



# AVANTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Approved by A.I.C.T.E., New Delhi, & Permanently Affiliated to J.N.T.U-GV, Vizianagaram)

NAAC "B++" Accredited Institute

Cherukupally (Village), Near Tagarapuvalasa Bridge, Vizianagaram (Dist) -531162.

www.aietta.ac.in, principal@aietta.ac.in

## Department of Mechanical Engineering

**Program: B.Tech- Mechanical Engineering**

**Regulation: R20**

**Course Outcomes**

**No. of Courses: 93**

<b>I-I Sem</b>	<b>Course: Mathematics - I (Calculus And Differential Equations)(BS)</b>
CO-1	Utilize mean value theorems to real life problems (L3)
CO-2	Solve the differential equations related to various engineering fields (L3)
CO-3	Familiarize with functions of several variables which is useful in optimization (L3)
CO-4	Apply double integration techniques in evaluating areas bounded by region (L3)
CO-5	Students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional and 3-dimensional coordinate systems(L5 )
<b>I-I Sem</b>	<b>Course: Engineering Physics</b>
CO-1	Explain the need of coherent sources and the conditions for sustained interference
CO-2	Understand the basic concepts of LASER light Sources
CO-3	Explain the concept of dual nature of matter
CO-4	Explain the concept of dielectric constant and polarization in dielectric materials
<b>I-I Sem</b>	<b>Course: Programming For Problem Solving Using C</b>
CO-1	To write algorithms and to draw flowcharts for solving problems
CO-2	To convert flowcharts/algorithms to C Programs, compile and debug programs
CO-3	To use different operators, data types and write programs that use two-way/ multi-way selection
CO-4	To select the best loop construct for a given problem
<b>I-I Sem</b>	<b>Course: Communicative English</b>
CO-1	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





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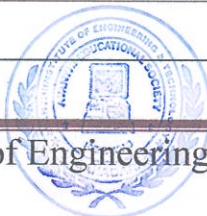
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<b>I-I SEM</b>	<b>Course: Engineering Drawing</b>
CO1	Use drawing instruments to draw polygons and Engineering Curves.
CO2	Construct scales and draw Orthographic projections
CO3	draw projections of points
CO4	draw projections of planes
CO5	Describe and draw projections of solids
<b>I-II Sem</b>	<b>Course: Applied Physics Lab</b>
CO-1	Develop skills to impart practical knowledge in real time solution.
CO-2	Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
CO-3	Design new instruments with practical knowledge.
<b>I-I Sem</b>	<b>Course: Programming For Problem Solving Using C Lab</b>
CO-1	Gains Knowledge on various concepts of a C language.
CO-2	Draw flowcharts and write algorithms.
CO-3	Design and development of C problem solving skills
<b>I-I Sem</b>	<b>Course: English Communication Skills Laboratory (HS)</b>
CO-1	Apply the concepts of English Language effectively in spoken and written forms.
CO-2	Rephrase the texts and respond appropriately
CO-3	Take part confidently in various formal and informal contexts.
<b>I-I Sem</b>	<b>Course: Environmental Science</b>
CO-1	Understand of the natural resources.
CO-2	Understand of the ecosystem and its diversity.
CO-3	Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
CO-4	Understand of the environmental impact of developmental activities.
CO-5	Create awareness on the social issues, environmental legislation and global treaties.







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<b>I-II Sem</b>	<b>Course: Mathematics-II</b>
CO-1	develop the use of matrix algebra techniques that is needed by engineers for practical applications
CO-2	solve system of linear algebraic equations using Gauss elimination, Gauss Jordan, Gauss Seidel
CO-3	evaluate the approximate roots of polynomial and transcendental equations by different algorithms
CO-4	apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals
CO-5	apply numerical integral techniques to different Engineering problems
<b>I-II</b>	<b>Course: Engineering Chemistry</b>
CO-1	Analyze the different types of composite plastic materials and interpret the mechanism of conduction in conducting 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 nanomaterials for modern advances of engineering technology. Summarize the preparation of semiconductors; analyze the applications of liquid crystals and superconductors.
CO-4	Analyze the principles of different analytical instruments and their applications. Design models for energy by different natural sources.
CO-5	Obtain the knowledge of computational chemistry and molecular machines
<b>I-II SEM</b>	<b>Course: Engineering Mechanics</b>
CO1	Identify the significance of centroid/ center of gravity and find centroids of composite figures and bodies.
CO2	Understand the moment of inertia and method of finding moment of inertia of areas and bodies
CO3	Identify the type of frame and analyze for the forces in the members of the truss (frame) by method of joints and method of sections.
CO4	Interpret the simple given dynamic problems and solve them for positions, velocities and accelerations, etc.,
CO5	Understand the kinetics of the rigid bodies and solve simple problems using work-energy method.
<b>I-II Sem</b>	<b>Course: Basic Electrical Engineering</b>
CO-1	Able to explain the operation of DC generator and analyze the characteristics of DC generator.
CO-2	Able to explain the principle of operation of DC motor and analyze their characteristics. Acquire the skills to analyze the starting and speed control methods of DC motors.





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CO-3	Ability to analyze the performance and speed – torque characteristics of a 3-phase induction motor and understand starting methods of 3-phase induction motor.
CO-4	Able to explain the operation of Synchronous Machines
CO-5	Capability to understand the operation of various special machines.
<b>I-II SEM</b>	<b>Course: Thermodynamics</b>
CO1	Describe basic concepts of thermodynamics
CO2	Explain Laws of thermodynamics
CO3	discuss Concept of entropy
CO4	evaluate vapours and their depiction in tables and charts
CO5	Evaluate properties of perfect gas mixtures.
<b>I-II SEM</b>	<b>Course: Engineering Workshop Practice Lab</b>
CO1	Design and model different prototypes in the carpentry trade such as Cross lap joint, Dove tail joint.
CO2	Design and model various basic prototypes in the trade of fitting such as Straight fit, V-fit.
CO3	Design various basic prototypes in the trade of Tin smithy such as rectangular tray, and open Cylinder.
<b>I-II</b>	<b>Course: Engineering Chemistry Lab</b>
CO-1	The students entering into the professional course have practically very little exposure to lab classes. The experiments introduce volumetric analysis; redox titrations with different indicators; EDTA titrations; then they are exposed to a few instrumental methods of chemical analysis. Thus at the end of the lab course, the student is exposed to different methods of chemical analysis and use of some commonly employed instruments. They thus acquire some experimental skills
CO-2	Learn and apply basic techniques used in chemistry laboratory for volumetric analysis; redox titrations with different indicators; EDTA titrations
CO-3	Expose to different methods of chemical analysis and use of some commonly employed instruments.
<b>I-II Sem</b>	<b>Course: Basic Electrical Engineering Lab</b>
CO-1	Determine and predetermine the performance of DC machines and transformers.
CO-2	Control the DC shunt machines.
CO-3	Compute the performance of 1-phase transformer.





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<b>I-II Sem</b>	<b>Course: Constitution Of India</b>
CO-1	Understand historical background of the constitution making and its importance for building a democratic India.
CO-2	Understand the functioning of three wings of the government i.e., executive, Legislative and judiciary.
CO-3	Understand the value of the fundamental rights and duties for becoming good citizen of India.
CO-4	Analyze the decentralization of power between central, state and local self government.
CO-5	Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.
<b>II-I SEM</b>	<b>Course: Mechanics Of Solids</b>
CO1	Analyze the behavior of basic structural members subjected to various loading and support conditions based on principles of equilibrium.
CO2	apply the concept of stress and strain to analyze and design structural members and machine parts under axial, shear and bending loads, moment and torsional moment
CO3	Analyze beams, columns, frames for normal, shear, and torsion stresses and to solve deflection problems in preparation for the design of such structural components.
CO4	Compare the loads, stresses, and strains acting on a structure and their relations in the elastic behavior
CO5	Design and analysis of Industrial components like pressure vessels.
<b>II-I SEM</b>	<b>Course: Fluid Mechanics &amp; Hydraulic Machines</b>
CO1	Explain basic concepts of fluid properties
CO2	discuss mechanics of fluids in static and dynamic conditions
CO3	Explain Boundary layer theory, flow separation and dimensional analysis.
CO4	Derive Hydrodynamic forces of jet on vanes in different position
CO5	Explain Working Principles and performance evaluation of hydraulic pump and turbines.
<b>II-I SEM</b>	<b>Course: Production Technology</b>
CO1	design the gating system for different metallic components
CO2	design the gating system for different metallic components
CO3	Compare different types of manufacturing processes
CO4	use forging, extrusion processes
CO5	Compare different types of welding processes used for special fabrication





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<b>II-I SEM</b>	<b>Course: Kinematics Of Machinery</b>
CO1	Draw Contrive a mechanism for a given plane motion with single degree of freedom
CO2	analyse a mechanism for a given straight line motion and automobile steering motion
CO3	Analyse the motion (velocity and acceleration) of a plane mechanism
CO4	analyse mechanisms for a prescribed intermittent motion like opening and closing of IC engine valves etc.
CO5	Select a power transmission system for a given application and analyse motion of different transmission system
<b>II-I SEM</b>	<b>Course: Computer Aided Engineering Drawing Practice</b>
CO1	Explain working of sheet metal with help of development of surfaces
CO2	Explain how to know the hidden details of machine components with the help of sections and interpenetrations of solids.
CO3	Explain modelling commands for generating 2D and 3D objects using computer aided drafting tools which are useful to create machine elements for computer aided analysis.
<b>II-I SEM</b>	<b>Course: Fluid Mechanics &amp; Hydraulic Machinery Lab</b>
CO1	Compute Impact of jets on Vanes
CO2	Analyse Performance Test on Pelton Wheel.
CO3	Analyse Performance Test on Francis Turbine.
<b>II-I SEM</b>	<b>Course: Production Technology Lab</b>
CO1	use sheet metal operations
CO2	Practice deep drawing and extrusion operations
CO3	Explain Basic powder compaction and interring
<b>II-I SEM</b>	<b>Course: Drafting And Modeling Lab</b>
CO1	Explain the concept of Traditional knowledge and its importance
CO2	Discuss importance of protecting traditional knowledge
CO3	Explain various enactments related to the protection of traditional knowledge





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<b>II-II SEM</b>	<b>Course: Materials Science &amp; Metallurgy</b>
CO1	Discuss the crystalline structure of different metals and study the stability of phases in different alloy systems.
CO2	Explain the behavior of ferrous and non ferrous metals and alloys and their application in different domains
CO3	Discuss the effect of heat treatment, addition of alloying elements on properties of ferrous metals.
CO4	Explain methods of making of metal powders and applications of powder metallurgy
CO5	Comprehend the properties and applications of ceramic, composites and other advanced methods
<b>II-II SEM</b>	<b>Course: Complex Variables And Statistical Methods</b>
CO1	apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic
CO2	find the differentiation and integration of complex functions used in engineering problems
CO3	make use of the Cauchy residue theorem to evaluate certain integrals
CO4	apply discrete and continuous probability distributions
CO5	design the components of a classical hypothesis test
<b>II-II SEM</b>	<b>Course: Dynamics of Machinery</b>
C01	compute the frictional losses and transmission in clutches, brakes and dynamometers
C02	determine the effect of gyroscopic couple in motor vehicles, ships and aeroplanes
C03	analyse the forces in four bar and slider crank mechanisms and design a flywheel
C04	determine the rotary unbalanced mass in reciprocating equipment
C05	determine the unbalanced forces and couples in reciprocating and radial engines
<b>II-II SEM</b>	<b>Course: Thermal Engineering – I</b>
C01	Derive the actual cycle from fuel-air cycle and air- standard cycle for all practical applications.
C02	Explain working principle and various components of IC engine
C03	Explain combustion phenomenon of CI and SI engines and their impact on engine variables.
C04	Analyse the performance of an IC engine based on the performance parameters.
C05	Explain the cycles and systems of a gas turbine and determine the efficiency of gas turbine





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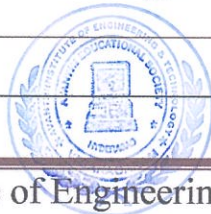
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C06	Explain the applications and working principle of rockets and jet propulsion.
<b>II-II SEM</b>	<b>Course: Industrial Engineering And Management</b>
C01	Design and conduct experiments, analyse, interpret data and synthesize valid conclusions
C02	Design a system, component, or process, and synthesize solutions to achieve desired needs
C03	Use the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for public health and safety, cultural, societal, and environmental constraints
C04	Function effectively within multi-disciplinary teams and understand the fundamental precepts of effective project management
<b>II-II SEM</b>	<b>Course:Mechanics Of Solids And Metallurgy Lab</b>
C01	impart practical exposure on the microstructures of various materials and their hardness evaluation
C02	impart practical knowledge on the evaluation of material properties through various destructive testing procedures.
C03	teach the mechanics of solids lab
<b>II-II SEM</b>	<b>Course:Machine Drawing Practice</b>
C01	Draw and represent standard dimensions of different mechanical fasteners and joints and Couplings.
C02	Draw different types of bearings showing different components
C03	Assemble components of a machine part and draw the sectional assembly drawing showing the dimensions of all the components of the assembly as per bill of materials
C04	Select and represent fits and geometrical form of different mating parts in assembly drawings.
C05	prepare manufacturing drawings indicating fits, tolerances, surface finish and surface treatment requirements
<b>II-II SEM</b>	<b>Course:Theory Of Machines Lab</b>
C01	Determine whirling speed of shaft theoretically and experimentally.
C02	Determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
C03	analyse the motion of a motorized gyroscope when the couple is applied along its spin axis







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<b>II-II SEM</b>	<b>Course:Python Programming Lab</b>
C01	Solve the different methods for linear, non-linear and differential equations
C02	Explain the PYTHON Programming language
C03	Explain the strings and matrices in PYTHON
<b>III-I SEM</b>	<b>Course:Thermal Engineering – II</b>
C01	Explain the basic concepts of thermal engineering and boilers
C02	Discuss the concepts of steam nozzles and steam turbines.
C03	Impart knowledge about the concepts of reaction turbine and steam condensers.
C04	Discuss the concepts of reciprocating and rotary type of compressors.
C05	impart knowledge about the centrifugal and axial flow compressors.
<b>III-I SEM</b>	<b>Course:Design Of Machine Members – II</b>
C01	Compare materials and their properties along with manufacturing considerations.
C02	impart knowledge about the strength of machine elements.
C03	Apply the knowledge in designing the riveted and welded joints, keys,cotters and knuckle joints
C04	Apply the knowledge in designing the shafts and shaft couplings.
C05	Apply the knowledge in designing the mechanical springs.
<b>III-I SEM</b>	<b>Course:Machining, Machine Tools &amp; Metrology</b>
C01	Discuss the concepts of machining processes
C02	Apply the principles of lathe, shaping, slotting and planning machines.
C03	Apply the principles of drilling, milling and boring processes.
C04	Analyze the concepts of finishing processes and the system of limits and fits.
C05	Explain the concepts of surface roughness and optical measuring instruments
<b>III-I SEM</b>	<b>Course:Sustainable Energy Technologies (OE-1)</b>
C01	Explain the importance of solar energy collection and storage.
C02	Apply the principles of wind energy and biomass energy.
C03	Analyze knowledge on geothermal and ocean energy





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C04	Justify the knowledge about energy efficient systems.
C05	Discuss the concepts of green manufacturing systems.
<b>III-I SEM</b>	<b>Course:Operations Research (OE-1)</b>
C01	Apply the basics of operations research and linear programming problems.
C02	Apply the knowledge in solving problems of transportation, assignment and sequencing
C03	Judge the replacement and game theories and apply the knowledge to solve problems
C04	Discuss the waiting line models and project management techniques.
C05	Apply the knowledge in solving problems of dynamic programming and simulation.
<b>III-I SEM</b>	<b>Course:Nano Technology (OE-1)</b>
C01	Explain about nano-structured materials and their applications.
C02	Apply knowledge about the nano crystalline materials, their properties and defects
C03	Justify various techniques of nanofabrication.
C04	Apply the tools to characterize nano materials.
C05	Analyze the applications of nano materials.
<b>III-I SEM</b>	<b>Course:Thermal Management Of Electronic Systems (OE-1)</b>
C01	Apply the basics of heat transfer and analyze heat transfer through fins
C02	Analyze the basics of convection and radiation modes of heat transfer.
C03	Analyze knowledge about the thermal analysis of printed circuit boards and their cooling.
C04	Explain the principles of two-phase cooling and heat pipes.
C05	Justify knowledge about the thermoelectric coolers
<b>III-I SEM</b>	<b>Course:Finite Element Methods (PE-1)</b>
C01	Apply basic principles of finite element methods
C02	Analyze about discretization principles and apply to analyse the trusses.
C03	Apply the finite element method to analyze and solve beam problems.
C04	Explain about two dimensional stress analysis.





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C05	Apply steady state and dynamic analysis.
<b>III-I SEM</b>	<b>Course:Industrial Robotics (PE-1)</b>
C01	Perceive the concepts of robotics and its sytems.
C02	Apply knowledge about the motion analysis and manipulator kinematics.
C03	Analyze the differential transformations.
C04	Apply the basics about path description and generation.
C05	Discuss about the actuators, feedback components and robotic applications.
<b>III-I SEM</b>	<b>Course:: Advanced Materials (PE-1)</b>
C01	Discuss metals and alloys and their utility in different environments.
C02	Judge about polymers and ceramics and their applications.
C03	Analyze composite materials along with reinforcements and their applications
C04	Utilize shape memory alloys and functionally graded materials for different applications.
C05	Discuss about the nanomaterials and their applications
<b>III-I SEM</b>	<b>Course:Renewable Energy Sources (PE-1)</b>
C01	Explain the importance of, solar energy collection and storage.
C02	Discuss the wind energy principles
C03	Analyze about biomass energy concepts.
C04	Apply the principles of tidal energy
C05	Utilize the concepts of geothermal energy.
<b>III-I SEM</b>	<b>Course:Mechanics Of Composites (PE-1)</b>
C01	Discuss the composite materials and their classification.
C02	Apply the micro mechanical analysis of a lamina.
C03	Explain about two dimensional angle lamina
C04	Apply the macro mechanical analysis of a lamina.
C05	Utilize knowledge in designing the laminates.





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<b>III-I SEM</b>	<b>Course:Machine Tools Laboratory</b>
C01	Demonstrate general purpose machine tools in the machine shop.
C02	Perform various operations on lathe machine
C03	Perform different operations on drilling machine.
<b>III-I SEM</b>	<b>Course:Thermal Engineering Lab</b>
C01	Experiment with two stroke and four stroke compression and spark ignition engines for various characteristics
C02	Perceive flash point, fire point, calorific value of different fuels using various apparatus
C03	Perform engine friction, heat balance test, volumetric efficiency, load test of petrol and diesel engines
<b>III-I SEM</b>	<b>Course:Advanced Communication Skills Lab</b>
C01	Use vocabulary and use it contextually
C02	Listen and speak effectively
C03	Develop proficiency in academic reading and writing
<b>III-I SEM</b>	<b>Course:Professional Ethics And Human Values</b>
C01	Explain the concepts of human values
C02	impart knowledge about the principles of engineering ethics.
C03	Interpret engineering as social experimentation
C04	Realize engineers' responsibility for safety and risk.
C05	Discuss the engineers' rights and responsibilities.
<b>III-II SEM</b>	<b>Course:Heat Transfer</b>
C01	Apply knowledge about mechanism and modes of heat transfer
C02	Invstigate the concepts of conduction and convective heat transfer.
C03	Access forced and free convection.
C04	Analyze the concepts of heat transfer with phase change and condensation along with heat exchangers.
C05	Impart the knowledge about radiation mode of heat transfer





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<b>III-II SEM</b>	<b>Course:Design Of Machine Members-Ii</b>
C01	Apply knowledge about the design of bearings
C02	Explain the concepts in designing various engine parts.
C03	Design curved beams and power screws.
C04	Discuss power transmission systems and to design pulleys and gear drives
C05	Apply the concepts in designing various machine tool elements.
<b>III-II SEM</b>	<b>Course:Introduction To Artificial Intelligence &amp; Machine Learning</b>
C01	Discuss basic concepts of artificial intelligence, neural networks and genetic algorithms
C02	Apply the principles of knowledge representation and reasoning.
C03	Explain about bayesian and computational learning and machine learning.
C04	Utilize various machine learning techniques.
C05	Apply the machine learning analytics and deep learning techniques
<b>III-II SEM</b>	<b>Course: Automobile Engineering (PE-2)</b>
C01	Discuss various components of four wheeler automobile
C02	Apply the knowledge of different parts of transmission system.
C03	Compare different steering and suspension systems.
C04	Compare different braking system and electrical system used in automobiles.
C05	Analyse the concepts about engine specifications and service, safety and electronic system used in automobiles
<b>III-II SEM</b>	<b>Course:Smart Manufacturing (PE-2)</b>
C01	Apply the basic concepts of smart manufacturing
C02	Analyze about smart machines and sensors.
C03	Utilize the principles of IoT connectivity to industry 4.0.
C04	Perceive about digital twin and its applications and machine learning and artificial intelligence in manufacturing
C05	Discuss the basic concepts of metaverse





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<b>III-II SEM</b>	<b>Course:Advanced Mechanics Of Solids (PE-2)</b>
C01	Explain the principles of failure criteria.
C02	Determine the stresses and deflection in unsymmetrical bending of beams
C03	Apply the knowledge about curved beam theory.
C04	Interpret the concept of torsion.
C05	Analyze the contact stresses
<b>III-II SEM</b>	<b>Course:: Statistical Quality Control (PE-2)</b>
C01	Discuss the concepts of quality systems and quality engineering in design and processes
C02	Utilize knowledge about the statistical process control charts and sampling techniques.
C03	Analyze the loss function and quality function deployment.
C04	Explain the models of reliability engineering
C05	Apply knowledge about the concepts of complex system and reliability engineering techniques.
<b>III-II SEM</b>	<b>Course:Industrial Hydraulics And Pneumatics (PE-2)</b>
C01	Discuss the principles and laws of fluid power
C02	Discuss the hydraulic and pneumatic elements and their accessories
C03	design the hydraulic and pneumatic circuits.
C04	Apply the principles of hydraulic and pneumatic devices.
C05	Examine knowledge of installation, maintenance and trouble shooting of hydraulic and pneumatic systems
<b>III-II SEM</b>	<b>Course:Industrial Robotics (OE-2)</b>
C01	Explain the basic concepts and components of industrial robotics and automation
C02	Impart the knowledge about robot actuators and feedback components
C03	Analyze the motion of robot and manipulator kinematics.
C04	Analyze the general considerations of path description and generation.
C05	Utilize knowledge about the image processing, machine vision and robotic applications.
<b>III-II SEM</b>	<b>Course:Essentials Of Mechanical Engineering (OE-2)</b>





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C01	Discuss the concepts about stresses and strains.
C02	Identify the components of transmission systems
C03	solve Problems related to project management techniques.
C04	Utilize knowledge about manufacturing processes and materials
C05	Explain the concepts of boilers, steam power plant, petrol and diesel engines.
<b>III-II SEM</b>	<b>Course:Advanced Materials (OE-2)</b>
C01	Explain the metals and alloys and their utility in different environments.
C02	Discuss polymers and ceramics and their applications.
C03	Compare composite materials along with reinforcements and their applications
C04	Use the basics of shape memory alloys and functionally graded materials.
C05	Analyse the knowledge about the nanomaterials and their applications
<b>III-II SEM</b>	<b>Course:Introduction To Automobile Engineering (OE-2)</b>
C01	Explain various components of a four wheeler automobile.
C02	Discuss the different parts of transmission system.
C03	apply the concepts of steering and suspension systems.
C04	Categorise the braking system and electrical system used in automobiles.
C05	Analyze the concepts about engine specifications and service, safety of automobiles.
<b>III-II SEM</b>	<b>Course:Heat Transfer Lab</b>
C01	Determine the heat transfer rate and coefficient.
C02	Determine the thermal conductivity, efficiency and effectiveness
C03	Determine the emissivity and Stefan-Boltzman constant
<b>III-II SEM</b>	<b>Course:CAE &amp; CAM LAB</b>
C01	Experiment with trusses and beams to determine stress, deflection, natural frequencies, harmonic analysis, HT analysis and buckling analysis
C02	Create part programmes using FANUC controller
C03	Apply G-codes for automated tool path using CAM software





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<b>III-II SEM</b>	<b>Course:Measurements &amp; Metrology lab</b>
C01	Demonstrate the calibration experiments with different gauges, transducers, thermocouple and temperature detector
C02	Demonstrate the calibration experiments with rotameter, seismic apparatus.
C03	Demonstrate the calibration experiments with vernier calipers, micrometer, height and dial gauges.
<b>III-II SEM</b>	<b>Course:Artificial Intelligence and Machine Learning Lab</b>
C01	apply the knowledge of artificial intelligence
C02	Explain machine learning models along with image classifiers using various software tools
C03	Explain machine learning models along with automatic facial recognition using various software tools
<b>III-II SEM</b>	<b>Course:Research Methodology and IPR</b>
C01	Discuss objectives and characteristics of a research problem
C02	Analyze research related information and to follow research ethics.
C03	compare types of intellectual property rights.
C04	find the scope of IPR.
C05	Impart the knowledge of new developments in IPR.
<b>IV-I SEM</b>	<b>Course:Mechanical Vibrations (PE-3)</b>
C01	Explain the concepts of vibrational analysis
C02	Compare the concepts of free and forced multi degree freedom systems
C03	Summarize the concepts of torsional vibrations
C04	Solve the problems on critical speed of shafts
C05	Apply and Analyse the systems subjected to Laplace transformations response to different inputs
<b>IV-I SEM</b>	<b>Course:Operations Research (PE-3)</b>
C01	Draw Linear Programming models
C02	Interpret Transportation and sequencing problems
C03	Solve replacement problems and analyze queuing models.





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C04	Analyse game theory and inventory problems
C05	Interpret dynamic programming and simulation
<b>IV-I SEM</b>	<b>Course:Unconventional Machining Processes (PE-3)</b>
C01	Discuss the concepts of modern machining processes
C02	explain the principles of ultrasonic machining.
C03	Apply the principles and procedure of electro chemical and chemical machining processes.
C04	Apply the principles and procedure of thermal metal removal processes
C05	Illustrate the principles and procedure of electron beam machining, laser beam machining and plasma machining
<b>IV-I SEM</b>	<b>Course:Computational Fluid Dynamics (PE-3)</b>
C01	Explain elementary details and numerical techniques for solving various engineering problems involving fluid flow
C02	Apply finite difference applications in heat conduction and convection
C03	Apply finite difference for flow modeling.
C04	Outline concepts of finite volume method
C05	Apply concepts of finite element method applied to heat transfer problems
<b>IV-I SEM</b>	<b>Course:Gas Dynamics And Jet Propulsion (PE-3)</b>
C01	Explain elementary details and numerical techniques for solving various engineering problems involving fluid flow.
C02	Examine finite difference applications in heat conduction and convection
C03	Apply finite difference for flow modeling
C04	Explain the concepts of finite volume method.
C05	Apply concepts of finite element method applied to heat transfer problem
<b>IV-I SEM</b>	<b>Course:Automation In Manufacturing (PE-4)</b>
C01	compare types and strategies and various components in Automated Systems
C02	Classify the types of automated flow lines and analyze automated flow lines
C03	Solve the line balancing problems in the various flow line systems with and without buffer storage
C04	Interpret different automated material handling systems, storage and retrieval





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	systems and automated inspection systems.
C05	compare types of automated inspection techniques and their applications
<b>IV-I SEM</b>	<b>Course:Power Plant Engineering (PE-4)</b>
C01	Identify the different components of the steam power plant for power production.
C02	Illustrate the component used in the diesel and gas power plant for power production
C03	Explain how the power is produced by hydro-electric and nuclear power plants
C04	Interpret the power production by combined power plants and operating principles of different instruments used in power plants
C05	Analyze power plant economics and implementation of pollution standards and control of pollution caused by the power plants.
<b>IV-I SEM</b>	<b>Course:Big Data Analytics (PE-4)</b>
C01	describe characteristics of big data and concepts of Hadoop ecosystem
C02	Design programs for big data applications using Hadoop components
C03	Apply Map reduce programming model to process big data
C04	Analyze Spark and its uses for big data processing
C05	Apply the concepts of NOSQL databases
<b>IV-I SEM</b>	<b>Course:Production Planning And Control (PE-4)</b>
C01	compare different types of production systems and the internal organization of production planning and control
C02	estimate forecasts in the manufacturing and service sectors using selected quantitative and qualitative techniques
C03	Describe the importance and function of inventory and to be able to apply for its control and management
C04	apply routing procedures and differentiate schedule and loading and interpret scheduling policies and aggregate planning
C05	Apply computers in production planning and control
<b>IV-I SEM</b>	<b>Course:Condition Monitoring (PE-4)</b>
C01	List out basics of vibration
C02	Analyze vibration measurement and analysis using transducers and mounting methods
C03	Find fault diagnosis and interpret vibration measurements





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C04	analyse oil and wear debris
C05	Interpret Ultrasonic monitoring and analysis
<b>IV-I SEM</b>	<b>Course:Advanced Manufacturing Processes (PE-5)</b>
C01	Describe the working principles of various surface coating methods.
C02	Discuss novel and promising techniques in the processing of ceramics and composites
C03	Select suitable fabrication methods for MEMS components.
C04	Explain the concepts and principles of nano manufacturing methods.
C05	Illustrate the working principles of RP and select appropriate RP process for the application.
<b>IV-I SEM</b>	<b>Course:Mechatronics (PE-5)</b>
C01	Discuss the use the various mechatronics systems, measurement systems, sensors and transducers
C02	Apply the concepts of solid state electronic devices
C03	Identify the components in the design of electro mechanical systems.
C04	Apply the concepts of digital electronics and applications of PLCs for control
C05	Explain system interfacing, data acquisition and design of mechatronics systems
<b>IV-I SEM</b>	<b>Course: Refrigeration &amp; Air-Conditioning (PE)</b>
C01	Illustrate the operating cycles and different systems of refrigeration
C02	Analyse cooling capacity and coefficient of performance of vapour compression refrigeration systems and understand the fundamentals of cryogenics
C03	Calculate coefficient of performance by conducting test on vapour absorption and steam jet refrigeration systems and understand the properties of refrigerants.
C04	Solve cooling load for air conditioning systems and identify the requirements of comfort air conditioning.
C05	Demonstrate different components of refrigeration and air conditioning systems
<b>IV-I SEM</b>	<b>Course:Additive Manufacturing (PE-5)</b>
C01	Discuss the principles of prototyping, classification of RP processes and liquid-based RP systems
C02	apply different types of solid-based RP systems
C03	Apply powder-based RP systems





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C04	Analyse and apply various rapid tooling techniques
C05	Compare different types of data formats and explore the applications of AM processes in various fields
<b>IV-I SEM</b>	<b>Course:Non Destructive Evaluation (PE-5)</b>
C01	Describe the concepts of various NDE techniques and the requirements of radiographytechniques and safety aspects
C02	Interpret the principles and procedure of ultrasonic testing (BL-2).
C03	Explain the principles and procedure of Liquid penetration and eddy current testing
C04	Illustrate the principles and procedure of Magnetic particle testing.
C05	Interpret the principles and procedure of infrared testing and thermal testing
<b>IV-I SEM</b>	<b>Course:Additive Manufacturing (OE-3)</b>
C01	Describe the principles of prototyping, classification of RP processes and liquid-based RP systems.
C02	Explain different types of solid-based RP systems
C03	discuss powder-based RP systems
C04	Discuss various rapid tooling techniques
C05	Compare different types of data formats and explore the applications of AM processes in various fields
<b>IV-I SEM</b>	<b>Course:Mechatronics (OE-3)</b>
C01	describe the various mechatronics systems, measurement systems, sensors and transducers
C02	Apply the concepts of solid state electronic devices
C03	Identify the components in the design of electro mechanical systems
C04	Explain the concepts of digital electronics and applications of PLCs for control.
C05	Discuss system interfacing, data acquisition and design of mechatronics systems
<b>IV-I SEM</b>	<b>Course:Finite Element Methods (OE-3)</b>
C01	Discuss basic principles of variational methods
C02	Explain the principles of Weighted residual methods
C03	Describe the basic procedure of finite element method
C04	Analyse finite element modeling of two dimensional analysis





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C05	Describe finite modeling using high order and isoparametric elements
<b>IV-I SEM</b>	<b>Course: Introduction To Artificial Intelligence &amp; Machine Learning (OE-3)</b>
C01	Discuss basic concepts of artificial intelligence, neural networks and genetic algorithms.
C02	Apply the principles of knowledge representation and reasoning
C03	Outline Bayesian and computational learning and machine learning
C04	Use various machine learning techniques.
C05	Apply the machine learning analytics and deep learning techniques
<b>IV-I SEM</b>	<b>Course: Optimization Techniques (OE-4)</b>
C01	Explain classification of optimization problem and apply classical optimization techniques
C02	examine unconstrained optimization techniques using various methods
C03	Describe the characteristics and approaches of constrained optimization techniques
C04	Identify optimized solutions using constrained and unconstrained geometric programming
C05	Discuss different integer programming methods
<b>IV-I SEM</b>	<b>Course: Smart Manufacturing (OE-4)</b>
C01	discuss smart manufacturing systems' components and can handle it more effectively in context of Industry 4.0
C02	Describe the smart machines and smart sensors
C03	Apply IoT to Industry 4.0 and they are able to make a system tailor-made as per requirement of the industry
C04	Explain concepts of Digital Twin and able to apply Machine Learning and Artificial Intelligence concepts in Manufacturing
C05	Compare concepts of AR/VR and Metaverse platform
<b>IV-I SEM</b>	<b>Course: Safety Engineering (OE-4)</b>
C01	Describe the concepts of industrial safety and management
C02	Discuss the smart machines and smart sensors
C03	Apply IoT to Industry 4.0 and they are able to make a system tailor-made as per requirement of the industry
C04	Compare fire prevention and protection systems





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C05	apply the fire safety principles in buildings
<b>IV-I SEM</b>	<b>Course: Operations Management (OE-4)</b>
C01	Apply appropriate forecasting techniques & Aggregate planning methods
C02	Compare Materials management analysis and scheduling policies
C03	Explain inventory control techniques, MRP and contemporary management techniques
C04	Apply quality management principles proposed by Taguchi, Juran & Demigs
C05	Apply optimization to LP model & transportation and assignment problems
<b>IV-I SEM</b>	<b>Course: Mechatronics Lab</b>
C01	Explain Characteristics of LVDT
C02	Find load, displacement and temperature using analogue and digital sensors
C03	Develop PLC programs for control of traffic lights, water level, lifts and conveyor belts.
<b>IV Sem -II</b>	<b>Project</b>
CO-1	Formulate., and apply mathematical, science and engineering principles to solve real time engineering problems
CO-2	Test the existing data, communicate and conduct research on complex problems using modern tools
CO-3	Validate the obtained results on contemporary issues related to society and environment
CO-4	Determine effectively the engineering principles used in their project individually and as a team as per the norms of engineering practice
CO-5	Structure future work to promote life long learning in the context of technological adaptation.



  
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