Mechanical Sandwich Program -2023-24 (COURSE PATTERN 2019)				
YEAR	**COURSE CODE**	**COURSE NAME**	**CO. Sr. No.**	**COURSE OUTCOMES**
BE	**402061**	**Industrial In-plant Training - II**	**CO-01**	WORK in industrial environment with professional ethics.
			CO-02	UNDERSTAND various industrial aspects of organizational behavior and professional ethics.
			CO-03	UNDERSTAND various industrial aspects viz. manufacturing processes, industrial design
			CO-04	UNDERSTAND various industrial aspects viz. productivity improvement, value engineering, quality control etc.
			CO-05	APPLY the theoretical concepts to solve industrial problems with teamwork and multidisciplinary approach
			CO-06	UNDERSTAND the basic concepts & broad principles of Industrial projects.
BE	**402062**	**Industrial Project#**	**CO-01**	CORRELATE and IMPLEMENT theory knowledge to solve industrial problems.
			CO-02	DEVELOP systematic approach to solve specific industrial problem.
			CO-03	FACE industrial problems competently.
			CO-04	DEMONSTARTE an ability to work in teams and manage the team work in industrial environment with professional ethics
			CO-05	UNDERSTAND and effective use of recent technology for providing solutions to industrial problems
			CO-06	Report and present the findings of the study conducted
BE	**402063**	**Technical Paper Presentation**	**CO-01**	DEVELOP interest towards research oriented field with ability to search the literature and brief report preparation
			CO-02	DEVELOP the professional skills and competencies in the field of mechanical Engineering
			CO-03	ANALYZE recent technologies with critical critical thinking
			CO-04	UNDERSTAND advanced technology and research in engineering.
			CO-05	DEVELOP technical writing skills.
			CO-06	DEVELOP presentation skills.
BE	**402064**	**Energy Engineering and Management(Self-Study - III)****	**CO-01**	ANALYZE working of thermal power plant and observe environmental impact of energy system.
			CO-02	EXPLAIN layout, construction and working of hydel Energy and Nuclear Energy plants.
			CO-03	EXPLAIN fundamental of Renewable Energy Systems
			CO-04	EXPLAIN the energy need and role of Energy management
			CO-05	CARRY OUT Audit of an organization/Industry.
			CO-06	ANALYZE the economics of power generation and EXPLAIN waste heat recovery systems.
BE	**402065**	**Industrial Engineering and Organizational Management (Self-Study - IV)****	**CO-01**	UNDERSTAND Concept of Industrial engineering and its role in production management.
			CO-02	APPLY work study techniques and understands its importance for better productivity in organization..
			CO-03	DEMONSTARTE the ability to select plant location, appropriate layout and material handling equipment.
			CO-04	USE PPC tools for effective planning, scheduling and managing the shop floor control and PLAN inventory requirements to exercise effective control on manufacturing requirements.
			CO-05	APPLY aspects of Process planning for process chart, ALB and group technology.
			CO-06	APPLY Ergonomics and legislations for human comfort at work place and understands the role of value engineering in improving productivity.
BE	**402066**	**Design of Transmission Elements*****	**CO-01**	UNDERSTAND & APPLY the principle of Spur & Helical gear design for industrial application and PREPARE a manufacturing drawing with the concepts of GD&T.
			CO-02	UNDERSTAND and DESIGN Bevel & Worm gear considering design parameters as per design standards.
			CO-03	SELECT&DESIGN Rolling and Sliding Contact Bearings from manufacturer's catalogue for a typical application considering suitable design parameters
			CO-04	UNDERSTAND and DESIGN various types of Clutches, Brakes, used in automobile.
			CO-05	UNDERSTAND & APPLY various concept of DESIGN Machine Tool Gear box, for different applications
			CO-06	UNDERSTAND & ELABORATE various modes of operation, degree of hybridization and allied terms associated with hybrid electric vehicles.

BE	**402067**	**Machine Dynamics and Vibration**	**CO-01**	APPLY balancing technique for static and dynamic balancing of multi cylinder inline and radial engines
			CO-02	ANALYZE the gyroscopic couple or effect for stabilization of Ship, Airplane and Four wheeler vehicles
			CO-03	ESTIMATE natural frequency for single DOF un-damped & damped free vibratory systems
			CO-04	DETERMINE response to forced vibrations due to harmonic excitation, base excitation and excitation due to unbalanced forces
			CO-05	ESTIMATE natural frequencies, mode shapes for 2 DOF un-damped free longitudinal and torsional vibratory systems
			CO-06	DESCRIBE vibration measuring instruments for industrial / real life applications along with suitable method for vibration control
BE	**402068**	**Artificial Intelligence in Mechanical Engineering**	**CO-01**	DEMONSTRATE fundamentals of artificial intelligence and machine learning.
			CO-02	APPLY feature extraction and selection techniques.
			CO-03	APPLY machine learning algorithms for classification and regression problems.
			CO-04	DEVISE AND DEVELOP a machine learning model using various steps.
			CO-05	EXPLAIN concepts of reinforced and deep learning
			CO-06	SIMULATE machine learning model in mechanical engineering problems.
TE	**302041**	**Numerical & Statistical Methods**	**CO-01**	SOLVE system of equations using direct and iterative numerical methods.
			CO-02	ESTIMATE solutions for differential equations using numerical techniques.
			CO-03	DEVELOP solution for engineering applications with numerical integration.
			CO-04	DESIGN and CREATE a model using a curve fitting and regression analysis.
			CO-05	APPLY statistical Technique for quantitative data analysis.
			CO-06	DEMONSTRATE the data, using the concepts of probability and linear algebra.
TE	**302042**	**Heat & Mass Transfer**	**CO-01**	ANALYZE & APPLY the modes of heat transfer equations for one dimensional thermal system.
			CO-02	.DESIGN a thermal system considering fins, thermal insulation and & Transient heat conduction.
			CO-03	EVALUATE the heat transfer rate in natural and forced convection & validate with experimentation results
			CO-04	INTERPRET heat transfer by radiation between objects with simple geometries, for black and grey surfaces.
			CO-05	ABILITY to analyze the rate of mass transfer using Fick's Law of Diffusion and understands mass diffusion in different coordinate systems.
			CO-06	DESIGN & ANALYSIS of heat transfer equipments and investigation of its performance.
TE	**302043**	**Design of Machine Elements**	**CO-01**	DESIGN AND ANALYZE the cotter and knuckle Joints, levers and components subjected to eccentric loading.
			CO-02	DESIGN shafts, keys and couplings under static loading conditions.
			CO-03	ANALYZE different stresses in power screws and APPLY those in the procedure to design screw jack.
			CO-04	EVALUATE dimensions of machine components under fluctuating loads.
			CO-05	EVALUATE & INTERPRET the stress developed on the different type of welded and threaded joints.
			CO-06	APPLY the design and development procedure for different types of springs.
TE	**302044**	**Mechatronics**	**CO-01**	UNDERSTAND key elements of Mechatronics system, representation into block diagram
			CO-02	UNDERSTAND concept of transfer function, reduction and analysis
			CO-03	UNDERSTAND principles of sensors, its characteristics, interfacing with DAQ microcontroller
			CO-04	UNDERSTAND the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application
			CO-05	UNDERSTAND the system modeling and analysis in time domain and frequency domain
			CO-06	UNDERSTAND control actions such as Proportional, derivative and integral and study its significance in industrial applications
TE	**302061**	**Fundamentals of Computer Aided Engineering**	**CO-01**	DEFINE the use of CAE tools and DESCRIBE the significance of shape functions in finite element formulations.
			CO-02	APPLY the various meshing techniques for better evaluation of approximate results.
			CO-03	APPLY material properties and boundary condition to SOLVE 1-D and 2-D element stiffness matrices to obtain nodal or elemental solution.
			CO-04	DEVELOP code for a component for CNC machines
			CO-05	DESCRIBE various methods of Automation and Robot Architecture
			CO-06	GENERATE the results in the form of contour plot by the USE of CAE tools.

TE	**302063**	**Industrial In-plant Training-I**	**CO-01**	To Work in industrial environment with professional ethics.
			CO-02	UNDERSTAND various industrial aspects
			CO-03	UNDERSTAND various industrial aspects
			CO-04	UNDERSTAND various industrial aspects
			CO-05	APPLY the theoretical concepts to solve industrial problems with teamwork and multidisciplinary approach
			CO-06	UNDERSTAND the basic concepts & broad principles of Industrial projects.
TE	**302064**	**Industrial Mini-Project**	**CO-01**	CORRELATE and IMPLEMENT theory knowledge to solve industrial problems.
			CO-02	DEVELOP systematic approach to solve specific industrial problem.
			CO-03	FACE industrial problems competently.
			CO-04	DEMONSTARTE an ability to work in teams and manage the team work in industrial environment with professional ethics
			CO-05	UNDERSTAND and effective use of recent technology for providing solutions to industrial problems
			CO-06	REPORT and PRESENT the findings of the study conducted
TE	**302065**	**Seminar**	**CO-01**	ESTABLISH motivation for any topic of interest and DEVELOP a thought process for technical presentation.
			CO-02	ORGANISE a detailed literature survey and BUILD a document with respect to technical publications.
			CO-03	ANALYSIS and COMPREHENSION of proof-of-concept and related data.
			CO-04	IMPROVE presentation skill effectively
			CO-05	IMPROVE soft skills.
			CO-06	MAKE USE of new and recent technology (e.g. Microsoft Office, Latex) for creating technical reports
TE	**302066**	**Process Planning & Tool Selection (Self-Study-I)**	**CO-01**	UNDERSTAND Concept of Industrial Engineering and its role in production management.
			CO-02	LEARN various Industrial Engineering techniques implemented in relation to production management in actual industrial practice.
			CO-03	UNDERGO with various world class techniques in practice.
			CO-04	CARRY out proper selection of process for production in actual practice in industry.
			CO-05	DEVELOP overall personality by exposing them to soft skills and professional ethics programs.
			CO-06	UNDERSTAND industrial psychology.
TE	**302067**	**Advanced Materials & Manufacturing (Self-Study-II)**	**CO-01**	EXPLAIN the various non-metallic materials with its applications
			CO-02	UNDERSTAND advanced materials and manufacturing processes and its use in industry.
			CO-03	DISCUSS the various forms of degradation of materials and apply the mechanisms for its prevention.
			CO-04	DISTINGUISH and APPLY various heat treatment processes, necessary for engineering practice.
			CO-05	DEVELOP a good product by using proper manufacturing process.
			CO-06	DISPLAYprofessional skills in selecting proper locating devices at work.
SE	**202041**	**Solid Mechanics**	**CO-01**	DEFINE Various types of stresses and strain developed on determinate & indeterminate beam.
			CO-02	SOLVE Shear force and bending moment diagram for various types of transverseloading and support.
			CO-03	COMPUTE the slope, deflection, bending stresses and shear stresses on a beam.
			CO-04	CALCULATE torsional shear stress in shaft and buckling on the column.
			CO-05	APPLY the concept of principle stresses and theories of failure to determine combinedstress developed due to normal and shear stress simultaneously applied on a 2-Dmember.
			CO-06	UTILIZE the concept of simple stress, strain, SFD/BMD, torsion, and principal stressto solve combined loading application based machine elements problem

SE	**202042**	**Solid Modeling and Drafting**	**CO-01**	UNDERSTAND basic concepts of CAD system, need and scope in Product Lifecycle Management.
			CO-02	UTILIZE knowledge of curves and surfacing features and methods to create complex solid geometry.
			CO-03	CONSTRUCT solid models, assemblies using various modeling techniques & PERFORM mass property analysis, including creating and using a coordinate system.
			CO-04	APPLY geometric transformations to simple 2D geometries.
			CO-05	USE CAD model data for various CAD based engineering applications viz. production drawings, 3D printing, FEA, CFD, MBD, CAE, CAM, etc.
			CO-06	USE PMI & MBD approach for communication.
SE	**202043**	**Engineering Thermodynamics**	**CO-01**	DESCRIBE the basics of thermodynamics with heat and work interactions.
			CO-02	APPLY laws of thermodynamics to steady flow and non-flow processes
			CO-03	EXPLAIN entropy, available and non-available energy for an Open and Closed System,
			CO-04	DETERMINE the properties of steam and their effect on performance of vapour power cycle.
			CO-05	ANALYSE the fuel combustion process and products of combustion.
			CO-06	SELECT various instrumentations required for safe and efficient operation of steam generator.
SE	**202044**	**Engineering Materials and Metallurgy**	**CO-01**	COMPARE crystal structures and ASSESS different lattice parameters.
			CO-02	DIFFERENTIATE and DETERMINE mechanical properties using destructive and non-destructive testing of materials.
			CO-03	IDENTIFY & ESTIMATE different parameters of the system viz., phases, variables, component, grains, grain boundary, and degree of freedom. etc.
			CO-04	ANALYSE effect of alloying element & heat treatment on properties of ferrous & nonferrous alloy.
			CO-05	DISCUSS various Ferrous metals with its application and Analyze the microstructures of ferrous materials and its effects on mechanical properties.
			CO-06	SELECT proper non-metal,their alloys & additive manufacturing technique for specific requirement.
SE	**203045**	**Electrical and Electronics Engineering**	**CO-01**	UNDERSTAND Arduino IDE; an open source platform and its basic programming features
			CO-02	INTERFACE Atmega328 based Arduino board with different devices and sensors
			CO-03	STUDY principle of operation of DC machines and speed control of DC motors
			CO-04	KNOW about three phase induction motor working and its applications
			CO-05	GET Acquainted with Electric Vehicle (EV) technology and subsystems
			CO-06	GET Familiar with various energy storage devices and electrical drives
SE	**207002**	**Engineering Mathematics - III**	**CO-01**	SOLVE higher order linear differential equations and apply to modeling and analyzing mass spring systems.
			CO-02	APPLY Laplace transform and Fourier transform techniques to solve differential equations involved in Vibration theory, Heat transfer and related engineering applications.
			CO-03	APPLY statistical methods like correlation, regression analysis in analyzing, interpreting experimental data and probability theory in testing and quality control.
			CO-04	PERFORM vector differentiation , analyze the vector fields and APPLY to fluid flow problems.
			CO-05	PERFORM vector integration, analyze the vector fields and apply to fluid flow problems.
			CO-06	SOLVE various partial differential equations such as wave equation, one and two dimensional heat flow equations.

SE	**202048**	**Kinematics of Machinery**	**CO-01**	PERFORM kinematic analysis of simple mechanisms
			CO-02	ANALYZE velocity and acceleration of four bar and single slider mechanisms by analytical methods
			CO-03	ANALYZE velocity and acceleration in mechanisms by ICR and Relative Velocity method
			CO-04	SYNTHESIZE a four bar mechanism with analytical and graphical methods
			CO-05	APPLY fundamentals of gear theory as a prerequisite for gear design
			CO-06	CONSTRUCT cam profile for given follower motion
SE	**202061**	**Thermal Engineering**	**CO-01**	UNDERSTAND the types of compressors, selection, work and related efficiencies
			CO-02	KNOW different refrigeration systems and COP
			CO-03	CONVERSANT with gas turbines and Jet propulsion
			CO-04	UNDERSTAND all the IC Engine systems, layouts and its importance
			CO-05	UNDERSTAND methods to test the IC Engine
			CO-06	UNDERSTAND the concept of normal and abnormal combustion in engine and emission
SE	**202062**	**Fluid Mechanics and Machinery**	**CO-01**	DETERMINE various properties of fluid and APPLY the laws of fluid statics and concepts of buoyancy.
			CO-02	IDENTIFY types of fluid flow and terms associated in fluid kinematics and APPLY principles of fluid dynamics.
			CO-03	ESTIMATE friction and minor losses in internal flows and CONSTRUCT mathematical correlation considering dimensionless parameters.
			CO-04	APPLY momentum principle and DRAW the velocity triangle on various turbines like Pelton wheel for its analysis.
			CO-05	UNDERSTAND the construction and working of different reaction turbines and DETERMINE performance parameters of different reaction turbines.
			CO-06	UNDERSTAND the construction and working of centrifugal Pump and DETERMINE performance parameters of Centrifugal pump.
SE	**202063**	**Manufacturing Engineering**	**CO-01**	SELECT appropriate molding, core making and melting practice and ESTIMATE pouring time, and DESIGN riser size and location for sand casting process.
			CO-02	DEMONSTRATE metal forming operations, CLASSIFY applications and CALCULATE load required for flat rolling.
			CO-03	CLASSIFY and EXPLAIN different welding processes and EVALUATE welding characteristics.
			CO-04	IDENTIFY lathe operations, CALCULATE machining time, shear angle, cutting forces in orthogonal cutting and DETERMINE tool life.
			CO-05	DISTINGUISH drilling and milling operations, CALCULATE machining time, and UNDERSTAND methods of Indexing.
			CO-06	RECOGNIZE Broaching and Grinding operations, CALCULATE of machining time for cylindrical and surface grinding operations.