and pneumatic systems.
C314.2	IDENTIFY & EXPLAIN various applications of hydraulic and pneumatic systems.
C314.3	SELECT an appropriate component required for hydraulic and pneumatic systems using manufactures' catalogues.
C314.4	SIMULATE & ANALYSE various hydraulic and pneumatic systems for industrial/mobile applications.
C314.5	DESIGN a hydraulic and pneumatic system for the industrial applications.
C314.6	DESIGN & DEMONESTRATE various IoT, PLC based controlling system using hydraulics and pneumatics.
302055A: Internship	
C315A.1	DEMONSTRATE professional competence through industry internship.
C315A.2	APPLY knowledge gained through internships to complete academic activities in a professional manner.
C315A.3	CHOOSE appropriate technology and tools to solve given problem.
C315A.4	DEMONSTRATE abilities of a responsible professional and use ethical practices in day to day life.
C315A.5	DEVELOP network and social circle, and DEVELOPING relationships with industry people.
C315A.6	ANALYZE various career opportunities and DECIDE career goals.

302055A Mini project	
C315B.1	EXPLAIN plan and execute a Mini Project with team.
C315B.2	IMPLEMENT hardware/software/analytical/numerical techniques, etc.
C315B.3	DEVELOP a technical report based on the Mini project.
C315B.4	DELIVER technical seminar based on the Mini Project work carried out.
	Academic Year 2022-23 Final Year Sem VII
402041: Heating, Ventilation, Air Conditioning and Refrigeration	
C401.1	ANALYSE different air-craft refrigeration systems and EXPLAIN the properties, applications and environmental issues of different refrigerants.
C401.2	ANALYSE multi pressure refrigeration system used for refrigeration applications.
C401.3	DISCUSS types of compressors, condensers, evaporators and expansion valves along with regulatory and safety controls and DESCRIBES Transcritical and ejector refrigeration systems.
C401.4	ESTIMATE cooling load for air conditioning systems used with concern of design conditions and indoor quality of air.
C401.5	DESIGN air distribution system along with consideration of ventilation and infiltration.
C401.6	EXPLAIN the working of types of desiccants, evaporative, thermal storage, radiant cooling, clean room and heat pump systems.
	402042: Dynamics of Machinery
C402.1	APPLY balancing technique for static and dynamic balancing of multi cylinder inline and radial engines.
C402.2	ANALYZE the gyroscopic couple or effect for stabilization of Ship, Airplane and Four wheeler vehicles.
C402.3	ESTIMATE natural frequency for single DOF un-damped & damped free vibratory systems.
C402.4	DETERMINE response to forced vibrations due to harmonic excitation, base excitation and excitation due to unbalance forces.

C402.5	ESTIMATE natural frequencies, mode shapes for 2 DOF un-damped free longitudinal and torsional vibratory systems.
C402.6	DESCRIBE noise and vibration measuring instruments for industrial / real life applications along with suitable method for noise and vibration control.
402043: Turbomachinery	
C403.1	VALIDATE impulse moment principle using flat, inclined and curved surfaces and INVESTIGATE performance characteristics of hydraulic turbines.
C403.2	DETERMINE performance parameters of impulse and reaction steam turbine along with discussion of nozzles, governing mechanism & losses.
C403.3	MEASURE performance parameters of single & multistage centrifugal pumps along with discussion of cavitation and selection.
C403.4	EXPLAIN performance parameters of centrifugal compressor along with discussion of theoretical aspects of axial compressor.
402044A: Automobile Design	
C404A.1	CO1: DESIGN of Principal Engine Components
C404A.2	CO2: DESIGN of Drive train
C404A.3	CO3: DESIGN of brakes and Suspension
402044B: Design of Heat Transfer Equipments	
C404B.1	CO1: EXPLAIN the design aspect of heat exchanger considering fouling factor for HeTransfer Applications
C404B.2	CO2: SELECT and DESIGN the double tube heat exchangers for process industry
C404B.3	CO3: DESIGN the Shell & Tube Heat Exchangers for specified conditions
C404B.4	CO4: DESIGN the condensers and evaporators for refrigeration applications
C404B.5	CO5: DESIGN the compact heat exchangers
C404B.6	CO6: ANALYSE the performance of counter and cross flow cooling tower.
402044C - Modern Machining Processes	

C404C.1	UNDERSTAND and ANALYZE the mechanism, process parameters of mechanical assisted modern machining processes.
C404C.2	UNDERSTAND the mechanism, construction and working of laser, plasma and electron beam assisted machining.
C404C.3	CLASSIFY and ANALYZE the mechanism, process parameters of the chemical and electrochemical machining.
C404C.4	RELATE and ANALYZE the mechanism and select process parameters Electrical Discharge Machining for an application.
C404C.5	ILLUSTRATE the application of micromachining processes. SUGGEST appropriate nanomachining process for the specific application.
402044D: Industrial Engineering	
C404D.1	EVALUATE the productivity and IMPLEMENT various productivity improvement techniques.
C404D.2	APPLY work study techniques and UNDERSTANDS its importance for better productivity.
C404D.3	DEMONSTRATE the ability to SELECT plant location, appropriate layout and material handling equipment.
C404D.4	USE of Production planning and control tools for effective planning, scheduling and managing the shop floor control.
C404D.5	PLAN inventory requirements and EXERCISE effective control on manufacturing requirements.
C404D.6	APPLY Ergonomics and legislations for human comfort at work place and UNDERSTANDS the role of value engineering in improving productivity.
402044E: Internet of Things	
C404E.1	EXPLAIN the Applications/Devices, Protocols and Communication Models of IoT
C404E.2	DEMONSTARTE small Mechanical Engineering IoT oriented applications using Sensors, Actuators, Microcontrollers and Cloud
C404E.3	SELECT commonly used IoT Simulation Hardware platforms
C404E.4	APPLICATION of Interfacing and Communication Technologies for IoT
C404E.5	ILLUSTRATE IoT Application Development and Security of IoT Ecosystem

C404E.6	EVALUATE Present and Future Domain specific Applications of IoT Ecosystem
402044F: Computational Fluid Dynamics	
C404F.1	DISTINGUISH and ANALYSE the governing equations of fluid mechanics and heat transfer in various formulations
C404F.2	ANALYZE and MODEL the conduction and advection problems
C404F.3	ANALYZE and MODEL the Convection-Diffusion problems
C404F.4	IDENTIFY and EVALUATE the External/Internal flow and its simulation
C404F.5	DISTINGUISH and COMPARE concepts of stability and turbulence.
C404F.6	USE and APPLY a CFD tool for effectively solving practical Fluid-Structure Interaction problems
402045A: Product Design and Development	
C405A.1	UNDERSTAND Product design and Product development processes
C405A.2	UNDERSTAND Processes, tools and techniques for Market Survey & Product Specification Finalization
C405A.3	UNDERSTAND Processes, tools and techniques for Concept Inception, Verification and selection
C405A.4	UNDERSTAND Processes, tools and techniques for Concept Exploration & Development
C405A.5	UNDERSTAND Processes, tools and techniques for Design Verification and Validation
C405A.6	UNDERSTAND Processes, tools and techniques for Robust Design and Development
402045B: Experimental Methods in Thermal Engineering	
C405B.1	IDENTIFY the suitable instrument for measuring parameters as per performance characteristics
C405B.2	ANALYZE experimental data by using different statistical techniques and estimate error

C405B.3	DISTINGUISH different methods of temperature measurements and thermal radiation
C405B.4	CLASSIFY various pressure measurement instruments and their comparison
C405B.5	EXPLAIN different flow measurement methods and flow visualization techniques
C405B.6	APPLY knowledge of modern engineering experimentation, including calibration, data acquisition, analysis and interpretation using different AI and ML techniques
402045C: Additive Manufacturing	
C405C.1	USE and CLASSIFY the fundamentals of Additive Manufacturing Technologies for engineering applications.
C405C.2	IDENTIFY and CATEGORIZE the methodology to manufacture the products using light-based photo-curing, LASER based technologies and STUDY their applications, benefits.
C405C.3	IDENTIFY and CATEGORIZE the methodology to manufacture the products using extrusion-based deposition, inkjet-based technologies and STUDY their applications, benefits.
C405C.4	SYNTHESIZE, RECOMMEND and DESIGN the suitable material and process for fabrication and build behavior of verities of product.
C405C.5	DESIGN and CONSTRUCT the AM equipment's for appropriate applications and the input CAD model.
C405C.6	DEVELOP the knowledge of additive manufacturing for various real-life applications.
402045D: Operations Research	
C405D.1	EVALUATE various situations of Games theory and Decision techniques and APPLY them to solve them in real life for decision making.
C405D.2	SELECT appropriate model for queuing situations and sequencing situations and FIND the optimal solutions using models for different situations.
C405D.3	FORMULATE various management problems and SOLVE them using Linear programming using graphical method and simplex method.
C405D.4	FORMULATE variety of problems such as transportation, assignment, travelling salesman and SOLVE these problems using linear programming approach.

C405D.5	PLAN optimum project schedule for network models arising from a wide range of applications and for replacement situations find the optimal solutions using appropriate models for the situation.
C405D.6	APPLY concepts of simulation and Dynamic programming
402045E: Augmented Reality and Virtual Reality	
C405E.1	UNDERSTAND fundamental Computer Vision, Computer Graphics and HumanComputer Interaction Techniques related to VR/AR
C405E.2	UNDERSTAND Geometric Modeling Techniques
C405E.3	UNDERSTAND the Virtual Environment
C405E.4	ANALYZE and EVALUATE VR/AR Technologies
C405E.5	APPLY various types of Hardware and Software in Virtual Reality systems
C405E.6	DESIGN and FORMULATE Virtual/Augmented Reality Applications
402046: Data Analytics Laboratory	
C406.1	UNDERSTAND the basics of data analytics using concepts of statistics and probability.
C406.2	APPLY various inferential statistical analysis techniques to describe data sets and withdraw useful conclusions from acquired data set.
C406.3	EXPLORE the data analytics techniques using various tools
C406.4	APPLY data science concept and methods to solve problems in real world context
C406.5	SELECT advanced techniques to conduct thorough and insightful analysis and interpret the results
402047: Project (Stage I)	
C407.1	Implement systems approach.
C407.2	To conceptualize a novel idea / technique into a product.
C407.3	To think in terms of a multi-disciplinary environment.
C407.4	To take on the challenges of teamwork, and document all aspects of design work.
C407.5	To understand the management techniques of implementing a project.

	Final Year Sem VIII
402048: Computer Integrated Manufacturing	
C408.1	EXPLAIN CIM and factory automation.
C408.2	UNDERSTAND the integration of hardware and software elements for CIM
C408.3	APPLY CNC program for appropriate manufacturing techniques.
C408.4	ANALYZE processes planning, quality and MRP integrated with computers.
C408.5	INTERPRET flexible, cellular manufacturing and group technology.
C408.6	ANALYZE the effect of IOT, Industry-4.0 and cloud base manufacturing.
402049: Energy Engineering	
C409.1	EXPLAIN the power generation scenario, the layout components of thermal power plant and ANALYZE the improved Rankine cycle.
C409.2	ANALYZE the performance of steam condensers, cooling tower system; RECOGNIZE an environmental impact of energy systems and methods to control the same.
C409.3	EXPLAIN the layout, component details of diesel engine plant, hydel and nuclear energy systems.
C409.4	ANALYZE gas and improved power cycles.
C409.5	EXPLAIN the fundamentals of renewable energy systems.
C409.6	EXPLAIN basic principles of energy management, storage and economics of power generation.
402050A: Quality & Reliability Engineering	
C410A.1	UNDERSTAND basic concepts of quality and RELATE various quality tools
C410A.2	DEVELOP analytical competencies to SOLVE problems on control charts and process capability.
C410A.3	UNDERSTAND fundamental concepts of reliability.
C410A.4	EVALUATE system reliability.
C410A.5	IDENTIFY various failure modes and CREATE fault tree diagram.

C410A.6	UNDERSTAND the concept of reliability centered maintenance and APPLY reliability tests methods.
402050B: Energy Audit and Management	
C410B.1	EXPLAIN the energy need and role of energy management
C410B.2	CARRY OUT an energy audit of the Institute/Industry/Organization
C410B.3	ASSESS the ENCON opportunities using energy economics
C410B.4	ANALYSE the energy conservation performance of Thermal Utilities
C410B.5	ANALYSE the energy conservation performance of Electrical Utilities
C410B.6	EXPLAIN the energy performance improvement by Cogeneration and WHR method
402050C: Manufacturing System and Simulation	
C410C.1	UNDERSTAND the concepts of manufacturing system, characteristics, type, etc.
C410C.2	UNDERSTAND the concepts of Facilities, manufacturing planning & control and Support System.
C410C.3	UNDERSTAND the concepts of manufacturing towards solving productivity related problems.
C410C.4	DEVELOP a virtual model to solve industrial engineering related issues such as capacity. utilization, line balancing.
C410C.5	BUILDING tools to view and control simulations and their results.
C410C.6	PLAN the data representation & Evaluate the results of the simulation.
402050D: Engineering Economics and Financial Management	
C410D.1	UNDERSTAND the business environment, concepts of economics and demand-supply scenario.
C410D.2	APPLY the concepts of costing and pricing to evaluate the pricing of mechanical components.
C410D.3	UNDERSTAND accounting systems and analyze financial statements using ratio analysis

C410D.4	SELECT and PREPARE the appropriate type of budget and understand the controlling aspects of budget. **neeringd**
C410D.5	UNDERSTAND the international business and trade system functioning
C410D.6	DEMONSTRATE understanding of financing decisions of new ventures and performance
402050E: Organizational Informatics	
C410E.1	Demonstrate an understanding of the scope, purpose and value of information systems in an organization.
C410E.2	Understand the constituents of the information system.
C410E.3	Demonstrate the Understanding of the management of product data and features of various PLM aspects.
C410E.4	Relate the basic concepts of manufacturing system and the ERP functionalities in context of information usage.
C410E.5	Understand the manufacturing execution system and it's applications in functional areas.
C410E.6	Outline the role of the information system in various types of business and allied emerging technologies.
402050F: Computational Multi Body Dynamics	
C410F.1	APPLY the basic terminology and concepts used in Multibody Dynamics to solve varieties of motion related applications
C410F.2	IDENTIFY and EVALUATE the types of joints, its kinematics and relevant transformations
C410F.3	DISTINGUISH and COMPARE the formulation methods
C410F.4	DERIVE equations of motion and EVALUATE the kinematics and dynamics of rigid Planar inter-connected bodies
C410F.5	DERIVE equations of motion and EVALUATE the kinematics of rigid Spatial inter-connected bodies
C410F.6	APPLY MBD tool effectively and SIMULATE it to solve and validate practical Multibody Dynamics problems and its solutions

402051A: Process Equipment Design	
C411A.1	INTERPRET the different parameters involved in design of process Equipments.
C411A.2	ANALYZE thin and thick walled cylinder
C411A.3	DESIGN cylindrical vessel, spherical vessel, tall vessels and thick walled high pressure vessels
C411A.4	DESIGN different process Equipments and select pump, compressor etc. and auxiliary services
C411A.5	EVALUATE Process parameters and their correlation
C411A.6	APPLY the concepts of process equipment design for specific applications
402051B: Renewable Energy Technologies	
C411B.1	DESCRIBE fundamentals, needs and scopes of renewable energy systems.
C411B.2	EXPLAIN performance aspects of flat and concentric solar collectors along with applications.
C411B.3	DESIGN solar photovoltaic system for residential applications.
C411B.4	DESIGN AND ANALYSIS of wind energy conversion system.
C411B.5	APPLY Installation practices of Wind and Solar Photovoltaic Systems for grid connection.
C411B.6	DETERMINE performance parameters of bio-energy conversion systems.
402051C: Automation and Robotics	
C411C.1	UNDERSTAND the basic concepts of Automation
C411C.2	UNDERSTAND the basic concepts of Robotics
C411C.3	IDENTIFY and EVALUATE appropriate Drive for Robotic Applications
C411C.4	COMPARE and SELECT End-effectors and Sensors as per Application
C411C.5	DEVELOPE the Mathematical Modeling Approaches of Robot
C411C.6	EVALUATE the fundamentals of robot programming and CLASSIFY the Applications
402051D: Industrial Psychology and Organizational Behavior	

C411D.1	DEMONSTRATE fundamental knowledge about need and scope of industrial - organizational psychology and behavior.
C411D.2	ANALYZE the job requirement, have understanding of fatigue, boredom and improve the job satisfaction.
C411D.3	UNDERSTAND the approaches to enhance the performance.
C411D.4	KNOWLEDGE of theories of organizational behavior, learning and social-system.
C411D.5	UNDERSTAND the mechanism of group behavior, various aspects of team, leadership and conflict management.
C411D.6	EVALUATE the organizational culture, manage the change and understands organizational development approaches.
402051E: Electric and Hybrid Vehicle	
C411E.1	UNDERSTAND the basics related to e-vehicle
C411E.2	CLASSIFY the different hybrid vehicles
C411E.3	IDENTIFY and EVALUATE the Prime Movers, Energy Storage and Controllers
C411E.4	DISCOVER and CATAGORIZE the Electric Vehicle Configuration with respect to Propulsion, Power distribution and Drive-Train Topologies
C411E.5	DEVELOP body frame with appropriate suspension system and TESTING of for e-Vehicles
C411E.6	CLASSIFY and EVALUATE Battery Charging techniques and management
402052: Mechanical Systems Analysis Laboratory	
C412.1	DEVELOP an understanding of the Systems Engineering Process and the range of factors that influence the product need, problem-specific information collection, Problem Definition, Task Specification, Solution Concept inception, Concept Development, System's Mathematical Modelling, Synthesis, Analysis, final solution Selection, Simulation, Detailed Design, Construction, Prototyping, Testing, fault-finding, Diagnosis, Performance Analysis, and Evaluation, Maintenance, Modification, Validation, Planning, Production, Evaluation and use of a system using manual calculation, computational tools to automate product development process, redesign from customer feedback and control of technological systems.

C412.2	ILLUSTRATE the concepts and USE the developed skill-set of use of computational tools (FEA, CFD, MBD, FSI, CAE) to automate the complete product development process.
C412.3	EVALUATE the knowledge of new developments and innovations in technological systems to carry forward to next stage of employment after passing your Undergraduate Degree Examination.
C412.4	APPRAISE how technologies have transformed people's lives and can be used to SOLVE challenges associated with climate change, efficient energy use, security, health, education and transport, which will be coming your ways in the coming future.
C412.5	PRIORITIZE the concept of quality and standards, including systems reliability, safety and fitness for the intended purpose.
C412.6	INVENT yourself to face the challenges of future technologies and their associated Problems.
402053: Project (Stage II)	
C413.1	Implement systems approach.
C413.2	To conceptualize a novel idea / technique into a product.
C413.3	To think in terms of a multi-disciplinary environment.
C413.4	To take on the challenges of teamwork, and document all aspects of design work.
C413.5	To understand the management techniques of implementing a project.