

Aditya College of Engineering & Technology



Aditya Nagar, ADB Road, Surampalem - 533437
Department of Mechanical Engineering-R16 REGULATION

I - I

S. No	Name of the subject	CO Number	Course Outcomes
1	English-1	CO 1	Identifying the life of people, culture and tradition interpreting the information, speaking English to elicit information, identifying the vocabulary and Nouns
		CO 2	Understanding the responsibility and values, conversing for expressing greetings and leave takings, usage of articles, prepositions
		CO 3	Remembering life and contributions of Stephen Hawking discuss about specific topics practice letter writing, CVs, E-mail etiquette, application of verb forms
		CO 4	Understanding the life of Wangari Maathai, Role plays, use of adjectives and adverbs, vocabulary
		CO 5	Understanding way of life and values, technical writing and presentation, Vocabulary, common errors
		CO 6	Understanding soft skills, recognize Scientific and Technical English
2	Mathematics - I	CO 1	Utilize mean value theorems to real life problems
		CO 2	Able to form differential equation from physical problems and to solve various first order differential equations.
		CO 3	Solve the differential equations related to various engineering fields
		CO 4	Familiarize with functions of several variables which is useful in optimization
		CO 5	Apply double integration techniques in evaluating areas bounded by region
		CO 6	Students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional and 3-dimensional coordinate systems
3	Engineering Chemistry	CO 1	Analyze the different types of composite plastic materials and interpret the mechanism of polymers.
		CO 2	Utilize the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and categorize the reasons for corrosion and study methods to control corrosion.
		CO 3	Synthesize advanced nanomaterials and its techniques in engineering. Summarize the techniques that detect and measure changes of state of reaction.
		CO 4	Differentiate petroleum, petrol, synthetic petrol and have knowledge how they are produced. Study alternate fuels and analyse fuel gases.
		CO 5	Analyze the suitable methods for purification and treatment of hard water and brackish water.
		CO 6	Identify chlorination methods in municipal water.
4	Engineering Mechanics	CO 1	Analyze the Forces and Free Body Diagrams of Coplanar Systems.
		CO 2	Analyze the equations of equilibrium of systems.
		CO 3	Determine displacement of completely constrained bodies by principles of virtual work and solve the mechanics problems associated with friction force.
		CO 4	Evaluate the centroid and moments of Inertia of Composite Figures.
		CO 5	Determine the paths of velocity and acceleration of rigid bodies in rectilinear and curvilinear motion.

		CO 6	Adapt the concepts of work, energy and particle motion for engineering applications.
5	Computer Programming	CO 1	To write algorithms and to draw flowcharts for solving problems, converts both to C program finally compile and debug the programs.
		CO 2	To use different operators, data types and write programs that use two-way/ multi-way selection.
		CO 3	To select the best loop construct for a given problem
		CO 4	To design and implement programs to analyze the different pointer applications
		CO 5	To decompose a problem into functions and to develop modular reusable code
		CO 6	To apply File I/O operation
6	Environmental Studies	CO 1	Overall understanding of the natural resources
		CO 2	Basic understanding of the ecosystem and its diversity
		CO 3	Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
		CO 4	An understanding of the environmental impact of developmental activities
		CO5	Awareness on the social issues and global treaties.
		CO6	An understanding of the environmental legislation
7	Engineering/Applied Chemistry	CO1	Understand different types of chemical analysis
		CO2	Experiment volumetric analysis of various classes
		CO3	Use some commonly employed simple instruments
8	English - Communication Skills Lab - I	CO 1	Experiment how to pronounce words using the rules they have been taught
		CO 2	Articulate better pronunciation through stress or word accent, intonation, and rhythm.
		CO 3	Acting out about a consistent accent and intelligibility in their pronunciation of English by providing an opportunity for practice in speaking.
		CO 4	Experimenting the fluency in spoken English and neutralize mother tongue influence
		CO 5	Mind Mapping of the students to a variety of self-instructional and learner-friendly modes of language learning.

I - II

1	English – II	CO 1	At the end of the module, the learners will be able to understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
		CO 2	Ask and answer general questions on familiar topics and introduce oneself/others
		CO 3	Employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
		CO 4	Recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
		CO 5	Form sentences using proper grammatical structures and correct word forms
2	Mathematics – II	CO 1	Solve the system of linear algebraic equations using Matrix techniques
		CO 2	Determine the Eigen values and Eigen vectors of a system represented by a matrix
		CO 3	Compute the approximate roots of algebraic and transcendental equations using Iterative methods

4	(Mathematical Methods)	CO 4	Apply various interpolation methods to estimate the unknown values from a known data values
		CO 5	Apply numerical integral techniques to different Engineering problems
		CO 6	Solve the ordinary differential equations of first order with initial conditions using numerical techniques
3	Mathematics – III	CO 1	Compute Line, Surface, Volume integrals using Green's, Stoke's and Divergence theorems.
		CO 2	Use Laplace Transform methods to solve initial value problems for constant coefficient linear ordinary differential equations.
		CO 3	Discuss the expansion of a given periodic function by Fourier series in the given interval.
		CO 4	Solve engineering problems using Fourier Transforms and Inverse Fourier Transforms.
		CO 5	Apply a range of techniques to solve first and second order linear partial differential equations.
		CO 6	Model physical phenomena of Heat and Wave equations by using Partial differential equations.
4	Engineering Physics	CO 1	Identify the applications of Interference, Diffraction and Polarization in engineering.
		CO 2	Describe the construction and working principles of various types of lasers.
		CO 3	Explain the concept of dielectric constant and polarization in dielectric materials.
		CO 4	Apply the concept of magnetism to magnetic devices.
		CO 5	Identify the use of Ultrasonics in different fields.
		CO 6	Analyze the crystalline structure by Bragg's X-ray diffractometer.
5	Basic Electrical and Electronics Engineering	CO 1	Ability to Analyze performance of single-phase transformer and acquire proper recognition and working of 3-phase alternator and 3-phase induction motors.
		CO 2	Able to explain on operation of DC generators, 3-point starter and DC machine testing by Swinburne's Test and Brake test.
		CO 3	Able to Analyze operation of half wave, full wave bridge rectifiers and OP-AMPs.
		CO 4	Ability to express the operations of CE amplifier and basic concept of feedback amplifier.
		CO 5	Able to Analyze different applications of OP-Amp as an (inverter, inverting, non-inverting, integrator and differentiator)
		CO 6	Ability to analyze various electrical networks and able to distinguish A.C and D.C network, parallel series networks and star and Delta connection .
6	Engineering Drawing	CO 1	Analyze the Forces and Free Body Diagrams of Coplanar Systems.
		CO 2	Analyze the equations of equilibrium of systems.
		CO 3	Determine displacement of completely constrained bodies by principles of virtual work and solve the mechanics problems associated with friction force.
		CO 4	Evaluate the centroid and moments of Inertia of Composite Figures.
		CO 5	Determine the paths of velocity and acceleration of rigid bodies in rectilinear and curvilinear motion.
		CO 6	Explain the concepts of work, energy and particle motion for engineering applications.
7	English - Communication Skills Lab -	CO 1	Discuss about Debating
		CO 2	Expalin about Group Discussions
		CO 3	Discuss Presentation Skills
		CO 4	Expalain Interview Skills

	II	CO 5	Describe about Email and Preapare Curriculum Vitae
		CO 6	List out Idiomatic Expressions,Identify Common Errors in English
8	Engineering /Applied Physics Lab	CO 1	Understand the concept of error and its analysis.
		CO 2	Compare the theory and correlate with experiment findings.
		CO 3	Identify the appropriate application of particular experiment.
		CO 4	Understand and apply the fundamentals of wave optics.
		CO 5	Develop experimental skills on basic physics experiments.
		CO 6	Develop experimental skills on basic physics experiments.
9	Engg.Worksh op & IT Workshop	CO 1	Practice on manufacturing of components using workshop trades including fitting and carpentry.
		CO 2	Design different types of models by using workshop trades including black smithy and tin smithy.
		CO 3	Apply basic electrical engineering knowledge for house wiring practice.
		CO 4	Identify, assemble and update the components of a computer. Configure, evaluate and select hardware platforms for the implementation and execution of computer applications, services and systems
		CO 5	Construct a fully functional virtual machine, summarize various Linux OS commands
		CO 6	Develop presentation, documents and small applications using productivity tools such as word processor, presentation tools, spreadsheets, HTML, LaTeX

II – I

1	Metallurgy & Materials Science	CO 1	Differentiate the crystalline structure of metals and study the stability of phases in different alloy systems
		CO 2	Identify the behavior of ferrous and alloys and their application in different domains
		CO 3	Identify the behavior of non-ferrous metals and alloys and their application in different domains
		CO 4	Explain the effect of heat treatment, addition of alloying elements on properties of ferrous metals
		CO 5	Identify the methods of making of metal powders and applications of powder metallurgy
		CO 6	Compare the properties and applications of ceramic, composites and other advanced methods..
2	Mechanics of Solids	CO 1	Explain fundamental concepts of stress and strain in structural members subjected to loads, mechanical properties of materials
		CO 2	Applying concept of stresses to calculate thermal and Composite stresses.
		CO 3	Analyze the behavior of basic structural members subjected to various loading and support conditions based on principles of equilibrium
		CO 4	Summarize bending and shear stresses induced in the beams which are made with different cross sections
		CO 5	Analyze beams, columns, frames for normal, shear, and torsion stresses and to solve deflection problems
		CO 6	Assess stresses across section of the thin and thick cylinders and analyze stability of columns with different end conditions
3	Thermodynam	CO 1	Illustrate basic concepts of Thermodynamics and Thermometry
		CO 2	Apply the first law of thermodynamics to the thermal Systems
		CO 3	Examine the second law of thermodynamics, spontaneity and irreversibility in nature

3	Physics	CO 4	Calculate the characteristic Properties of Pure Substance and their depiction in tables and charts
		CO 5	Apply the ideal gas equation, Dalton's Law and Avogadro's Law
		CO 6	Explain the Psychrometric Properties and Psychrometric Chart.
4	Managerial Economics & Financial Analysis	CO 1	Enumerate the concepts of Economics, Demand and its Forecasting methods
		CO 2	Understanding the relationship among inputs, output, nature of cost, cost combinations.
		CO 3	State the nature of Markets, its structure, Price- Output decisions under different market structures & pricing strategies
		CO 4	Identify various types of organizations and their characteristics based on ownership
		CO 5	Illustrate financial statements by using various accounting tools
		CO 6	Discuss various methods to select a financial proposal by using capital budgeting methods
5	Fluid Mechanics & Hydraulic Machines	CO 1	Identify the basic concepts of fluid properties
		CO 2	Apply the principles of mechanics of fluids in static conditions
		CO 3	Apply the principles of mechanics of fluids in dynamic conditions
		CO 4	Evaluate Boundary layer theory conditions, flow separation and dimensional analysis
		CO 5	Solve Hydrodynamic forces of jet on vanes in different positions
		CO 6	Determine the Working Principles and performance evaluation of hydraulic pump and turbines.
6	Computer Aided Engineering Drawing Practice	CO 1	Sketch and represent Projection of Solids in 3D modeling and animation
		CO 2	Sketch the Sectional Views of Right Regular Solids-Prism, Cylinder, Pyramid, Development of solids
		CO 3	Interpretation of Right regular solids-Cylinder vs Prism, Prism vs Cone, Cone vs Cylinder. Perspective Projections-points, lines, planes, simple solids
		CO 4	Sketch points, lines, curves, polygons
		CO 5	Sketch the View point coordinates and views displayed
		CO 6	Sketch isometric and orthographic projections with CAD
7	Electrical & Electronics Engg. Lab	CO 1	Determine Magnetization characteristics of D.C. Shunt generator.
		CO 2	Calculate efficiency of dc machine & single phase transformer Induction motor.
		CO 3	Compare and control Speed of D.C.shunt motor above and below rated speeds.
		CO 4	Compute Regulation of three phase alternator
		CO 5	Predict no load and full load losses of single phase transformer without loading transformer.
		CO 6	Analyze performance of shunt motor, three phase induction motor
8	Mechanics of Solids & Metallurgy Lab	CO 1	Evaluate the young's modulus of elasticity of the given steel rod by conducting the direct tension test
		CO 2	Evaluate the hardness value for the metal specimen using rock well hardness testing machine
		CO 3	Evaluate the modulus of rigidity of the material for the given spring by conducting deflection test
		CO 4	Analyse the microstructure of heat treated steel using muffle furnace
		CO 5	Analyse hardenability of steels by jomney end quench test

		CO 6	Study and draw the microstructure of ferrous and non ferrous alloys
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II -II

1	Kinematics of Machinery	CO 1	Describe the principles of kinematic links, pairs, chains and their classification, DOF, mechanism, and inversion of mechanism.
		CO 2	Explain exact and approximate straight line motion mechanisms, conditions for correct steering, Universal coupling, and applications.
		CO 3	Examine the velocity and acceleration of various links using various approaches.
		CO 4	Sketch the cam profile for various follower motions.
		CO 5	Select best drive among belt, rope, and chain drives.
		CO 6	Solve variety of gear and gear train problems.
2	Thermal Engineering -I	CO 1	Understand the reasons and effects of various losses in the actual engines.
		CO 2	Explain working principles of an I.C. engines and their components.
		CO 3	Explain about normal combustion phenomenon and knocking in engines.
		CO 4	Calculate performance and emission parameters.
		CO 5	Explain classifications of compressors and calculate efficiency of reciprocating compressor
		CO 6	calculate efficiency of rotary compressor
3	Production Technology	CO 1	Describe various casting methods for product making with their merits and demerits
		CO 2	Explain various gating systems, Risers, Types of furnances
		CO 3	Identify different welding processes with their applications
		CO 4	Explain the various process in making of plastic components for engineering / domestic applications.
		CO 5	Identify the manufacturing process suitable for making products.
		CO 6	Differentiate various process involved in sheet metal forming with its applications and salient features
4	Design of Machine Members -I	CO 1	Calculate different stresses in the machine components subjected to various static loads, failures and suitability of a material for an engineering application
		CO 2	Calculate dynamic stresses in the machine components subjected to variable loads
		CO 3	Design riveted, welded, bolted joints, keys, cotters and knuckle joints subjected to static loads and their failure modes
		CO 4	Design of shafts for combined bending and axial loads, shaft sizes, BIS code
		CO 5	Design procedure for rigid and flexible type coupling
		CO 6	Calculate stresses in different types of springs subjected to static loads and dynamic loads
5	Machine Drawing	CO 1	Draw and represent standard dimensions of different mechanical fasteners, joints and couplings
		CO 2	Draw different types of bearings showing different components
		CO 3	Assemble Components of machine part and draw the sectional assembly showing the dimensions of all the components of the assembly as per bill of materials
		CO 4	Select and represent fits and geometrical form of different mating parts in assembly drawings.
		CO 5	To prepare manufacturing drawings, indicating fits, tolerances
		CO 6	To prepare manufacturing drawings indicating surface finish and surface treatment requirements

6	Industrial Engineering and Management	CO 1	Able to understand and apply the concept of management and administration, functions of management
		CO 2	Discuss and analyze operations management and inventory management techniques.
		CO 3	Determine & analyze the importance of human resources and their functions and marketing strategies to promote the products
		CO 4	Illustrate to apply the knowledge of project management techniques to complete the project in optimum cost and time.
		CO 5	Formulate to analyze components of strategic management
		CO 6	to apply various contemporary management practices.
7	Fluid Mechanics & Hydraulic Machines Lab	CO 1	Calculate the fluid properties and flow characteristics
		CO 2	Calculate the flow of fluid in circular conduits
		CO 3	Discuss the importance of dimensional and model analysis
		CO 4	Discuss centrifugal and reciprocating pumps using velocity triangles
		CO 5	Estimate the performance of impulse and reaction turbines
		CO 6	Calculate the flow characteristics and performance of hydraulic machines for real time applications
8	Production Technology Lab	CO 1	Understand how patterns are created and how their tolerances are calculated
		CO 2	Prepare the mold cavity and casting
		CO 3	Understanding metal joining by welding process such as TIG welding and gas welding processes, to join thin metals using spot welding and its heat-affected zone welding.
		CO 4	Understand the characteristics of foundry sand using a permeability meter, Universal sand strength machine
		CO 5	Understand how to make hollow parts like bottles with a blow molding machine
		CO 6	Understand plastic parts with injection molding machines

III - I

1	Dynamics of Machinery	CO 1	Explain and solve the basic concepts of gyroscopes used in mechanical devices.
		CO 2	Explain and solve the basic concepts of friction, brakes and dynamometers and their applications in mechanical Engineering.
		CO 3	Calculate and analyze the static and dynamic force analysis of turning moment diagrams.
		CO 4	Explain and solve the basic concepts of governors used in mechanical devices.
		CO 5	Calculate and analyze the balancing of rotating masses and reciprocating masses. Of an engines.
		CO 6	Calculate and analyze the vibrations and their result in the mechanical systems.
2	Metal Cutting and Machine Tools	CO 1	Learn the fundamental knowledge and principals in material removal process
		CO 2	Acquire the knowledge on operations in conventional, automatic, Capstan and turret lathes
		CO 3	Capable of understanding the working principles and operations of shaping, slotting, planning
		CO 4	Capable of understanding the working principles and operations of drilling and boring
		CO 5	Able to make gear and keyway in milling machines and understand the indexing mechanisms
		CO 6	Understand the different types of grinding methods and principles of finishing processes.

3	Design of Machine Members-II	CO 1	Explain the types of Bearings, Design methods for journal Bearings, Selection method for rolling contact Bearings
		CO 2	Design the I C engine parts
		CO 3	Calculate stresses in curved beams
		CO 4	Explain types of Belt Drives and their Nomenclature, usage of Belt Drives, Design Parameters
		CO 5	Design SPUR & HELICAL GEAR DRIVES
		CO 6	Design levers, Calculate Stresses in wire ropes,
4	Operations Research	CO 1	Solve the LP and DP problems
		CO 2	Solve transportation and sequencing problems
		CO 3	Understand the replacement of items with time
		CO 4	Understand the usage of game theory and waiting lines for Solving Business Problems
		CO 5	Calculate Inventory costs
		CO 6	Understand the usage of simulation models for Solving Business Problems
5	Thermal Engineering - II	CO 1	Explain the Rankine cycle, different methods to increase the efficiency, Fuels and their combustion processes
		CO 2	Classification of Boilers, Draught and analyzing their performances
		CO 3	Calculate the flow through Nozzles, velocity at exit, velocity coefficient, critical pressure ratio
		CO 4	Sketch and analyze the turbine velocity diagram, compounding of turbines, condition for maximum discharge
		CO 5	Explain reaction turbine properties, blade height, types of condensers, air leakages
		CO 6	Evaluate gas turbines and their performance increasing methods, Principles of Jet propulsions and Rockets, calculate thrust and propulsion efficiency
6	Theory of Machines Lab	CO 1	Find the moment of inertia of a flywheel, coefficient of friction between belt and pulley.
		CO 2	Analyse the motion of a motorized gyroscope when the couple is applied along its spin axis
		CO 3	Explain various types of gears- Spur, Helical, Worm and Bevel Gears
		CO 4	Determine the frequency of undamped free vibration of an equivalent spring mass system., damped free vibration of a spring mass system
		CO 5	Determine whirling speed of shaft theoretically and experimentally,
		CO 6	Determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
7	Machine Tools Lab	CO 1	Demonstrate and explain the basic parts of various machine tools and operate them.
		CO 2	Understand the basic operating concept of lathe machine.
		CO 3	Select appropriate process parameters in a machine tool while machining a workpiece.
		CO 4	Apply to produce different part features using machining process
		CO 5	Create and analyze cutting forces developed in various metal cutting operations
		CO 6	Identify and selecting different super finishing operations
		CO 1	Demonstrate the working of reciprocating air compressor.

8	Thermal Engineering Lab	CO 2	Determine the efficiency of the single cylinder SI engine, VCR engine, and performance of diesel engine.
		CO 3	Summarize the losses in VCR engine by motor test and retardation test in 4S single cylinder diesel engine.
		CO 4	Demonstrate the working of multi cylinder 4S petrol engine for performance, morse and heat balance tests
		CO 5	Sketch the valve timing and port timing diagrams for SI and CI engines to understand the processing
		CO 6	Explain the working of the boiler models
		CO 1	Explain the overview of Intellectual Property Rights and its types
9	IPR & Patents	CO 2	Discuss the procedure for registration of the copyrights and how to protect the creative works by using copyright law.
		CO 3	Explain the use of patents and procedure for registration of the patents.
		CO 4	Discuss what is trade mark, use of trade mark and procedure for the registration of trade mark.
		CO 5	Demonstrate about trade secrets and its law.
		CO 6	Explain the use of cyber law and international aspects of computer and online crimes.

III - II

1	Metrology	CO 1	Discuss the systems of limits and fits
		CO 2	Explain linear measurement, measurement of angles and tapers and limit gauges
		CO 3	Analyse the working optical measuring instruments and Interferometry
		CO 4	Evaluate the Surface roughness measurement by various Numerical assessment methods and Discuss the comparators
		CO 5	Explain the gear measurement and screw thread measurement
		CO 6	State the principle of flatness measurement and machine tool alignment tests
2	Instrumentation & Control Systems	CO 1	Understand the basic principles of measurement and their performance characteristics to use displacement measuring devices
		CO 2	Identify the principles and working of temperature and pressure measuring devices
		CO 3	Apply the fundamental principles of force, resistance, capacitance, and voltage to utilize level, speed, Acceleration and Vibration measuring devices
		CO 4	Recognize the fundamental concepts of stress-strain relations to use different stress and strain measuring devices
		CO 5	Interpret different humidity, force and torque measuring devices
		CO 6	Identify the elements of control system that are used to measure temperature, speed and positioning control systems
3	Refrigeration & Air-conditioning	CO 1	Demonstrate the fundamental concepts of refrigeration and air conditioning systems, as well as their applications
		CO 2	Analyze and assess the performance of various air refrigerating cycles.
		CO 3	Examine various vapour compression refrigeration systems to determine cooling capacity and coefficient of performance.
		CO 4	Describe the properties, applications, and environmental impacts of various refrigerants.
		CO 5	Analyze the cooling load for various air conditioning systems
		CO 6	Evaluate and operate the refrigeration and air conditioning systems.
		CO 1	Demonstrate 3D conduction heat transfer in Cartesian, cylindrical and

4	Heat Transfer	CO 2	Compute correlations and solve the problems on fins and transient with conduction
		CO 3	Analyze convection process in natural and forced modes
		CO 4	Explain and solve convection problems
		CO 5	Design heat exchanger and understand the process involving in heat
		CO 6	Explain radiation incorporated in heat transfer and solve the problems
5	Green Engineering Systems	CO 1	Explain Solar radiation, instruments for measuring solar radiation, Photo voltaic energy conversion, Solar energy collectors
		CO 2	Explain different methods of solar energy storages and Wind energy, Applications
		CO 3	Discuss the principles and working of Bio-Mass, Geothermal energy, Ocean energy
		CO 4	Summarizet the various energy efficient systems, Electrical & Mechanical
		CO 5	Paraphrase the different types of power plant, its function and issues related to them
		CO 6	Explain the energy, economic and environmental issues of power plants
6	Heat Transfer Lab	CO 1	Demonstrate 3D conduction heat transfer in Cartesian, cylindrical and spherical coordinates
		CO 2	Compute correlations and solve the problems on fins and transient with conduction
		CO 3	Analyze convection process in natural and forced modes
		CO 4	Explain and solve convection problems
		CO 5	Design heat exchanger and understand the process involving in heat exchanger like boiling and condensation
		CO 6	Explain radiation incorporated in heat transfer and solve the problems
7	Metrology & Instrumentation Lab	CO 1	Demonstrate the correct methods for measurement and calibration of various measuring devices
		CO 2	Compute the internal bore diameter measurement by using bore gauge and internal micrometer
		CO 3	Explain the effective methods of measuring straightness, flatness, gear profile, screw threads
		CO 4	Compute the temperature measurement using thermocouple
		CO 5	Compute the Displacement measurement using LVDT
		CO 6	Determine the photo and magnetic Speed pickups
8	Computational Fluid Dynamics Lab	CO 1	Develop mathematical models for flow phenomena.
		CO 2	Analyse mathematical and computational methods for fluid flow and heat transfer simulations.
		CO 3	Solve computational problems related to fluid flows and heat transfer.
		CO 4	Evaluate the grid sensitivity and analyse the accuracy of a numerical solution.
		CO 5	Evaluate flow parameters in internal and external flows.
		CO 6	Develop flow simulation code for fluid flow and heat transfer problems.
		CO 1	Understand the basic perception of profession, professional ethics and role of human values in governing profession
		CO 2	Bring consensus in controversial engineering decisions through the application of theories of ethics and moral development while playing the role of engineering professionals.

9	Professional Ethics & Human Values	CO 3	Apply professional codes in research and development while playing different roles as professionals by not sacrificing ethical issues
		CO 4	Aware of responsibilities of an engineer for safety and risk
		CO 5	Understand the concepts of loyalty, collegiality and collective bargaining in solving complex engineering problems and in shunting occupational crimes
		CO 6	Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives

IV – I

1	Mechatronics	CO 1	Discussion about levels associated with mechatronics, design process of mechatronics and discussion of sensors and transducers associated control systems
		CO 2	Solid state electronic devices and signal processing
		CO 3	Basic Principals and elements of Actuators like (Hydraulic, Pneumatic, Electrical, Mechanical)
		CO 4	Digital Electronics, Microprocessors, Micro-controllers and Summarize the functionality of Programmable Logic Controller.
		CO 5	Data Acquisition Systems and Digital Signal Processing Associate the mechatronics and actuator systems for real time applications
		CO 6	Dynamic Models and analogies, Design of Mechatronics systems and future trends.
2	CAD/CAM	CO 1	Describe the mathematical basis in the technique of representation and transformation of geometric entities
		CO 2	Design geometric models using curve and surface representation methods
		CO 3	Explain NC and CNC machines and part programming methods
		CO 4	Describe the use of GT and CAPP for the product development
		CO 5	Explain computer aided quality control
		CO 6	Identify the various elements and their activities in the Computer Integrated Manufacturing Systems
3	Finite Element Methods	CO 1	Demonstrate numerical methods to solve mechanics of solids problems
		CO 2	Formulate and Solve axially loaded bar Problems
		CO 3	Formulate and analyze truss and beam problems
		CO 4	Evaluate the formulation techniques to solve two-dimensional problems using triangle and quadrilateral elements
		CO 5	Formulate and solve Axi-symmetric and heat transfer problems
		CO 6	Calculate frequency in terms of Eigen values and vectors of bars and beam members
4	Power Plant Engineering	CO 1	Discuss the layout of thermal power plant and working principle of various types of boilers.
		CO 2	Explain the working of diesel and gas turbine power plant along with optimization technique
		CO 3	Discuss the principles and working of various renewable energy power plants.
		CO 4	Summarize various types of nuclear reactors used in nuclear power plant
		CO 5	Paraphrase the different types of power plant, its function and issues related to them
		CO 6	Explain the energy, economic and environmental issues of power plants

5	Additive Manufacturing	CO 1	Describe Prototyping fundamentals and State the working of Stereo lithography Apparatus (SLA) and Solid Ground Curing (SGC)
		CO 2	Analyse the working of solid-based rapid prototyping systems (LOM and FDM)
		CO 3	Analyse the working of powder-based rapid prototyping systems (SLS and 3DP)
		CO 4	Differentiate rapid tooling (RT) and Conventional tooling
		CO 5	Discuss various rapid prototyping data formats and rapid prototyping software's
		CO 6	Describe rapid prototyping applications in various fields
6	Advanced Materials	CO 1	Explain the classification of composite materials and their behaviour compared to isotropic materials.
		CO 2	Explain the relationship between polymer properties, microstructure and molecular weight; Relate polymer properties to their processing and uses.
		CO 3	Develop competency in one or more common composite manufacturing techniques, and be able to select the appropriate technique for manufacture of fibre-reinforced composite products.
		CO 4	Design composite structures, conduct stress analyses of selected practical applications using laminated plate theories and appropriate strength criteria.
		CO 5	Summarize the fundamental properties, characteristics and their applications of functionally graded materials (FGMs) and shape memory alloys.
		CO 6	Define a basic understanding of the length scale, understanding of the properties of materials with strong dependence on size, approaches to nanomaterials characterization, nanostructures and applications.
7	CAD/CAM Lab	CO 1	Utilize standard software tools to create part, assemblies and check for clearances using Creo software
		CO 2	Analyse the Mechanical behavior of beams and trusses using ANSYS Work bench
		CO 3	Analyse the stresses and displacements of plane-stress and plane-strain problems using ANSYS Work bench
		CO 4	Analyse the dynamic behavior of beams using harmonic analysis
		CO 5	Summarize the modern control in manufacturing systems (FANUC)
		CO 6	Utilize the concepts of G and M codes and manual part programming for modern manufacturing technology in the applications of turning and milling
8	Mechatronics Lab	CO 1	Measure load, displacement and temperature using analogue and digital sensors.
		CO 2	Develop PLC programs for control of traffic lights
		CO 3	Develop PLC programs for control of water level
		CO 4	Develop PLC programs for control of lifts and conveyor belts.
		CO 5	Simulate and analyze PID controllers for a physical system using MATLAB.
		CO 6	Develop pneumatic and hydraulic circuits using Automaton studio.

IV - II

	Production	CO 1	Recognize the objectives, functions, applications of PPC and organization structures of control departments in industries
		CO 2	Calculate the future demand by using qualitative and quantitative methods

1	Planning and Control	CO 3	Explain Inventory control techniques
		CO 4	Solve routing and scheduling problems by using johnson's technique
		CO 5	Summarize various aggregate production planning strategies.
		CO 6	Describe way of integrating departments to execute PPC functions and computer roles in PPC
2	Unconvention al Machining Processes	CO 1	Compare non-traditional machining with conventional; classify NTM, material applications in material removal process.
		CO 2	Apply the principles, processes and applications of Ultrasonic Machining Process.
		CO 3	Apply the principles, processes and applications of Electrochemical Machining Process
		CO 4	Apply the principles, processes and applications of EBM and LBM and Compare EBM and LBM
		CO 5	Apply he principles, processes and applications of Plasma Machining.
		CO 6	Compare the principle and processes of abrasive jet machining to AWJM, and related Processes.
3	Automobile Engineering	CO 1	Describe basic knowledge on the Components of four wheeler automobile
		CO 2	Explain different transmission system of an automobile
		CO 3	Apply the fundamental concepts of steering system.
		CO 4	Develop fundamental concepts suspension, breaking, and electrical systems of an automobile.
		CO 5	Assess fundamental concepts engine specification and safety systems.
		CO 6	Compare different engine emission control concepts and Engine service systems.
4	Non Destructive Evaluation	CO 1	Express theoretical and practical understanding of the radiographic testing, interpretation, evaluation, exposure time for a better imaging and safety precautions to avoid radiation hazards.
		CO 2	Describe a basic knowledge of ultrasonic testing, Calibration of the instrument, evaluation for imperfections and selecting the appropriate NDT methods for the specimen.
		CO 3	Express theoretical and practical knowledge of liquid penetrant & eddy current testing, test procedure, advantages, disadvantages and applications.
		CO 4	Apply principles of magnetism, magnetic fields, magnetization, methods of testing, interpretation of indications, demagnetization, and methods of assessing sensitivity.
		CO 5	Summarize the fundamental concepts of infrared and thermal testing and their practical applications in automobile, aerospace and off-shore areas
		CO 6	Summarize the applications of non-destructive evaluation techniques in oil& gas, off-shore, Coal mining, aerospace and castings.

5	Seminar	CO 1	Demonstrate a sound technical knowledge of their selected seminar topic
		CO 2	Contrast the understanding perceptive of techniques applicable to their domain
		CO 3	Demonstrate the knowledge, skills and attitudes of a professional engineer
		CO 4	Construct the solutions upon their own knowledge
		CO 5	Develop ability to utilize technical resources
		CO 6	Justify the presentation content individually to a group
6	Project	CO 1	Show that they are well-versed in the technical aspects of the project they are working on.
		CO 2	Shoulder the responsibility of identifying, formulating, and solving an issue.
		CO 3	To use a systematic approach, design engineering solutions to challenging problems.
		CO 4	Execute a project in engineering.
		CO 5	Interact in written and orally with engineers and the general public.
		CO 6	Demonstrate professional engineering knowledge, abilities, and attitudes.