

- **Department Name: - Mechanical Engineering**
- **UG Program Name: - Mechanical Engineering**

Vision

To transform the department into center of excellence by synergizing teaching, learning and research to produce globally competent, innovative and entrepreneurial Mechanical Engineers.

Mission

- To develop state of the art facilities to stimulate faculty, staff and students to create, analyse, apply and disseminate knowledge.
- To build the competency to transform students into globally competent mechanical engineers by imparting quality education.
- To collaborate with research organizations, reputed educational institutions, industries and alumni for excellence in teaching, research and consultancy practices.

Sr. No.	Program Outcomes
PO_1	Apply the knowledge of mathematics, science, engineering fundamentals, and mechanical engineering to the solution of complex engineering problems.
PO_2	Identify, formulate, review research literature, and analyze complex mechanical engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO_3	Design solutions for complex mechanical engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO_4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO_5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex mechanical engineering activities with an understanding of the limitations.
PO_6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practices.
PO_7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO_8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

PO_9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO_10	Communicate effectively on complex mechanical 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 presentations, and give and receive clear instructions.
PO_11	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	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological changes

Sr. No.	Program Specific Outcomes
PSO_1	Use Company standards, national and international standards like IS, BS, SAE, ISO, ASTM, etc. for designing and manufacturing mechanical components and systems.
PSO_2	Engage professionally in industries or as an entrepreneur by applying manufacturing, design, thermal and management practices.

Sr. No.	Semester	Course Code	Course Name	Course Outcome
1.	III	ME2053	Engineering Mechanics	1. Calculate the resultant for concurrent and non-concurrent force systems. 2. Draw the free body diagram and apply the equations of equilibrium to 2D and 3D rigid bodies 3. Evaluate the moment of inertia of standard composite section. 4. Explain particle dynamics and compute various forms of stored energy under gradually and suddenly applied load conditions 5. Apply the D'Alembert's, Work Energy and collision principle to analysis in plane motion bodies

2.	III	ME2073	Fluid Mechanics	1. Define, calculate, measure properties of fluid
				2. Apply continuity equation, Bernoulli's equation, equation of motion and momentum equation for different flow system.
				3. Identify different types of flows & forces acting on fluid.
				4. Estimate different energy losses in fluid flow.
				5. Estimate forces acting on bodies submerged in fluid
				6. Apply basic concept of fluid mechanics for dimensional analysis & compressible flow.
3.	III	ME2093	Manufacturing Processes and Machine Tools	1. Select casting as manufacturing process suitable for the component design and production volume
				2. Select suitable furnaces in casting process as per requirement.
				3. Select appropriate joining process for given application.
				4. Select suitable Engineering forming process for production of component of required specification.
				5. Select machine tools for metal cutting operations
4.	III	ME2113	Electrical Technology	1. Explain different types of electrical machines, their characteristics and control.
				2. Analyze different types of electrical machines.
				3. Select special motors, electric drives and

				electric heating for specific applications.
5.	III	SH2173	Environmental Science	1. Discuss the importance and sensitivity of environment.
				2. Interpret the over exploitation of natural resources and follow the environmental ethics.
				3. Explain methods to protect environment and prevent environmental pollution.
				4. Apply their knowledge and skills to solve environment related problems
6.	III	ME2513	Engineering Mechanics Lab	1. Explain the various laws studied in engineering mechanics.
				2. Calculate the forces and deflection in structural member.
				3. Develop the physical sense towards the engineering mechanics term and establish relation between them.
7.	III	ME2533	Fluid Mechanics and Electrical Technology Lab	1. Verify and apply Bernoulli's Theorem.
				2. Determine coefficient of discharge of fluid flow apparatus.
				3. Calculate various losses through pipes.
8.	III	ME2553	Material Science & Metallurgy Lab	1. Illustrate stress strain diagram for Mild steel.
				2. To measure hardness of material.
				3. To measure micro-hardness of various delicate samples
				4. Test materials for their impact strength.
				5. To explain non-destructive testing methods.

				6. Correlate mechanical properties with microstructures of steel and cast iron.
				7. To estimate composition of various ferrous and non-ferrous metals.
				8. Measure Hardenability of given steel using Jominy End Quench Test
9.	III	ME2573	Workshop Practice –I	1. Demonstrate effect of variables such as Voltage,current on welding process.
				2. Produce given joint by MIG welding process.
				3. Produce welding run on S.S. by TIG welding.
				4. Produce welding run on Aluminum by TIG welding.
				5. Produce given job with proper taper and V threading within dimensional tolerances ± 0.2 m.m. on diameter and ± 0.5 m.m. on length. (Job – A)
10.	III	ME2593	Technical Aptitude -I	1. Apply the knowledge acquired during the course work.
				2. Develop the ability of problem solving.
11.	III	SH 2613	Environmental Science project	1. Utilize scientific methods to solve environmental problems.
				2. Evaluate technologies for restoration of degraded environment.
				3. Develop presentation and report writing skills.
				4. Develop as an individual and in group leadership quality

12.	III	SH2633	Professional Leadership Skills	1. Explain the traits of a leadership through real life examples.
				2. Exhibit the ability to work effectively in team.
				3. Prepare a presentation as per the audience and context requirements.
13.	III	SH2613	Interpersonal Skills ('Jeevanvidya' for Work Life Balance)	1. Exhibit interpersonal communication skills.
				2. Demonstrate decision-making skills.
				3. Apply conflict resolution styles appropriate in different situations.
				4. Demonstrate skills to manage balance in work and life.
				5. Apply Jeevanvidya wisdom in day to day life.
14.	III	SH2693	Innovation Tools and Methods for Entrepreneurs	1. Explain structured approach to define the problem with every possible detail, identify conflicts and solve them
				2. Apply User Journey Map to the selected problem to show user interaction at various stages
				3. Analyze the solutions provided by competitors for effectiveness and gaps if any.
15.	III	SH2593	Personal Effectiveness and Body Language	1. Develop skills to build self-esteem and positive attitude.
				2. Develop interpersonal skills characterized by effective communication and conflict resolution.
				3. Discover ways to overcome procrastination.

				4. Demonstrate responsiveness towards stress and health issues.
				5. Interpret the non-verbal behaviour of a person.
16.	III	SH2733	German Language - Basic Level	1. Interpret the language if the next person is speaking slowly and clearly.
				2. Make use of the language in routine life with the routing topics like family, shopping, work etc.
				3. Demonstrate the language by self-introduction in German with simple sentences
17.	III	SH2713	Japanese Language - Level III	1. Make use of basic conversations in various situations.
				2. Identify the sentence patterns.
				3. Explain insights about the communication required for living in Japan.
				4. Interpret Japanese work ethics required in their professional career.
18.	IV	SH2063	Engineering Mathematics III	1. Evaluate differential equation using appropriate concept.
				2. Analyze system and its mathematical model and select suitable differential equation method to solve model.
				3. Analyze the problem and apply the concept of partial differential equations.
				4. Evaluate Laplace & inverse Laplace transform of function and solve ordinary differential equations and linear time invariant systems.

				5. Develop Fourier series of periodic functions.
				6. Apply the concept of Fourier transform to engineering problems.
19.	IV	ME2023	Strength of Materials	1. Determine different types of stresses and strains induced in any machine component.
				2. Develop shear force and bending moment diagram for different types of beam.
				3. Determine stress distribution for various cross sections of beam.
				4. Estimate the deflection of beams by analytical and graphical method
				5. Analyze axially loaded column for different end conditions.
20.	IV	ME2043	Applied Thermodynamics	1. Differentiate SI and CI engine and cycles and relate different performance parameters, and compare different pollution norms
				2. Illustrate and analyse the performance of various the refrigeration system.
				3. Differentiate between various types of boilers and evaluate performance of boiler
				4. Design a steam nozzle for given condition and calculate nozzle efficiency
				5. Compute different efficiencies and power developed by impulse and reaction turbine.
				6. Estimate cooling water required and calculate vacuum and condenser efficiency.

21.	IV	ME2063	Tool Engineering	1. Explain the mechanism of metal cutting.
				2. Analyze the effect of various parameters such as process variables, cutting tool materials etc. on the performance of machining.
				3. Explain the importance of the various elements of tool geometry of single and multi-point cutting tools.
				4. Design jigs and fixtures for given components.
				5. Design press tools for cutting and forming press working operations.
				6. Estimate machining cost.
22.	IV	ME2083	Kinematics of Machines	1. Select suitable mechanisms for given application
				2. Analyze the mechanism for velocity and acceleration
				3. Design the CAM for given condition
				4. Apply appropriate power transmission method for mechanical system
				5. Analyse kinematically flywheel, governor and gear system.
				6. Synthesize given mechanical system
23.	IV	ME2103	Computer Programming C++	1. Build Object Oriented Programs.
				2. Elaborate the concepts of “inline function”, “friend function”, “function overloading” and “operator overloading”.

				3. Extend the program by using inheritance.
				4. Use memory management technique “constructors” & “destructors”.
				5. Handle different file handling techniques like “Create”, “Open”, “Close” files and perform “Read”, “Write” and “Append” operations.
				6. Write C++ programme to draw simple geometric shapes.
24.	IV	ME2503	Applied Thermodynamics Laboratory	1. Exposure to constructional details of engine, compressor and its components
				2. Perform testing on different systems
				3. Analyze effect of different variables on performance of systems.
25.	IV	ME2523	Machine Drawing Lab	1. Recognize the significance & importance of BIS conventions
				2. Identify & draw the proportionate dimensioned free hand sketches of various engineering components.
				3. Prepare details & assembly drawing from given detail drawings
				4. Prepare the manufacturing drawing
				5. Identify appropriate limits, fits, tolerances, tolerances of form & position, surface finish symbols for given machine components & incorporate the same in the orthographic

				<p>drawing of given machine component</p> <p>6. Identify & draw the curves of interpenetration</p>
26.	IV	ME2563	Computer Programming C++ Lab	1. Build Object Oriented Programs.
				2. Elaborate the concepts of “inline function”, “friend function”, “function overloading” and “operator overloading”.
				3. Extend the program by using inheritance.
				4. Use of memory management technique “constructors” & “destructors”.
				5. Handle different file operations like “Create”, “Open”, “Close” files and perform “Read”, “Write” and “Append” operations.
				6. Write programs to draw simple geometric shapes.
27.	IV	ME2583	Workshop Practice – II	1. Demonstrate effect of variables such as speed, feed and depth of cut on machining process
				2. Produce given job with proper taper fitting and within dimensional tolerances ± 0.2 m.m. on diameter and ± 0.5 m.m. on length. (Job – b)
				3. Produce given job with proper V threading fitting and within dimensional tolerances ± 0.2 m.m. on diameter and ± 0.5 m.m. on length. (Job – c)
				4. Produce given job of sq. threading of given

				specifications. (Job – D)
28.	IV	ME2603	Technical Aptitude -II	1. Apply the knowledge acquired during the course work.
				2. Develop the ability of problem solving.
29.	IV	SH 2643	German Language - Advanced Level	1. Interpret the language if the next person is speaking slowly and clearly.
				2. Make use of the language in routine life with the routing topics like family, shopping, work etc.
				3. Demonstrate the language by self-introduction in German with simple sentences.
30.	IV	SH2623	Japanese Language - Level IV	1. To be able to make basic conversations in various situations.
				2. To recognize the sentence patterns.
				3. To improve Japanese Language proficiency.
				4. To give students insights about the communication required for living in Japan.
				5. To expose students to the Japanese work ethics required in their professional careers.
31.	V	ME3013	Dynamics of Machines	1. Apply the theoretical knowledge to balance the rotary and reciprocating systems
				2. Identify and investigate the stability of spinning bodies due to the gyroscopic effect
				3. Apply different principles to convert the physical vibratory system into a mathematical model

				<p>4. Identify the effect of external excitation on the system and effect of dampers to control the system vibration</p> <p>5. Recognize the suitable method for minimizing or eliminating the vibration from the system</p>
32.	V	ME3033	Design of Machine Elements	<p>1. Identify the customers need, formulate the problem and draw the design specifications.</p> <p>2. Design a machine component using theories of failure.</p> <p>3. Design a simple machine components like joints, shafts, keys, couplings</p> <p>4. Design a spring and power screw</p> <p>5. Select belt drives for given application</p> <p>6. Design a flywheel for different applications.</p>
33.	V	ME3053	Metrology & Control Engineering	<p>1. Apply knowledge of various tools and techniques to determine geometry and dimensions of components in engineering applications.</p> <p>2. Design system to meet desire needs within realistic constraints.</p> <p>3. Analyze and interpret data by using QC tools.</p> <p>4. Explain feedback control system.</p> <p>5. Represent control system mathematically and by using block diagrams and determine their response to various input conditions.</p>
34.	V	ME3073	Heat Transfer	<p>1. Explain modes of heat</p>

				transfer and analyze steady state heat conduction.
				2. Examine heat transfer from extended surfaces.
				3. Formulate and Solve problems on heat conduction with heat generation and unsteady heat conduction.
				4. Illustrate different concepts in radiation mode of heat transfer.
				5. Develop and use various correlations to solve heat convection problems.
				6. Design an indirect tube type heat exchanger.
35.	V	ME3513	Workshop Practice- III	1. Demonstrate effect of variables such as speed, feed and depth of cut on machining process
				2. Produce given job with proper taper fitting and within dimensional tolerances ± 0.1 mm on diameter and ± 0.2 mm on length. (Job A)
				3. Produce bearing diameter on job a maintaining fit H7g6.
				4. Produce Gear Teeth - Job B on Milling Machine as per specifications.
				5. Produce Job C to fit Job A with proper threading fitting on Turret. Prepare process sheet for all Jobs
36.	V	ME353	Kinematics and Dynamics of Machinery Lab	1. Estimate moment of inertia of Irregular shape bodies.
				2. Analyse the controlling force and stability of governor.

				3. Investigate the stability of spinning bodies due to gyroscopic effect. 4. Apply the theoretical knowledge to balance the rotary systems 5. Determine the natural frequency, vibration level, damped frequency and resonant frequency of any vibratory system 6. Recognize the whirling speed conditions of shaft and methods to eliminate
37.	V	ME3553	Metrology and Measurement lab	1. Use Vernier Calliper, Vernier Height Gauge, and Micrometre, V-block for accurate linear and angular Measurement 2. Measure screw thread terminology by using use the Tool Makers Microscope. 3. Measure the straightness using Autocollimator 4. Measurement of screw thread parameter using floating carriage micrometre. 5. Determine amount of variation in the process by using Measurement System Analysis 6. Use load cell for measurement of Force. 7. Select suitable tachometer for speed measurement
38.	V	ME3573	Heat Transfer Lab	1. Analyze heat conduction experimentally 2. Compare heat transfer coefficient in natural as well as forced convection environment.

				3. Determine emissivity and Stefan Boltzmann constant for the case of radiation
				4. Evaluate the performance of heat exchanger.
				5. Determine critical heat flux of material
39.	V	ME3593	CAD Modeling Lab	1. List the different CAD software used for mechanical engineering.
				2. Create sketches of machine parts.
				3. Model machine parts using CAD software.
				4. Assemble machine Parts by using CAD tool.
				5. Generate detailed drawing views.
				6. Create surface features using surfacing tools.
40.	V	ME3613	Technical Aptitude -III	1. Apply the knowledge acquired during the course work.
				2. Develop the ability of problem solving.
41.	V	SH3033	Scholastic Aptitude-I	1. Develop a logical approach towards solving Aptitude and Reasoning problems.
				2. Analyze usage of basic aptitude terms of percentages, averages, ratios and applications of business aptitude terms of profits and interests
				3. Develop a bridge in analogies, series and visualizing directions.
				4. Apply various short cuts & techniques to manage speed and accuracy to get equipped for various competitive and

				campus recruitment exams
42.	V	ME3633	Summer Internship	1. Apply the Technical knowledge in real industrial situations.
				2. Formulate Technical reports/projects.
				3. Develop and refine oral and written communication skills.
				4. Explain the activities and functions of business professionals.
				5. Discuss knowledge of the industry in which the internship is done.
43.	V	SH3013	Indian Constitution	1. Create awareness about law depiction and importance of Constitution
				2. Define Fundamental Rights and Fundamental Duties of the Indian Citizen to instill morality, social values, honesty, dignity of life and their social Responsibilities.
				3. Create Awareness of their Surroundings, Society, Social problems and their suitable solutions while keeping rights and duties of the citizen keeping in mind.
				4. Recognize distribution of powers and functions of Local Self Government.
				5. Comprehend the National Emergency, Financial Emergency and their impact on Economy of the country.
44.	V	ME3313	Mechanics of Composite Material	1. Choose suitable composite materials based on field applications

				2. Explain different fabrication processes and perform cost comparison
				3. Compute composite properties for given fraction of fibers and matrix
				4. Design lamina to bring tailor maid properties in composite material
				5. Predict failure of composite laminates by selecting appropriate failure criteria
				6. Design laminate for given loading conditions
45.	V	ME3333	Solid Mechanics	1. Analyze the mechanical components based on stress or strain approach
				2. Use energy methods to solve continuum mechanics problems.
				3. Illustrate various membrane analogies to investigate torsion in non-circular cross section.
				4. Describe the effect of shear center in symmetrical and unsymmetrical bending of beams
46.	V	ME3353	Biomechanics	1. Apply fundamental principles of Bio-mechanics to activities like jumping, running, swimming, etc.
				2. Model anatomical systems in to mechanical system and perform force analysis
				3. Analyze the effect of viscosity on type of blood flow in blood vessels
				4. Examine the behavior of arterial wall as a membrane subjected to

				uniaxial, biaxial and torsion loading
				5. Outline the relationship between cardiac muscles and parameters like force, length, velocity and calcium concentration
				6. Estimate the parameters like displacement, velocity, acceleration and energy consumed in a particular activity through GAIT analysis.
47.	V	ME3373	Energy Conservation and Management	1. Summarize energy scenario and the need for energy conservation.
				2. Conduct energy audit of a system
				3. Illustrate various techniques of waste heat recovery and cogeneration.
				4. Identify energy conservation measures in various thermal utilities.
				5. Summarize different financial terms and techniques used in Energy Conservation.
48.	V	ME3393	Nuclear Power Engineering	1. Understand the nuclear fuel cycle to design reactors.
				2. Apply numerical methods to solve energy technology problems.
				3. Develop mathematical models to design equipments, plants processes and systems.
				4. Analyse different techniques to optimize overall nuclear power plant.

49.	V	ME3413	World Class Manufacturing	1. Explain characteristics of world class organization.
				2. Explain WCM tools.
				3. Plot control charts and comment on the process.
				4. Elaborate the concept of TQM.
				5. Explain the 8 pillars of Total productive maintenance (TPM).
				6. Explain the 13 pillars of Toyota production system (TPS).
				7. Explain the six sigma methodologies.
50.	V	ME3433	Non Traditional Machining Processes	1. Compare the various nontraditional machining processes.
				2. Discuss the operational principles, advantages applications, limitations of the various non-traditional machining processes
				3. Explain the material removal mechanism, effect of parameters/ factors associated with the processes on the machining performance.
				4. Select a process /a combination of processes for a specific application/ need/situation depending upon the availability of sources.
51.	V	ME3453	Advanced Engineering Materials	1. Select suitable material for engineering applications.
				2. Justify the selection of composite materials for engineering applications.
				3. Explain various applications of polymeric materials.

				4. Categorize various modern materials for selective applications.
				5. Explain the use of smart materials for bio-engineering applications.
				6. Explain the use of semi and super conducting materials for various applications.
52.	V	ME3473	Industrial Organization and Management	1. Recognize the factors that influence business environment and visualize their effect on business
				2. Appraise the scope and objectives of functional areas of business and their integration
				3. Formulate an effective and efficient solution for business problems
				4. Identify several ways in which financial accounting information is used to make business decisions
				5. Apply engineering economics principles for evaluation of a business
53.	VI	ME3023	Machine Design	1. Apply the principle of Spur & Helical gear design for industrial application
				2. Design Bevel & Worm gear considering design parameters as per design standards.
				3. Apply principles of interaction of materials processing and design.
				4. Select & design Rolling and Sliding Contact Bearings from manufacturer's catalogue for a typical application considering

				<p>suitable design parameters.</p> <p>5. Elaborate various modes of operation, degree of hybridization and allied terms associated with hybrid electric vehicles</p>
54.	VI	ME3043	Fluid and Turbo Machinery	<p>1. Explain construction and working of different types of turbines, centrifugal pump & compressors.</p> <p>2. Calculate different efficiencies; power developed and discharge requirement of turbine.</p> <p>3. Draw velocity triangles & calculate different heads on pumps, discharge of pump, various efficiency of pump, power required to drive the pump</p> <p>4. Explain necessity & concept of model testing.</p> <p>5. Draw & Explain performance characteristics of the turbine & pump.</p> <p>6. Compute different efficiencies of compressor & solve numerical problems.</p> <p>7. Select proper fluid & turbo Machine for particular operation</p>
55.	VI	ME3063	Finite Element Method	<p>1. Apply various approximate methods to solve Linear differential equations appearing in the field of solid mechanics and heat transfer from the perspective of finite element analysis</p> <p>2. Formulate the structural problems and</p>

				illustrate the use of interpolation function to derive shape functions
				3. To develop stiffness matrix and load vectors of problems related to elasticity and heat transfer
				4. Compare linear element with higher order element and comment on significance of using higher order element
56.	VI	SH3021	Biology for Engineers	1. Apply biological engineering principles, procedures needed to solve real-world problems
				2. Describe the functions of biological systems
				3. Analyze biological phenomena and compute work done at microscale.
				4. Explain working of different biomedical instruments
				5. Select the sensors for given biological applications
				6. Explain relevant aspect of movement control process.
57.	VI	ME348	Design Engineering Lab	1. Design a mechanical system using standard design procedure.
				2. Use design data books, hand books and design standards.
				3. Develop production drawing with conventions.
				4. Print 3D object of designed component on 3D printer.
58.	VI	ME350	Python Programming Lab	1. Use loops, functions, different libraries, custom functions.

				2. Develop Python programs to solve engineering problems.
				3. Handle different file operations
				4. Interpret the data by plotting the graphs
59.	VI	ME352	Fluid & Turbo Machinery lab	1. Conduct trial & analyze performance parameters of fluid and turbo machinery.
				2. Draw and compare actual performance characteristics curves with standard.
60.	VI	ME3543	Software Training-I	1. Use software effectively related to design/manufacturing and synthesis of mechanical systems and components.
				2. Develop solution for the mechanical engineering problem using program/software
61.	VI	ME3563	Technical Aptitude -IV	1. Apply the knowledge acquired during the course work.
				2. Develop the ability of problem solving.
62.	VI	ME3583	Capstone Project Phase I	1. Convert an open-ended problem statement into a statement of work or a set of design specifications
				2. Identify the literature gap by conducting a survey of several available literatures in the preferred field of study.
				3. Decompose problem/task into subtasks, prioritizes subtasks, and establishes a timetable and milestones by which progress may be evaluated.

				<p>4. Select and apply the appropriate design of experiments, experimental setup, models, or simulation technique for the project task.</p>
				<p>5. Collaborates with team members of diverse backgrounds and perspectives to achieve a common goal.</p>
				<p>6. Produce usable documents of record regarding the design process and design state and communicate effectively.</p>
63.	VI	SH304	Psychology for Engineers	<p>1. Interpreted human behavior as a system from a psychological perspective.</p>
				<p>2. Evaluate human behavior in terms of “Engineer-In-Environment” from a psycho-social approach in problem-solving with individuals, groups and organizations.</p>
				<p>3. Apply systems theories, research and other theories and knowledge regarding human behavior and emotional intelligence in assessing and interacting with individuals, groups and organizations.</p>
64.	VI	SH3062	Scholastic Aptitude - II	<p>1. Develop a logical approach towards solving Aptitude and Reasoning problems.</p>
				<p>2. Analyze usage of basic aptitude terms of percentages, averages, ratios and applications of business aptitude terms of profits and interests</p>
				<p>3. Develop a bridge in</p>

				<p>analogies, series and visualizing directions.</p> <p>4. Apply various short cuts & techniques to manage speed and accuracy to get equipped for various competitive and campus recruitment exams</p>
65.	VI	ME3643	Condition Monitoring	<p>1. Apply maintenance schemes in industries.</p> <p>2. Monitor and analyze condition of rotating machinery using vibration based techniques.</p> <p>3. Apply oil analysis techniques to diagnose the wear debris.</p> <p>4. Apply temperature monitoring techniques to diagnose the faults in mechanical applications.</p> <p>5. Apply modern technologies for effective plant maintenance.</p>
66.	VI	ME3663	Tribology	<p>1. Determine tribological parameters of mechanical systems analytically by using suitable theories of friction and theories of wear.</p> <p>2. Select hydrostatic step bearing for real life application in mechanical engineering based on axial load applied and lubricant available.</p> <p>3. Calculate the maximum load carrying capacity and pressure equation for hydrodynamic thrust bearing by using engineering principles.</p>

				<p>4. Evaluate elastohydrodynamic lubrication occurred in gears, cams and rolling element bearing by using hertz and ertel-grubin equation.</p>
				<p>5. Estimate pressure distribution in gas lubricated bearings by applying reynolds equation for gas lubrication within elastic limits</p>
67.	VI	ME3683	Fracture Mechanics	<p>1. Apply the basic principles of Linear elastic fracture mechanics.</p>
				<p>2. Design the engineering components using elastic-plastic fracture mechanics principles.</p>
				<p>3. Explain the process of crack growth and arrest in the presence of creep.</p>
				<p>4. Compare the fracture behavior in metals and non-metals.</p>
				<p>5. Analyze the crack growth under fatigue loading.</p>
				<p>6. Choose the suitable computational fracture mechanics approach to solve the real mechanical engineering problem</p>
68.	VI	ME3743	Steam Engineering	<p>1. Classify different types of boilers.</p>
				<p>2. Design a steam nozzle for a particular application.</p>
				<p>3. Calculate turbine performance at various loads</p>
				<p>4. Justify the use of impulse and reaction turbines</p>
				<p>5. Represent regenerative heating cycles and their</p>

				representation on T-s and h-s diagram
				6. State the use of reheating of steam.
69.	VI	ME3763	Gas Turbine and Jet Propulsion	1. Compare ideal and real cycles of gas turbines
				2. Illustrate different techniques used in jet propulsion
				3. Explain centrifugal compressor used in gas turbines and jet propulsion
				4. Design axial flow compressor used in gas turbines and jet propulsion
				5. Analyze combustion system of the gas turbines
				6. Evaluate the different turbines used in gas turbine and jet propulsion
70.	VI	ME3783	Power Plant Engineering	1. Explain economics of power generation and energy scenario
				2. Explain improvisations in Rankine cycle and its effect on performance
				3. Analyze thermodynamics gas power cycles and effect of various parameter on efficiency.
				4. Analyze different techniques for improvement of efficiency of gas turbine plant
				5. Explain construction and working of nuclear power plants and its subsystems
				6. Explain construction and working of different renewable energy power plants

71.	VI	ME3803	Additive Manufacturing	1. Recognize the Importance of AM technologies in Manufacturing
				2. Classify and select additive manufacturing processes for a given application.
				3. Design for manufacturing of AM and conduct Process Analysis
				4. Identify software issues related to additive manufacturing process.
				5. Discuss the Different methods for Post-processing of AM parts
				6. Recognize the Applications of AM in Automobile, Aerospace, and Bio-medical etc.
72.	VI	ME3823	Computer Integrated Manufacturing Systems	1. Describe and classify computer integrated manufacturing systems (CIMS)
				2. Recognize socio-economic impact of CIMS
				3. Explain principle of operation of CNC machine
				4. Describe part family forming methods
				5. Perform quantitative analysis of Flexible Manufacturing Systems (FMS)
				6. Analyze various computer integrated planning and control techniques
				7. Explain use of IoT in manufacturing
73.	VI	ME3843	Industrial Hydraulics and Pneumatics	1. Describe the structure and function of common hydraulic and pneumatic components such as cylinders,

				valves, pumps and motors etc.
				2. Model and Analyze common hydraulic and pneumatic components such as cylinders, valves, pumps and motors.
				3. Create simple hydraulic and pneumatic circuit diagrams for different applications.
				4. Create and Analyze simple hydraulic and pneumatic systems.
74.	VI	ME3882	Precision Engineering	1. Describe meaning and importance of precision machining
				2. Explain the requirements of machine network elements to achieve precision in the components.
				3. Select different precision engineering processes in actual field
				4. Explain Various methods precision manufacturing
				5. Explain various methods of micromachining using LASER and other processes
75.	VI	ME3883	Total Productive Maintenance	1. Predict the maintenance issues for system effectiveness
				2. Schedule the work related to preventive maintenance
				3. Apply concepts of condition monitoring techniques
				4. Use the TPM concepts for online monitoring of processes

76.	VI	OE3263	Aircraft Systems	1. Get an exposure to the Aircraft and Aerospace Industry.
				2. Understand Aircraft Control Systems and Engine Control System.
				3. Know the need and functioning of Environmental Control System.
				4. Explain and conceptually design Fuel, Hydraulic and Pneumatic systems for Aircraft.
				5. Explain and conceptually design Electrical System of Aircraft.
				6. Evaluate and decide avionics and information system for aircraft.
77.	VI	OE3283	Supply Chain Management	1. Identify the role and key issues in the supply chain management.
				2. Select appropriate SC strategies under given situations.
				3. Design the inventory system and level at various locations in supply chain.
				4. Select the distribution and transportation options.
				5. Develop appropriate strategic alliances for enhancing the performance of SC.
				6. Describe the use of Information technology to improve SC performance
78.	VI	ME3303	New Product Design and Development	1. Identify the new product opportunities and sources of new product ideas.

				<p>2. Elaborate the product life cycle and product design process.</p> <p>3. Integrate the customer and end-consumer needs into design process.</p> <p>4. Apply the concepts and tools like DFMA, VE and QFD in design process</p> <p>5. Assimilate the various product characteristics to design a novel product</p> <p>6. Participate in group work sessions and teams to become acquainted with the importance of teamwork and collaboration that is critical to new product success.</p>
79.	VI	OE3323	Entrepreneurship Development	<p>1. Identify, analyze & select business opportunity to suit his personality based on SWOT analysis</p> <p>2. Make market research & survey for selected business</p> <p>3. Prepare and apprise detailed Project Report</p> <p>4. Formulate plan for financial management of project.</p> <p>5. Apply managerial inputs for starting & establishing his own business</p>
80.	VI	OE334	Research Methodology	<p>1. Select, analyze and interpret research evidences published on a topic to establish a suitable research problem/issue or opportunity to explore further.</p>

				<p>2. Design the research study using a suitable paradigm, associated methodologies and methods of data collection and analysis.</p> <p>3. Write a research proposal (research blueprint) describing the topic.</p> <p>4. Demonstrate the ability to use the statistical software to solve problems</p>
81.	VII	ME4013	Industrial Engineering	<p>1. Apply various methods of method study and time study to improve productivity.</p> <p>2. Use value analysis technique in engineering projects.</p> <p>3. Select the plant location and design appropriate type of layout along with material handling system.</p> <p>4. Plan production activities using tools like capacity and aggregate planning</p> <p>5. Design the inventory system using appropriate inventory model</p> <p>6. Implement project management knowledge, tools and techniques to achieve project success.</p>
82.	VII	ME4112	Engineering Acoustics	<p>1. Determine acoustic parameters in terms of decibel levels for pressure, power, intensity and impedance.</p> <p>2. Calculate sound levels by applying 1-d wave equation for air-borne</p>

				and structure borne sound.
				3. Estimate absorption coefficient for different acoustic materials.
				4. Measure sound levels for mechanical systems and reduce it up to audible range by using suitable method.
83.	VII	ME4132	Material Handling Systems	1. Explain the flow and type of movement of industrial goods
				2. Apply general rules for the type of movement, and
				3. Identify the appropriate material handling systems to suit the said requirement
				4. Explain current trends in material handling.
84.	VII	ME4152	Machine Tool Design	1. Select & design proper transmission system for machine tool
				2. Decide layout of machine tool
				3. Select proper speed & feed boxes & design the same.
				4. Design machine tool structure-Bed, Columns & Housings, Select & Design Guide ways & slide ways, spindle.
				5. Determine dynamic characteristics of machine tool & carry stability analysis using FEA
				6. Design control systems in machine tools and SPM.
85.	VII	ME4192	Cryogenics	1. Summarize the applications of low temperature engineering in various fields.

				2. Discuss the properties of materials and cryogenic fluids at low temperature.
				3. Compare cryogenic Liquefaction systems.
				4. Describe Cryogenic Refrigeration and Measurement Systems.
				5. Calculate performance of gas separation systems.
				6. Explain the methods of fluid storage, transfer, insulation and vacuum technology in cryogenics.
86.	VII	ME4232	Industrial Automation and Robotics	1. Explain manufacturing automation.
				2. Analyse transfer lines for its efficiency and effect of break downs
				3. Analyse automated assembly lines for its efficiency and effect of defective components
				4. Analyse forward and reverse kinematics of robot.
				5. Perform economic analysis of robot
87.	VII	ME4312	Mechanical Vibrations	1. Define and use the fundamental terms of vibration in design.
				2. Find natural frequencies and mode shapes of 2DOF and Multi DOF systems.
				3. Describe methods of vibration control.
				4. Select instrument and transducers for vibration measurement
				5. Analyze and interpret vibration data.
88.	VII	ME4332	Experimental Mechanics	1. Determine stresses and strains in machine component by using photelasticity

				2. Use of coating methods to determine strains and stresses
				3. Apply strain gauge technique to determine strains and stresses in machine component
89.	VII	ME4352	Automobile Engineering	1. Explain anatomy of an automotive vehicle with location of different parts and systems
				2. Expound various configurations of transmission systems and auxiliary components
				3. Compute different performance parameters of an automobile
				4. Differentiate between various types of braking system with its specific features
				5. Explain various steering and suspension system.
				6. Elucidate working of automotive electronic components and electrical systems.
90.	VII	ME4392	Mechatronics System Design	1. Demonstrate the importance of integration of Mechanical, Electronics, computers and control in the design of Mechatronics system.
				2. Describe/identify key elements of sensors and transducers and techniques of interfacing with PLC, Microprocessor, Microcontroller etc.
				3. Apply a systematic approach to the design process for

				Mechatronics systems. (Concurrent engineering).
				4. Create system modeling of basic models and analyze.
				5. Demonstrate the practical application of mechatronics systems in areas such as manufacturing, automobile systems and robotics.
				6. Develop the capacity to think creatively and independently about new design problems and challenges.
91.	VII	ME4752	Condition Monitoring	1. Apply maintenance schemes in industries.
				2. Monitor condition of rotating machinery using signature, temperature and corrosion analysis.
				3. Apply oil analysis technique to diagnose the wear debris.
				4. Apply modern technologies for effective plant maintenance.
92.	VII	ME4772	Aircraft Conceptual Design	1. Understand the design process of aircraft and decide the aircraft configuration.
				2. Choose type of powerplant as per flight regime.
				3. Decide the fuselage layout as per type of aircraft.
				4. Design the wing for type of aircraft and its wing loading.
				5. Accurately evaluate lift, drag and mass for design synthesis process.

				6. Examine the influence of various design requirements on the configuration of an aircraft to derive an optimized design.
93.	VII	ME4792	Mechanical System Design	1. Select brake and clutch based on functional requirements of automobile transmission systems.
				2. Calculate the stresses induced in pressure vessel subjected to various types of loading
				3. Apply design principles and obtain suitable dimensions for IC Engine components.
				4. Design the flat belt conveyor systems for suitable applications.
				5. Design the machine tool gear box for different speeds and torques at driven shaft.
				6. Apply statistical considerations for design.
94.	VII	ME4832	Computational Fluid Dynamics	1. Derive governing equations for fluid dynamics and heat transfer.
				2. Implement different techniques for discretization of governing equations
				3. Apply different CFS tools for real field complex problem
				4. Select appropriate grid generation methods for CFD analysis
				5. Modify the available schemes and methods for multi-physics problem
				6. Develop suitable simple numerical

				model for given application
95.	VII	ME4852	Air Conditioning system	1. Determine cooling load on the system by considering various heat sources
				2. Select suitable air distribution method, distribution outlet and inlet, and fan.
				3. Select and design the suitable ventilation system for the commercial applications.
96.	VII	ME4892	Total Quality Management	1. Evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.
				2. Identify the key aspects of the quality improvement cycle and to select and use appropriate tools and techniques for controlling, improving and measuring quality.
				3. Critically appraise the organizational, communication and teamwork requirements for effective quality management.
				4. Critically analyze the strategic issues in quality management, including current issues and developments, and to devise and evaluate quality implementation plans.
97.	VII	ME4512	Industrial Engineering and Quality Control Lab	1. Perform work and method study at given work station by using suitable industrial engineering tools.

				2. Design the work system for the given application
				3. Apply inventory management principles for controlling the inventory
				4. Conduct process capability analysis
				5. Use modern tools and techniques for solving industrial engineering problems.
98.	VII	ME4532	Advanced Machining Lab	1. Develop CNC program and simulate it on CNC Simulation Software for a given job.
				2. Perform Set-up operation for CNC Turning Operations.
				3. Produce a job with given specifications on CNC Turning Machine.
				4. Perform Set-up operation for CNC Milling Operations.
				5. Produce a job with given specifications on CNC Milling Machine.
99.	VII	ME4552	Software Training II	1. Use simulation and analysis software in Mechanical Engineering.
				2. Develop solution for the Mechanical Engineering problems using simulation and analysis software.
100	VII	ME4592	Mechanical Vibrations Lab	1. Estimate natural frequencies and mode shapes of given machine component.
				2. Find modal parameters of vibratory system.
				3. Control the vibration by using principle of DVA.
				4. Use vibration measurement technique

				for fault diagnosis and machinery health monitoring
101	VII	ME4612	Experimental Mechanics Lab	1. Use of transmission polariscope for measurement of stresses in machine components.
				2. Apply reflection polariscope technique for measurement of strain/stress in photoelastic coating.
				3. Use strain gauge technique in various applications.
102	VII	ME4632	Automobile Engineering Lab	1. Explain the structure of an automobile.
				2. Describe and Design transmission systems of an automobile.
				3. Demonstrate and select different types of an automobile systems.
				4. Test wheel balancing and wheel alignment.
				5. Model any automobile system/component
103	VII	ME4672	Mechatronics System Lab	1. Demonstrate/select proper types of sensors/transducers for given task.
				2. Design signal conditioning circuits for various signal conditioning processes like signal level change, signal form change, filters, bridge circuits etc.
				3. Demonstrate ability of control and automation of simple devices such as motors, cylinders using PLC.
				4. Demonstrate the ability to create microcontroller programs and properly

				interface them to input and output devices.
104	VII	ME4712	Capstone Project Phase-II	1. Select and apply appropriate design of experiments, experimental setup, models, or simulation techniques for project tasks.
				2. Fabricate project or experimental setup, or model and analyze output of models/simulations to provide information for decisions
				3. Perform feasibility analysis and uses results to choose candidate solutions and evaluate quality of solutions to select the best one
				4. Collaborates with team members of diverse backgrounds and perspectives to achieve a common goal.
				5. Write technical report and communicate effectively.
105	VIII	OE438	Finance for Engineers (Online Course)	1. Discuss the fundamental aspects of accounting and finance.
				2. Apply rules of accounting while recording transactions.
				3. Prepare financial statements and analyze financial position of the firm by applying various techniques.
				4. Describe the various long term sources of finance available for the business organization.
106	VIII	OE436	Engineering Management &	1. Develop administrative, organizational and

			Economics (Online Course)	planning skills to execute engineering project.
				2. Develop bar chart/milestone chart for the project.
				3. Analyze profit/cost data and carry out economic analysis to take optimal decision.
				4. Calculate depreciation as per various methods.
107	VIII	IP4022	Internship & Project	Internship
				1. Examine the functioning of the company on the terms of inputs, transformation process and the outputs (products and services)
				2. Develop an attitude to adjust with the company culture, work norms, code of conduct.
				3. Recognize and follow the safety norms, Code of conduct.
				4. Demonstrate the ability to observe, analyse and document the details as per the industry practices.
				5. Interpret the processes, systems and procedures and to relate to the theoretical concepts-studies.
				6. Develop the leadership abilities, communication.
				7. Demonstrate project management and finance sense
				Project
				1. Identify the project/problem in the domain of a program relevant for the company.

				2. Compile the information to the pertaining to the problem identified.
				3. Analyse the information using the statistical tools/ techniques.
				4. develop the feasible solution for given problem.
				5. Analyse the impact of the project on the performance of company/department.
108	VIII	RE4042	Research Project	1. Investigate the technical literature.
				2. Recognize and evaluate theories, practices, and/or research on a chosen topic by conducting a thorough literature review and submitting a written integrative, critical summary of the current literature.
				3. Design a research problem and develop a methodology.
				4. Develop and implement an advanced original research or creative project.
				5. Develop the ability to explain the conceptual viability of the project and describe the major components involved.
				6. Develop the ability to explain how the project will impact the relevant body of work.
				7. Develop advanced discipline-relevant skills and competencies.
				8. Construct an accurate record of research performed.

				9. Write a research report and paper.
109	VIII	ED4102	Project Management	1. Prepare business Plan for selected business.
				2. Make risk analysis & market analysis of selected project.
				3. Make risk analysis & market analysis of selected project
				4. Make financial appraisal of selected project.
110	VIII	ED4042	Commercial Aspects of the Project	1. Interpret basic Financial Terminologies.
				2. Prepare & analyze financial statements.
				3. Prepare financial Plan for venture.
				4. Apply basic principles of marketing for various products.
				5. Prepare market survey.
				6. Apply knowledge of marketing management for selected business.
111	VIII	ED4062	Entrepreneurship Development Program (EDP)	1. Apply knowledge of engineering, economics, marketing and finance for formulation of business plan, starting & managing new business.
112	VIII	ED4082	Entrepreneurship Development Project	1. Apply knowledge of engineering, economics, marketing and finance for preparation of project report.
				2. Make commercial, technical and financial appraisal of project.

- **Department Name: Mechanical Engineering Department**
- **PG Program Name: M. Tech Design Engineering**

Sr. No.	Program Outcomes
1.	Independently carry out research /investigation and development work to solve practical problems.
2.	Write and present a substantial technical report/document
3.	Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4.	Accomplish collaborative and multi-disciplinary scientific research with consideration of professional, legal, and ethical issues.
5.	Manage the projects and its financial aspects on the strength of engineering knowledge and management principles.
6.	Engage in lifelong learning to address contemporary issues through independent and reflective learning.

Programme Educational Objective (PEO):

PEO1: - Students will apply knowledge of design engineering to pursue successful career in the field of Mechanical Engineering.

PEO2: - Students will become innovators, entrepreneurs to design and develop products and services to address social, technical and business challenges.

PEO3: - Students will engross in lifelong learning such as higher studies, research and other continuous professional development activities.

Sr. No.	Semester	Course Code	Course Name	Course Outcome
1	I	MDE1015	Advanced Solid Mechanics	Co:1 Analyze mechanical components based on stress and strain point of view.
				Co:2 Formulate constitutive matrix for isotropic materials and establish the relationship between elastic constants.
				Co:3 Use energy methods to solve structural problem.
				Co:4 Select appropriate analogy like membrane, fluid flow, electrical to solve torsion problem.
				Co:5 Design pressure vessel and rotating disks under given constraints

				Co:6 Evaluate deformation and stresses between two contact bodies with point and line contact.
2	I	MDE102 5	Finite Element Methods	Co:1 Apply the knowledge of mathematics and engineering to solve problems in stripped structural and thermal engineering by approximate and numerical methods
				Co:2 Solve problems in 1-D structural systems involving bars, trusses, beams, and frames.
				Co:3 Develop 2-D and 3-D FE formulations involving triangular, quadrilateral elements and higher order elements.
				Co:4 Apply the knowledge of FEM for stress analysis, model analysis, heat transfer analysis and flow analysis.
				Co:5 Develop algorithms and FE code for solving design problems and adapt commercial packages for complex problems
3	I	MDE103 5	Computer Aided Design	Co:1 Describe the principles of CAD systems, the implementation of these principles, and its connections to CAM and CAE systems.
				Co:2 Demonstrate 2D, 3D transformations and projection transformations.
				Co:3 Describe various approaches of geometric modelling.
				Co:4 Represent 2D and 3D entities mathematically.
4	I	MDE104 5	Mechanics of Composite Materials (Programme Elective - I)	Co:1 Understand the basic concepts and difference between composite materials with conventional materials.
				Co:2 Apply the knowledge of constituent materials in defining the average properties and response of composite materials on macroscopic level.
				Co:3 Apply knowledge for finding failure envelopes and stress-strain plots of laminates.
				Co:4 Develop a clear understanding to utilize subject knowledge using computer programs to solve problems at structural level.
5	I	MDE105 5	Design for Manufacturing & Assembly	Co:1 Apply the proper manufacturing process to a new product development process.

			(Programme Elective - I)	Co:2 Identify the factors contributing reduction in assembly time and to incorporate assembly & disassembly guidelines in product design.
				Co:3 Utilize reliability concepts, failure analysis tools and techniques and accelerated life test methods for improving product life cycle.
				Co:4 Calculate the factors controlling cost and time required for the product maintenance and utilize this information for design for maintenance.
6	I	MDE1065	Experimental Mechanics (Programme Elective - I)	Co:1 Determine direction and magnitude of principal stresses by using various techniques of Experimental Stress Analysis.
				Co:2 Solve two and three dimensional problems of stress-strain analysis in the field of mechanical engineering.
				Co:3 Formulate solutions using digital image processing technique.
7	I	MDE1075	Reliability Engineering (Programme Elective - I)	Co:1 Apply the concepts of Reliability, Availability and Maintainability.
				Co:2 Develop hazard-rate models to know the behaviour of components.
				Co:3 Build system reliability models for different configurations.
				Co:4 Assess reliability of components and systems using field and test data.
				Co:5 Implement strategies for improving reliability of repairable and non-repairable systems
8	I	MDE1290	Reverse Engineering and Benchmarking (Programme Elective - I)	Co:1 Interpret the Reverse Engineering (RE) Methodology
				Co:2 Appraise the Computer Aided Reverse Engineering Technology
				Co:3 Design experiments to evaluate a Reverse Engineering tool
				Co:4 Analyse disassemble products and specify the interactions between its subsystems and their functionality
9	I	MDE1085	Advanced Engineering Materials (Programme Elective - II)	Co:1 Analyse the importance of various engineering materials (metals, polymers, ceramics, composites, Semi-conductor).
				Co:2 Recite polymers, ceramics and composites, their manufacturing techniques, properties and applications.

				Co:3 Propose appropriate ceramics, glass, plastics and polymers for different applications.
				Co:4 Understand and apply Electrical, Thermal, Optical and Magnetic Properties of metals, ceramics, polymers and composites for various applications.
				Co:5 Adapt economic considerations in usage and recycling of materials in human use.
				Co:6 Apply nano materials and nanocomposites for various applications.
10	I	MDE109 5	Industrial Tribology (Programme Elective - II)	Co:1 Determine tribological parameters of mechanical systems analytically by using suitable theories of friction and theories of wear.
				Co:2 Select hydrostatic step bearing for real life application in mechanical engineering based on axial load applied and lubricant available.
				Co:3 Calculate the maximum load carrying capacity and pressure equation for hydrodynamic thrust bearing by using engineering principles.
				Co:4 Evaluate elasto-hydrodynamic lubrication occurred in gears, cams and rolling element bearing by using hertz and ertel-grubin equation.
				Co:5 Estimate pressure distribution in gas lubricated bearings by applying reynolds equation for gas lubrication within elastic limits.
11	I	MDE110 5	Advanced Mathematical Methods in Engineering (Programme Elective - II)	Co:1 Evaluate Fourier Series for given function and apply it to solve the partial differential equations in Engineering problems.
				Co:2 Apply the specific method of solution of partial differential equations for solving the given problems
				Co:3 Formulate and solve a boundary value problem (Partial differential equation, boundary and initial conditions).
				Co:4 Estimate numerically the solution of given algebraic equation.
12	I	MDE111 5	Smart Materials and Systems (Programme Elective - II)	Co:1 Describe the behaviour and applicability of various smart materials.
				Co:2 Demonstrate knowledge of the physical principles underlying the behaviour of smart materials.

				Co:3 Describe the basic principles and mechanisms of the stimuli-response for the most important smart materials.
				Co:4 Design simple models for smart structures & materials.
13	I	MDE1300	Safety Engineering and Management (Programme Elective - II)	Co:1 List out and describe the various functions and activities of safety engineering department.
				Co:2 Provide knowledge on design features for a process industry and safety in the operation of various equipment in industry
				Co:3 Carry out a safety audit and prepare a report for the audit.
				Co:4 Prepare an accident investigation report and estimate the cost due to accident.
				Co:5 Evaluate the safety performance of an organization from accident records.
				Co:6 Identify various agencies, support institutions and government organizations involved in safety training and promotion.
14	I	MDE1125	Stress Analysis Software Lab	Co:1 Solve 1D, 2D and 3D structural analysis problems using the ANSYS software
				Co:2 Evaluate dynamic behavior of components
				Co:3 Appraise Linear buckling concept in Design of members which are succumbed to buckling
				Co:4 Solve structural analysis problems subjected to fatigue load.
				Co:5 Appraise steady state and transient thermal concept in design of members.
				Co:6 Apply basics of MATLAB programming for Engineering applications.
15	I	MDE1135	Design Engineering Lab-I	Co:1 Determine and analyze the stresses and strains in machine component.
				Co:2 Analyze the stresses and strains on combined bending and torsion.
				Co:3 Experiment on demonstration of photoelastic techniques.
				Co:4 Calibration of the photoelastic constant, determination of the stress field in a beam under bending.
				Co:5 Determine stress and strain fields using DIC.

				Co:6 Measure friction and wear using pin on disc.
				Co:7 Find lubricant properties using 4-ball tester.
16	I	SHP5511	Technical Communication	Co:1 Use grammatically correct sentences in different types of technical writings.
				Co:2 Apply technical writing skills to improve readability of documents.
				Co:3 Demonstrate professional skills required in job interviews and at workplace.
17	II	MDE1145	Mechanical Vibrations	Co:1 Derive and interpret equation of motions of multi-degrees of freedom systems.
				Co:2 Derive and interpret equation of motions of continuous systems.
				Co:3 Derive and interpret response of the system subjected to Transient vibrations.
				Co:4 Analyze the systems with Non-linear vibrations.
				Co:5 Select suitable instrument and transducers for vibration measurement.
18	II	MDE1155	Advanced Design of Mechanisms	Co:1 Design mechanism to meet certain motion as per defined application.
				Co:2 Apply the graphical and analytical techniques commonly used in the synthesis of mechanisms.
				Co:3 Design higher pair kinematic linkages for a given applications.
19	II	MDE1165	Acoustics and Noise Control (Programme Elective - III)	Co:1 Determine acoustic parameters in terms of decibel levels for pressure, power, intensity and impedance.
				Co:2 Formulate 1- d wave equation for air-borne sound.
				Co:3 Estimate absorption coefficient for different acoustic materials.
				Co:4 Measure sound levels for mechanical systems and reduce it up to audible range by using suitable method.
20	II	MDE1175	Fracture Mechanics (Programme Elective - III)	Co:1 Apply the basic principles of Linear elastic fracture mechanics.
				Co:2 Design the engineering components using elastic-plastic fracture mechanics principles.
				Co:3 Explain the process of crack growth and arrest in the presence of creep.
				Co:4 Compare the fracture behavior in metals and non-metals.

				Co:5 Analyze the crack growth under fatigue loading.
				Co:6 Choose the suitable computational fracture mechanics approach to solve the real mechanical engineering problem.
21	II	MDE1185	Product Design and Development (Programme Elective - III)	Co:1 Explore and analyse product development processes used in product design and development.
				Co:2 Apply various product development techniques.
				Co:3 Analyse, evaluate and apply design consideration like concurrent engineering, aesthetic and ergonomics for industrial product design.
				Co:4 Apply different methods, tools and technique to create new product design for consumer product.
22	II	MDE1195	Additive Manufacturing (Programme Elective - III)	Co:1 Describe the Importance of AM technologies in Manufacturing.
				Co:2 Classify and select additive manufacturing processes for a given application.
				Co:3 Design for manufacture for AM and carry out Process Analysis.
				Co:4 Point out the software issues addressed in additive manufacturing process.
				Co:5 Identify the Different methods for Post-processing of AM parts.
				Co:6 Suggest the Applications of AM in Automobile, Aerospace, and Bio-medical etc.
23	II	MDE1300	Design of Pressure Vessels and Piping (Programme Elective - III)	Co:1 Apply the design consideration of pressure vessel.
				Co:2 Design the support of the pressure vessel.
				Co:3 Design nozzle for pressure vessel.
				Co:4 Design piping system for pressure vessel.
24	II	MDE1205	Rotor Dynamics (Programme Elective - IV)	Co:1 Model the Rotor bearing systems and formulate the governing equations.
				Co:2 Describe the role of damping, gyroscopic, centrifugal, stiffness and inertial effects on rotors
				Co:3 Compute the critical speeds and stability limits for rotors under axial, transverse and torsional modes

				Co:4 Analyse the rotor bearing systems using transfer matrix method and Finite Element Method.
				Co:5 Compute the transient response of rotors.
25	II	MDE121 5	Design for Optimization (Programme Elective - IV)	Co:1 Identify and apply mathematical models in optimization method.
				Co:2 Recognize the suitable method of optimization in nonlinear programming with and without constraints.
				Co:3 Apply optimization method for static and dynamic applications.
				Co:4 Apply knowledge of design of experiment to complex system.
				Co:5 Use genetic algorithm, ANN and Fuzzy logic to optimize various design parameters.
26	II	MDE122 5	Robotics (Programme Elective - IV)	Co:1 Comprehend basic terminologies and concepts associated with Robotics and Automation.
				Co:2 Demonstrate comprehension of various Robotic sub-systems.
				Co:3 Compute kinematics and dynamics to explain exact working pattern of robots.
				Co:4 Design and select robots for Industrial and Non - Industrial applications.
27	II	MDE123 5	Multi-Body Dynamics (Programme Elective - IV)	Co:1 Derive equations of motion for interconnected bodies in multi-body systems with three dimensional motion.
				Co:2 Implement and analyze methods of formulating equations of motion for interconnected bodies.
				Co:3 Write programs to solve constrained differential equations for analyzing multi-body systems.
				Co:4 Simulate and analyze all types of static and dynamic behaviours of the multi-body systems.
				Co:5 Lead team projects in academic research or the industry that require modelling and simulation of multi-body systems.
28	II	MDE132 0	Process Equipment Design	Co:1 Apply the role of design engineer in designing procedures of various process equipments.
				Co:2 Design of pressure vessels as per standard codes.

				Co:3 Develop the process equipments and test the design for safety.
				Co:4 Apply the procedure for the planning of erection of process equipments.
29	II	MDE124 5	Research Methodology & IPR	Co:1 Formulate a research problem.
				Co:2 Analyse research related information.
				Co:3 Prepare and present research proposal/paper by following research ethics.
				Co:4 Make effective use of computers and computing tools to search information, analyze information and prepare report.
				Co:5 Describe nature and processes involved in development of intellectual property rights.
30	II	MDE133 0	Python Programming Lab	Co:1 Use loops, functions, different libraries, custom functions.
				Co:2 Develop Python programs to solve engineering problems.
				Co:3 Develop Python program to solve problems on Numerical methods.
				Co:4 Handle different file operations.
				Co:5 Interpret the data by plotting the graphs.
31	II	MDE126 5	Design Engineering Lab II	Co:1 Estimate natural frequency, damping factor, modal density of given component experimentally.
				Co:2 Find experimental mode shapes of plates.
				Co:3 Predict fault of machine by vibration and sound measurement.
				Co:4 Solve and interpret the vibration engineering problems by using MATLAB codes.
32	II	MDE127 5	Mini Project	Co:1 Identify structural engineering problems reviewing available literature.
				Co:2 Study different techniques used to analyze complex structural systems.
				Co:3 Work on the solutions given and present solution by using his/her technique applying engineering principles.
33	II	MDE128 5	Seminar	Co:1 Survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of Seminar.
				Co:2 Learn to write technical reports.
				Co:3 Develop oral and written communication skills to present and

				defend their work in front of Department Post Graduate Committee.
34	II	SHP552	Framework of Indian Constitution	Co:1 Realise the significance of constitution of India to students from all walks of life and help them to understand the basic concepts of Indian constitution.
				Co:2 Identify the importance of fundamental rights as well as fundamental duties.
				Co:3 Understand the functioning of Union, State and Local Governments in Indian federal system.
				Co:4 Learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.
35	III	MDE2015	Industry Internship	Co:1 Identify the real applications and practices of courses studied, at industry level
				Co:2 Recognize various modeling, analysis and validation techniques adopted at industries
				Co:3 Demonstrate the issues at design, manufacturing and assembly levels
				Co:4 Summarize and present technical data in report format.
36	III	MOE2011	Artificial Intelligence – Machine Learning (Open Elective)	Co:1 Describe central machine learning methods and techniques and how they relate to artificial intelligence.
				Co:2 Differentiate between supervised and unsupervised learning techniques.
				Co:3 Apply the ML algorithms to a real-world problem.
				Co:4 Optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
				Co:5 Evaluate a given problem and apply appropriate machine learning technique.
37	III	MOE2021	Creative Thinking: Tools & Techniques (Open Elective)	Co:1 Comprehend importance in tackling global challenges as well as in everyday problem-solving scenarios.
				Co:2 Apply different brainstorming techniques in group activities.
				Co:3 Be proficient in the application of the 6 thinking hats tool in different life scenarios.
				Co:4 Develop a systematic approach to idea generation through the use of morphological analysis.

				Co:5 Innovate on an existing product, service or situation applying the SCAMPER method.
				Co:6 Get confident with the theory of inventive problem solving, called TRIZ.
38	III	MOE203 1	MOOC Course (Open Elective)	Co:1 Identify the real applications and practices of courses studied, at industry level
				Co:2 Recognize various modelling, analysis and validation techniques adopted at industries.
				Co:3 Demonstrate the issues at design, manufacturing and assembly levels.
				Co:4 Summarize and present technical data in report format.
39	III	MOE204 1	Condition Monitoring and Signal Processing (Open Elective)	Co:1 Identify the maintenance scheme, their scope and limitations – apply the maintenance strategies to various problems in the industrial sectors.
				Co:2 Analyze for machinery condition monitoring and explain how this compliments monitoring the condition.
				Co:3 Develop an appreciation for the need of modern technological approach for plant maintenance to reduce the maintenance expenditure.
				Co:4 Emphasizes on case studies that require gathering information using the modern testing equipment and processing it to identify the malfunction in that system.
				Co:5 Identify vibration measurement, lubrication oil analysis.
40	III	MOE205 1	Aircraft Conceptual Design (Open Elective)	Co:1 Analyze the design process of aircraft and decide the aircraft configuration.
				Co:2 Choose type of power plant as per flight regime.
				Co:3 Design the fuselage layout as per type of aircraft.
				Co:4 Design the wing for type of aircraft and its wing loading.
				Co:5 Evaluate lift, drag and mass for design synthesis.
				Co:6 Examine the influence of various design requirements on the configuration of an aircraft to derive an optimized design.

41	III	MDE2060	Augmented Reality and Virtual Reality (Open Elective)	Co:1 Define the basic concepts of Virtual and Augmented Reality
				Co:2 Identify the differences in AR/VR concepts and technologies
				Co:3 Describe the fundamental concepts relating to Virtual Reality such as presence, immersion, and engagement
				Co:4 Evaluate usability of AR/VR applications and critique their use of AR/VR capabilities
				Co:5 Design and prototype effective AR/VR applications using UNITY platform for various application.
42	III	MDE2070	Industrial Instrumentation (Open Elective)	Co:1 Elaborate working principal of different transducers.
				Co:2 Select suitable transducer/sensor for specific application.
				Co:3 Justify the use of specific measurement technique for specific task.
				Co:4 Evaluate the Calibration and Interfacing of the transducers.
43	III	MDE2080	Advanced Mechatronics Systems (Open Elective)	Co:1 Explain Mechatronics System.
				Co:2 Analyze the Mechatronics Based System.
				Co:3 Model, simulate, and verify the mechatronics systems.
				Co:4 Identify Electrical, Hydraulic and Pneumatic Components.
44	III	MDE2024	Dissertation Stage-I	Co:1 Explain the contributions of various researchers in the field of design engg after carrying out literature survey from reputed journals.
				Co:2 Recognize the gap in the research and define a problem statement.
				Co:3 Explain significance and applicability of problem statement.
				Co:4 Summarize and present technical data in report format.
45	III	MDE2034	Dissertation Stage-II	Co:1 Outline the work plan for problem statement.
				Co: 2 Identify the proper modelling and analysis tool.
				Co:3 Reproduce the preliminary results of problem statement.
				Co:4 Summarize and present technical data in report format.
46	IV	MDE2044	Dissertation Stage-III	Co:1 Explain the issues related to method adopted in solving the problem

				Co:2 Select proper technique in solving the problem
				Co:3 Compare the results with available literature
47	IV	MDE205 4	Dissertation Stage-IV	Co:1 Design new methodology to address the problem
				Co:2 Justify the results obtained from new methodology
				Co:1 Write technical report and defend work

- **Department Name :-Mechanical Engineering**
- **PG Program Name :-Mechanical Thermal Engineering**

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Sr. No.	Program Outcomes
1.	To independently carry out research /investigation and development work to solve practical problems
2.	To write and present a substantial technical report/document
3.	To demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
4.	To accomplish collaborative and multi-disciplinary scientific research with consideration of professional, legal, and ethical issues.
5.	To Manage the projects and its financial aspects on the strength of engineering knowledge and management principles.
6.	To Engage in lifelong learning to address contemporary issues through independent and reflective learning.

Programme Educational Objectives for the M. Tech Mechanical Thermal Engineering

PEO1: - Graduates will apply concepts of thermal engineering to design, model, simulate and solve problems to develop energy efficient systems to pursue successful career in the field of Mechanical Engineering and allied sciences.

PEO2: - Graduates will have technical competency in thermal engineering or related areas to become innovators, academicians and provide services to address technical, business and social challenges.

PEO3: - Graduates will involve in lifelong learning such as higher studies, research to maintain professionalism and ethical standards.

Sr. No.	Semester	Course Code	Course Name	Course Outcome
1	I	SHP5131	Advanced Mathematical Methods in Engineering	Co:1 Evaluate Fourier series for given function and apply it to solve the partial differential equations in Engineering problems.
				Co:2 Apply the specific method of solution of partial differential equations for solving the given problems
				Co:3 Formulate and solve a boundary value problem (Partial differential equation, boundary and initial conditions).
				Co:4 Use the relevant method for solving the simultaneous linear equations and compute the Eigen values.
				Co:5 Estimate numerically the solution of given algebraic equation.
				Co:6 Analyze the variance and explain the different research designs.
2	I	MTE1011	Classical and Statistical Thermodynamics	Co:1 Explain different behavior of gases and thermodynamic relations
				Co:2 Interpret thermodynamics property relations to various mixtures and solutions.
				Co:3 Compare thermodynamics equilibrium of system

				Co:4 Explain the kinetic theory of gases.
				Co:5 Apply the principle of statistical thermodynamics to the various processes.
				Co:6 Develop and analyze the various thermodynamic cycles.
3	I	MTE1021	Principles of Heat Transfer	Co:1 Analyze heat conduction and Radiation
				Co:2 Develop a solution to heat convection to external laminar flow
				Co:3 Formulate heat convection to internal laminar flow.
				Co:4 Examine heat convection in turbulent flow
				Co:5 Interpret convection with phase change
				Co:6 Solve heat transfer problem numerically
4	I	MTE1031	Advanced Fluid Mechanics (Program Elective-I)	Co:1 Explain basic concepts in the fluid mechanics.
				Co:2 Analyze practical problems of fluid flow.
				Co:3 Explain concepts of boundary layer theory.
				Co:4 Evaluate the performance of fluid flow devices in laminar and turbulent flows.
				Co:5 Apply the concepts in the analysis of fluid flow problems.
5	I	MTE1041	Design of Pumps, Compressor and Blower (Program Elective-I)	Co:1 Select suitable pump, blower, fan and compressor for a given application.
				Co:2 Design pump, blower, fan or compressor for a given application.
				Co:3 Analyze the performance of compressor and pump
				Co:4 Model and simulate pump, blower, fan and compressor.

6	I	MTE1051	Gas turbine and Jet Propulsion (Program Elective-I)	Co:1 Describe the ideal and real thermodynamic cycles of air-breathing engines and Industrial gas turbines.
				Co:2 Design the blading, study the velocity triangles and estimate the performance of centrifugal and axial flow compressors.
				Co:3 Explain the combustion process and design the combustion chamber of a gas turbine.
				Co:4 Design the blading, study the velocity triangles and estimate the performance of axial and radial in-flow turbines.
				Co:5 Analyze off-design performance and matching of the components of a gas turbine.
7	I	MET1061	Finite Element Method for Thermal Engineering (Program Elective-I)	Co:1 Establish the mathematical model for the complex analysis problems and predict the nature of the solution.
				Co:2 Formulate element characteristic matrices and vectors.
				Co:3 Identify the boundary conditions and their incorporation into FE equation
				Co:4 Analyze simple geometry problems for Thermal and stress analysis.
				Co:5 Interpret the analysis results for the improvement or modification of the system.
8	I	MTE1071	Hybrid & Electric Vehicles (Program Elective-II)	Co:1 Select suitable drive scheme for developing an electric hybrid vehicle.
				Co:2 Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
				Co:3 Choose proper energy storage systems, electric machine and drive train for vehicle applications.

				Co:4 Analyze various communication protocols and technologies used in vehicle networks.
9	I	MTE1081	Materials for Thermal System (Program Elective-II)	Co:1 Select suitable material for thermal systems
				Co:2 Justify use and suitability of thermal materials for different systems
				Co:3 Compose advanced materials for different application
				Co:4 Explain applications of thermal materials
10	I	MTE1091	Solar Energy (Program Elective-II)	Co:1 Estimate and quantify available solar radiation
				Co:2 Design the components of solar energy systems.
				Co:3 Justify economics of the solar energy systems
11	I	MTE1101	Power Plant Engineering (Program Elective-II)	Co:1 Explain analytical and technological aspects of power plant design, systems and their effects.
				Co:2 Analyze and explain various power plants.
				Co:3 Summarize advanced power cycles.
				Co:4 Recognize environmental issues.
				Co:5 Estimate economics of power plants.
12	I	MTE1111	Modeling Lab	Co:1 Model the components of thermal system using suitable software.
				Co:2 Create computational domain for selected geometry.
				Co:3 Generate mesh and refine mesh elements of given geometry.
13	I	MTE1121	Thermal Engineering Lab-I	Co:1 Conduct test and interpret the theoretical and experimental data of conduction and convection experiments.

				Co:2 Relate the theory and the experimentation pertaining to thermal system.
				Co:3 Examine various thermal systems
14	I	MTE1131	Computational Methods in Thermal Engineering Lab	Co:1 Develop codes for numerical methods to tackle simple thermal problems
				Co:2 Simulate codes of computational methods of given conditions
				Co:3 Analyze and validate output of written codes with analytical solution.
15	I	SHP551	Technical Communication	Co:1 Acquire skills required for good oral and written communication
				Co:2 Demonstrate improved writing and reading skills
				Co:3 Ensure the good quality of oral and written communication
16	II	MTE2011	Computational Fluid Dynamics	Co:1 Derive governing equations for fluid dynamics and heat transfer.
				Co:2 Develop finite difference algorithms for fluid flow and heat transfer problems.
				Co:3 Develop finite volume algorithms for fluid dynamics equations.
				Co:4 Select appropriate grid generation methods for CFD analysis.
				Co:5 Apply different CFD Techniques to various fluid flow problems
17	II	MTE2021	Design and Analysis of Thermal System	Co:1 Illustrate basic principles of modeling and optimization of design of thermal systems.
				Co:2 Design thermal systems.
				Co:3 Analyze thermal system.
18	II	MTE2031	Design of Heat Transfer Equipment	Co:1 Select suitable heat exchanger for particular application.
				Co:2 Design of heat exchanger.

			(Program Elective III)	Co:3 Design and analyse boiler furnace.
				Co:4 Analyse different heat transfer equipments.
19	II	MTE2041	Cryogenics Engineering (Program Elective III)	Co:1 Apply the basic principles of low temperature engineering.
				Co:2 Explain the behavior of solids and liquid at low temperatures
				Co:3 Analyze cryogenic systems.
				Co:4 Discuss gas separation systems.
				Co:5 Design Heat Exchangers for Cryogenic System.
20	II	MTE2051	Food Processing, Preservation and Transport (Program Elective III)	Co:1 Analyze mechanism of food spoilage
				Co:2 Design suitable food processing and preservation system
				Co:3 Select suitable cold storage system
				Co:4 Design and analysis transport system of preserved foods
				Co:5 Model the preservation system
21	II	MTE2061	Battery Thermal Management System (Program Elective III)	Co:1 Illustrate major functions and parts of a battery management system.
				Co:2 Design various configurations of battery pack and recent trends in battery pack.
				Co:3 Compute stored energy in a battery pack.
				Co:4 Measure and control current, temperature and isolation in battery-management system
22	II	MTE2071	Heating Ventilation Air Conditioning and Refrigeration (Program Elective IV)	Co:1 Explain different vapor compression refrigeration system and refrigerants.
				Co:2 Design of cooling and heating components of refrigeration system
				Co:3 Explain fundamentals of air conditioning and estimate cooling load on

				the building by considering various heat sources
				Co:4 Illustrate various air conditioning systems.
				Co:5 Design ducting systems and select air distribution system.
				Co:6 Explain air handling units in various applications.
23	II	MTE2081	Energy Audit and Management (Program Elective IV)	Co:1 Summarize energy scenario and the need for energy conservation.
				Co:2 Conduct energy audit of a system
				Co:3 Illustrate various techniques of waste heat recovery and cogeneration.
				Co:4 Explain the various measures for energy conservation and financial implications for various thermal utilities.
24	II	MTE2091	Cogeneration and Waste Heat Management (Program Elective IV)	Co:1 Estimate and quantify available waste heat
				Co:2 Explore different waste heat recovery systems
				Co:3 Explain economics of cogeneration and waste heat recovery systems
				Co:4 Illustrate different cogeneration techniques.
25	II	MTE2101	Advanced Thermal Storage Technology (Program Elective IV)	Co:1 Select thermal storage systems and the storage materials
				Co:2 Develop a model and analyze the thermal storage systems
				Co:3 Explain applications of thermal storage systems
26	II	MTE2111	Research Methodology & IPR	Co:1 Formulate a research problem.
				Co:2 Analyze research related information.
				Co:3 Prepare and present research proposal/paper by following research ethics.

				Co:4 Make effective use of computers and computing tools to search information, analyze information and prepare report.
				Co:5 Describe nature and processes involved in development of intellectual property rights
27	II	MTE2121	Computational Fluid Dynamics Lab	Co:1 Formulate problems in fluid flow and heat transfer.
				Co:2 Apply initial and boundary conditions to solve heat transfer problems.
				Co:3 Use ANSYS-Fluent for solving real life engineering problems
28	II	MTE2131	Thermal Engineering Lab-II	Co:1 Evaluate COP of different refrigeration systems.
				Co:2 Estimate cooling load needed for given space.
				Co:3 Design a refrigeration and air conditioning system for given application.
				Co:4 Calculate efficiency and effectiveness of different types of heat exchangers.
29	II	MTE2141	Mini Project	Co:1 Solve a live problem using software/analytical/Experimental / computational tools.
				Co:2 Write technical reports.
				Co:3 Develop skills to present the findings.
30	III	MTE3011	Industry Internship	Co:1 Identify the real applications and practices of courses studied, at industry level
				Co:2 Recognize various modeling, analysis and validation techniques adopted at industries.
				Co:3 Demonstrate the issues at design, manufacturing and assembly levels.
				Co:4 Summarize and present technical data in report format.

31	III	MOE2010	Artificial Intelligence – Machine Learning	Co:1 Describe central machine learning methods and techniques and how they relate to artificial intelligence
				Co:2 Differentiate between supervised and unsupervised learning techniques
				Co:3 Apply the ML algorithms to a real-world problem
				Co:4 Optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
				Co:5 Evaluate a given problem and apply appropriate machine learning technique
32	III	MOE2020	Creative Thinking: Tools & Techniques	Co:1 Comprehend importance in tackling global challenges as well as in everyday problem-solving scenarios
				Co:2 Apply different brainstorming techniques in group activities
				Co:3 Be proficient in the application of the 6 thinking hats tool in different life scenarios
				Co:4 Develop a systematic approach to idea generation through the use of morphological analysis
				Co:5 Innovate on an existing product, service or situation applying the SCAMPER method
				Co:6 Get confident with the theory of inventive problem solving, called TRIZ
				Co:7 Select and apply the appropriate technique based on the opportunity to seize or the problem to tackle
33	III	MOE2030	MOOC Course	Co:1 Identify the real application and practices of the courses studied, at the industry level.
				Co:2 Recognize various modeling ,analysis and validation techniques adopted at industries.

				Co:3 Demonstrate the issue at design, manufacturing and assembly level
34	III	MOE2040	Condition Monitoring and Signal Processing	Co:1 Identify the maintenance scheme, their scope and limitations – apply the maintenance strategies to various problems in the industrial sectors.
				Co:2 Analyze for machinery condition monitoring and explain how this compliments monitoring the condition
				Co:3 Develop an appreciation for the need of modern technological approach for plant maintenance to reduce the maintenance expenditure.
				Co:4 Emphasizes on case studies that require gathering information using the modern testing equipment and processing it to identify the malfunction in that system.
				Co:5 Identify vibration measurement, lubrication oil analysis.
35	III	MOE2050	Aircraft Conceptual Design	Co:1 Understand the design process of aircraft and decide the aircraft configuration.
				Co:2 Choose type of power plant as per flight regime.
				Co:3 Decide the fuselage layout as per type of aircraft.
				Co:4 Design the wing for type of aircraft and its wing loading.
				Co:5 Accurately evaluate lift, drag and mass for design synthesis process.
				Co:6 Examine the influence of various design requirements on the configuration of an aircraft to derive an optimized design.
36	III	MTE3021	Dissertation Phase I	Co:1 Explain the contributions of various researchers in the field of thermal engineering after carrying out literature survey from reputed journals

				Co:2 Recognize the gap in the research and define a problem statement
				Co:3 Explain significance and applicability of problem statement
				Co:4 Summarize and present technical data in report format
37	III	MTE3031	Dissertation Phase II	Co:1 Outline the work plan for problem statement
				Co:2 Identify the proper modeling and analysis tool
				Co:3 Reproduce the preliminary results of problem statement
				Co:4 Summarize and present technical data in report format
38	IV	MTE4011	Dissertation Phase III	Co:1 Explain the issues related to method adopted in solving the problem
				Co:2 Select proper technique in solving the problem
				Co:3 Compare the results with available literature.
39	IV	MTE4021	Dissertation Phase- IV	Co:1 Design new methodology to address the problem
				Co:2 Justify the results obtained from new methodology
				Co:3 Write technical report and defend work.

- **Department Name :-Mechanical Engineering**
- **PG Program Name:-Mechanical Manufacturing Engg.**

Sr. No.	Program Outcomes
1.	An ability to independently carry out research /investigation and development work to solve practical problems
2.	An ability to write and present a substantial technical report/document
3.	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4.	To accomplish collaborative and multi-disciplinary scientific research with consideration of professional, legal, and ethical issues.
5.	Manage the projects and its financial aspects on the strength of engineering knowledge and management principles.
6.	Engage in lifelong learning to address contemporary issues through independent and reflective learning.

Programme Educational Objectives for the M. Tech Mechanical Manufacturing Engg.

PEO1: - Graduates will apply knowledge of manufacturing engineering to design, model, simulate and solve problems to develop most efficient manufacturing systems to pursue successful career in the field of Mechanical Engineering.

PEO2: - Graduates will have technical competency in thermal engineering or related areas to become innovators, academicians and provide services to address technical, business and social challenges

PEO3: - Graduates will engage in lifelong learning such as higher studies, research and other continuous professional development activities.

Sr. No.	Semester	Course Code	Course Name	Course Outcome
1	I	SHP5131	Advanced Mathematical Methods in Engineering	Co:1 Evaluate Fourier series for given function and apply it to solve the partial differential equations in Engineering problems.

				Co:2 Apply the specific method of solution of partial differential equations for solving the given problems
				Co:3 Formulate and solve a boundary value problem (Partial differential equation, boundary and initial conditions).
				Co:4 Use the relevant method for solving the simultaneous linear equations and compute the Eigen values.
				Co:5 Estimate numerically the solution of given algebraic equation.
				Co:6 Analyze the variance and explain the different research designs.
2	I	MMF101	Additive Manufacturing for Industry 4.0	Co:1 Describe the Importance of AM technologies in Manufacturing
				Co:2 Classify and select additive manufacturing processes for a given application.
				Co:3 Design for manufacture for AM and carry out Process Analysis
				Co:4 Point out the software issues addressed in the additive manufacturing process.
				Co:5 Identify the Different methods for Post-processing of AM parts
				Co:6 Suggest the Applications of AM in Automobile, Aerospace, and Bio-medical etc
3	I	MMF102	Industrial Process Automation Systems	Co:1 Select appropriate automation technologies for process control system.
				Co:2 Design industrial process automation as per specifications of the customers
				Co:3 Analyze system performance.
4	I	MMF1031	Advanced System components & Integration	Co:1 Identify hardware and software issues for system integration in process and manufacturing automation and be able to offer solutions.
				Co:2 Use engineering software tools such as VB & C++, .NET, NetDDE, OPC (including

			(Programme Elective – I)	COM & DCOM), web services, HMI, DLLs and APIs.
				Co:3 Specify hardware and software components and functions of advanced systems such as robotics and vision, automated work cells, flexible manufacturing systems, and computer integrated manufacturing as related to plant wide automated system integration and IIoT.
				Co:4 Implementation of Fuzzy Logic and Neural Network Control Systems, and identify advantages, and disadvantages of such controllers.
				Co:5 Select state-of-the art advanced sensors and actuators for process and manufacturing automation systems.
				Co:6 Describe and apply wireless standards and applications used in industrial automation projects.
				Co:7 Apply process and machine safety standards in the design, integration and maintenance of process automation systems.
5	I	MMF1041	Mechatronics System Design for Manufacturing (Programme Elective – I)	Co:1 Demonstrate the method and importance of integration of Mechanical, Electronics and Control in the design of mechatronics system.
				Co:2 Select key elements of sensors and transducers and interfacing the same with problem under consideration through PLC.
6	I	MMF1051	Industrial Network & Controllers (Programme Elective – I)	Co:1 Design Industrial Networking architecture.
				Co:2 Select networking technologies for industrial automation applications.
				Co:3 Follow I/O bus installation and wiring connections guidelines for setting up industrial networks.
				Co:4 Design, configure, and program fieldbus networks. Program the communication among industrial automation controllers.

7	I	MMF106	Metal Cutting & Tool Design (Programme Elective – I)	Co:1 Analyze fundamental phenomena in metal cutting and grinding, through application of the principles of mechanics, materials, and allied engineering fields.
				Co:2 Develop quantitative and qualitative skills necessary to address practical issues pertaining to machining productivity and innovation and machine stability.
				Co:3 Design of press tools for given component.
8	I	MMF107	Applied Data Analytics (Programme Elective – I)	Co:1 Explain need of Data analytics in real time application.
				Co:2 Apply ANOVA to the given data set.
				Co:3 Apply machine learning to the given data set.
				Co:4 Explain and apply different supervised learning techniques.
9	I	MMF108	Advanced Manufacturing Technology (Programme Elective – I)	Co:1 Select appropriate process for manufacturing products.
				Co:2 Have appropriate degree of competency in the evaluation of various manufacturing technologies and their applications in modern manufacturing processes.
10	I	MMF109	Finite Element Methods in Manufacturing (Programme Elective – I)	Co:1 Apply finite element method to solve problems in solid mechanics.
				Co:2 Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axis-symmetric and plate bending problems.
				Co:3 Apply principles of FEM to solve heat transfer and fluid mechanics problems.
				Co:4 Analyze deformation processes using finite element principles
11	I	MMF1101	Solidification Processes (Programme Elective – II)	Co:1 Design gating & Riser system for casting.
				Co:2 Select the proper advanced casting method.

				Co:3 Develop plastic shaping process for new product.
				Co:4 Select suitable manufacturing method for glass & rubber products.
				Co:5 Use appropriate welding technique as per application.
12	I	MMF1111	Digital Process Control	Co:1 Design, model & tune digital PID controllers.
			(Programme Elective – II)	Co:2 Analyze system variables using MATLAB/SIMULINK.
13	I	MMF1121	Machine Vision & Applications	Co:1 Demonstrate image processing techniques.
			(Programme Elective – II)	Co:2 Identify various stages in applying the technique.
14	I	MMF1131	Advanced MEMS Fabrication & Microfluidics	Co:1 Design MEMS device using basic planer & non-planer micro fabrication method.
			(Programme Elective – II)	Co:2 Demonstrate use of various methods & techniques for microfluidics actuation control.
15	I	MMF114	Industrial Surface Engineering (Programme Elective – II)	Co:1 Select the surface preparation methods suitable for different substrate materials.
				Co:2 Describe suitable method for testing & evaluation of metallic coatings.
				Co:3 Explain importance of specific coatings & its applications on specific Engineering Components.
				Co:4 Explain the effect of process parameters on the properties & microstructure of The Surface coating processes.
				Co:5 Describe the importance & role of surface modifications to achieve several Technological Properties.
16	I	MMF115		Co:1 Explain Manufacturing methods of composites.

			Composite Materials & Processing (Programme Elective – II)	Co:2 Discuss the nature of various forms of composite reinforcement and matrix.
				Co:3 Select an appropriate processing method for variety of composite and products.
17	I	MMF1161	Software Proficiency-I	Co:1 Develop/ select appropriate orientation of the casting & parting plane.
				Co:2 Calculate modulus of the casting & number of cavities in the mould.
				Co:3 Calculation of riser & gating system design.
18	I	MMF1171	Manufacturing Simulation Lab	Co:1 Demonstrate the broad applicability of discrete-event simulation to solve complex manufacturing systems problems
				Co:2 apply the essential steps of the simulation methodology
				Co:3 Learn to use the WITNESS 13/Arena Simulation Software Tool to build credible valid simulation models, design and run simulation experiments, and critically evaluate decision- support simulation results.
				Co:4 Learn analytical techniques for interpreting input data and output results pertinent to simulation models.
				Co:5 Gain insight into system behavior by measuring the performance characteristics of proposed new manufacturing system or the impact of proposed changes for existing
19	I	SHP5511	Technical Communication	Co:1 Acquire skills required for good oral and written communication
				Co:2 Demonstrate improved writing and reading skills
				Co:3 Ensure the good quality of oral and written communication
20	II	MMF201	Robotic & Automation	Co:1 Evaluate the different mechanical configurations available for a modern industrial robot.

				Co:2 Analyze complex robot kinematic theory and devise kinematic calculations for a given case study.
				Co:3 Program an industrial robot off-line using kinematic simulation software to perform a specified task.
				Co:4 Appraise the impact of automation, both economic and social, on modern industry and future applications in industry.
21	II	MMF202	Lean Six Sigma	Co:1 Explain Six Sigma Methodology
				Co:2 Generate process capability indices
				Co:3 Perform ANOVA
				Co:4 Perform regression analysis
				Co:5 Design experiments
				Co:6 Perform measurement system analysis
22	II	MMF2031	Material Characterization & Failure Analysis (Programme Elective – III)	Co:1 Interpret various materials characterization techniques.
				Co:2 Select the characterization tool for specific application
				Co:3 Analyze the characterization results by various equipment
23	II	MMF2041	System Modelling & Simulation (Programme Elective – III)	Co:1 Model any system from different fields.
				Co:2 Implement numerical algorithm to meet simple requirements, expressed in English
				Co:3 Discuss the simulation methods and select the suitable technique on the problems.
24	II	MMF205	Polymer Processing & Die Design (Programme Elective – III)	Co:1 Demonstrate the key practical theory with the operation principles of polymer processing technologies and their potential limitations.
				Co:2 Select and justify appropriate processing technologies for specific applications.
				Co:3 Demonstrate the constructional features and working of basic elements in

				injection molds, extrusion and blow molding dies
				Co:4 Design the mold for optimum performance
25	II	MMF206	Product Life cycle Management (Programme Elective – III)	Co:1 Understand & explain the concept of PLM, set PLM Vision and Prepare PLM Strategy.
				Co:2 Plan for Integrated Product Development Process.
				Co:3 Plan for Collaborative Product Development Process.
				Co:4 Perform Product Structure Modelling with relationships between different components of the product and their versions.
				Co:5 Create Product Data & Manage it
				Co:6 Implement Digital Manufacturing Technique.
26	II	MMF207	Metrology 4.0 (Programme Elective – III)	Co:1 Explain the basics of coordinate metrology as well as the application of the methods of mechanical (tactile) and non-contact probing in 3D coordinate metrology.
				Co:2 Demonstrate the concept of reverse engineering
				Co:3 Use software to generate data for analysis
27	II	MMF2081	Sustainable Manufacturing Processes (Programme Elective – IV)	Co:1 Understand the three pillars of sustainability and how they are manifested in sustainable manufacturing.
				Co:2 Incorporate economic, environmental, and social aspects into decision making processes using multi-criteria decision-making methods.
				Co:3 Identify the link between manufacturing process models and sustainable manufacturing metrics for product and process improvement
				Co:4 Identify manufacturing system level sustainability issues and how they are linked

				with manufacturing process level issues.
28	II	MMF2091	Logistic & Supply Chain Management (Programme Elective – IV)	Co:1 Discuss and describe the key issues in SCM and logistic network.
				Co:2 Demonstrate Bullwhip effect in SCM and Develop physical distribution strategies
				Co:3 Decide the location of warehouses and develop various inventory models based on risk and uncertainty.
29	II	MMF210	Project Management for Industry4.0 (Programme Elective – IV)	Co:1 Discuss Project Management relevance in the context of IND4.0
				Co:2 Evaluate the needs of an organization regarding IND 4.0, taking into account maturity / readiness models (Evaluate)
				Co:3 Plan, develop and manage projects in the context of IND 4.0, using frameworks of project management, such as PMI, IPMA and Agile/Lean.
				Co:4 Support team decision making processes in accordance with the contingencies and uncertain environments of IND 4.0.
30	II	MMF211	Quality and Reliability (Programme Elective – IV)	Co:1 Explain the concept of design for Quality
				Co:2 Analyze the process and capability using various methods
				Co:3 Determine Process and measurement Systems Capability
				Co:4 Carry out reliability data analysis.
				Co:5 Apply various reliability prediction and evolution methods.
31	II	MMF212	Optimization Techniques & Industrial Applications (Programme Elective – IV)	Co:1 Identify and apply mathematical models in optimization method.
				Co:2 Recognize the suitable method of optimization in non-linear programming with and without constraints.
				Co:3 Apply optimization method for static applications like shafts and springs.

				Co:4 Design dynamic applications like linkage mechanism by using optimization method
				Co:5 Use genetic algorithm, ANN and Fuzzy logic to optimize various manufacturing systems
32	II	MMF2131	Research Methodology & IPR	Co:1 Formulate research
				Co:2 Analyze research related information
				Co:3 Prepare and present research proposal/paper by following research ethics
				Co:4 Make effective use of computers and computing tools to search information, analyze information and prepare report.
				Co:5 Describe nature and processes involved in development of intellectual property
33	II	MMF2141	CAM Lab.	Co:1 Develop sketches using suitable CAD software.
				Co:2 Develop part models using suitable CAD software.
				Co:3 Develop Assembly model using suitable CAD software.
				Co:4 Develop 2D drawings using suitable CAD software.
				Co:5 Generate tool path and part program for plain milling operation.
34	II	MMF2151	Software Proficiency-II	Co:1 Develop/ select appropriate model required for simulation.
				Co:2 Apply proper constraints and boundary conditions.
				Co:3 Select suitable solver settings of simulation software.
35	II	MMF2161	Mini Project	Co:1 Identify structural engineering problems reviewing available literature.
				Co:2 Study different techniques used to analyze complex structural systems.

				Co:3 Work on the solutions given and present solution by using his/her technique
36	III	MMF3011	Industry Internship	Co:1 Identify the real applications and practices of courses studied, at industry level
				Co:2 Recognize various modeling, analysis and validation techniques adopted at industries
				Co:3 Demonstrate the issues at design, manufacturing and assembly levels
				Co:4 Summarize and present technical data in report format.
37	III	MOE2010	Artificial Intelligence – Machine Learning (Open Elective)	Co:1 Describe central machine learning methods and techniques and how they relate to artificial intelligence
				Co:2 Differentiate between supervised and unsupervised learning techniques
				Co:3 Apply the ML algorithms to a real-world problem
				Co:4 Optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
				Co:5 Evaluate a given problem and apply appropriate machine learning technique
38	III	MOE2020	Creative Thinking: Tools & Techniques (Open Elective)	Co:1 Comprehend importance in tackling global challenges as well as in everyday problem-solving scenarios
				Co:2 Apply different brainstorming techniques in group activities
				Co:3 Be proficient in the application of the 6 thinking hats tool in different life scenarios
				Co:4 Develop a systematic approach to idea generation through the use of morphological analysis
				Co:5 Innovate on an existing product, service or situation applying the SCAMPER method
				Co:6 Get confident with the theory of inventive problem solving, called TRIZ

				Co:7 Select and apply the appropriate technique based on the opportunity to seize or the problem to tackle
39	III	MOE2030	MOOC Course (Open Elective)	Co:1 Identify the real application and practices of the courses studied, at the industry level.
				Co:2 Recognize various modeling ,analysis and validation techniques adopted at industries.
				Co:3 Demonstrate the issue at design, manufacturing and assembly level
40	III	MOE2040	Condition Monitoring and Signal Processing (Open Elective)	Co:1 Identify the maintenance scheme, their scope and limitations – apply the maintenance strategies to various problems in the industrial sectors.
				Co:2 Analyze for machinery condition monitoring and explain how this compliments monitoring the condition
				Co:3 Develop an appreciation for the need of modern technological approach for plant maintenance to reduce the maintenance expenditure.
				Co:4 Emphasizes on case studies that require gathering information using the modern testing equipment and processing it to identify the malfunction in that system.
				Co:5 Identify vibration measurement, lubrication oil analysis.
41	III	MOE2050	Aircraft Conceptual Design (Open Elective)	Co:1 Understand the design process of aircraft and decide the aircraft configuration.
				Co:2 Choose type of power plant as per flight regime.
				Co:3 Decide the fuselage layout as per type of aircraft.
				Co:4 Design the wing for type of aircraft and its wing loading.
				Co:5 Accurately evaluate lift, drag and mass for design synthesis process.

				Co:6 Examine the influence of various design requirements on the configuration of an aircraft to derive an optimized design.
42	III	MMF3031	Dissertation Phase-I	Co:1 contributions of various researchers in the field of design engg after carrying out literature survey from reputed journals
				Co:2 Recognize the gap in the research and define a problem statement
				Co:3 Explain significance and applicability of problem statement
				Co:4 Summarize and present technical data in report format.
43	III	MMF3041	Dissertation Phase-II	Co:1 Outline the work plan for problem statement
				Co:2 Identify the proper modeling and analysis tool
				Co:3 Reproduce the preliminary results of problem statement
				Co:4 Summarize and present technical
44	IV	MMF4011	Dissertation Phase-III	Co:1 Explain the issues related to method adopted in solving the problem
				Co:2 Select proper technique in solving the problem
45	IV	MMF4021	Dissertation Viva-Voce	Co:1 Design new methodology to address the problem
				Co:2 Justify the results obtained from new methodology
				Co:3 Write the project report