AURORA'S TECHNOLOGICAL AND RESEARCH INSTITUTE
(Approved by AICTE and Affiliated to JNTUH) (Accredited by NAAC with 'A' Grade)
Parvathapur, Uppal, Medipally (M), Medchal (D), Telangana, Hyderabad - 500 098

DEPARTMENT OF MECHANICAL ENGINEERING
COURSE OUTCOMES (COs)
B.Tech. I Year I Sem R18 Syllabus Mechanical Engineering

Course Code	Course Title / Name	Course Outcomes
MA101BS	Mathematics – I	**At the end of this course, each student should beable to:** **CO1:**Write the matrix representation of a set of linear equations and to analyse the solution of the system of equations **CO2:**Find the Eigen values and Eigen vectors **CO3:**Reduce the quadratic form to canonical form Using orthogonal transformations. **CO4:**Analyse the nature of sequence and series. **CO5:**Solve the applications on the mean value theorems. **CO6:**Evaluate the improper integrals using Beta and Gamma functions **CO7:**Find the extreme values of functions of two Variables with/ without constraints.
PH102BS	Engineering Physics	**At the end of this course, each student should beable to:** **CO1:**The knowledge of Physics relevant to engineering Is critical for converting ideas into technology. **CO2:**An understanding of Physics also helps engineers understand the working and limitations of existing devices and techniques, which eventually leads to new innovations and improvements. **CO3:**In the present course, the students can gain knowledge on the mechanism of physical bodies upon the action of forces on them, the generation, transmission and the detection of the waves, Optical Phenomena like Interference, diffraction, the principles of lasers and Fibre Optics. **CO4:**Various chapters establish a strong foundation on

		the different kinds of characters of several materials and pave a way for them to use in at various technical and engineering applications.
CS103ES/CS203ES	Programming For Problem Solving	**At the end of this course, each student should beable to:** **CO1:**To write algorithms and to draw flowcharts for solving problems. **CO2:**To convert the algorithms/flowcharts to C programs. **CO3:**To code and test a given logic in C programming language. To decompose a problem into functions and to develop modular reusable code. **CO4:**To use arrays, pointers, strings and structures to write C programs. **CO5:**Searching and sorting problems.
ME104ES/ME204ES:	Engineering Graphics	**At the end of this course, each student should beable to:** **CO1:**Preparing working drawings to communicate the ideas and information. **CO2:**Read, understand and interpret engineering drawings.
PH105BS	Engineering Physics Lab	**At the end of this course, each student should beable to:** **CO1 :** Apply the various procedures and techniquesfor the experiments. **CO2 :** Use the different measuring devices and meters to record the data with precision. **CO3 :** Apply the mathematical concepts/equationsto obtain quantitative results. **CO4 :** Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.

CS106ES/CS206ES	Programming For Problem Solving Lab	**The experiments will make the student gain skills on:** **CO1:**Formulate the algorithms for simple problems **CO2:**Translate given algorithms to a working and correct program **CO3:**Correct syntax errors as reported by the compilers **CO4:**Identify and correct logical errors encountered during execution **CO5:**Represent and manipulate data with arrays, strings and structures **CO6:**Use pointers of different types **CO7:**Create, read and write to and from simple text and binary files **CO8:**Modularize the code with functions so that they can be reused
MC109ES	Environmental Science	**At the end of this course, each student should beable to:** **CO1:**Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

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Course Code	Course Title / Name	Course Outcomes
MA201BS	Mathematics - II	**At the end of this course, each student should beable to:** **CO1:**Identify whether the given differential equation of first order is exact or not **CO2:**Solve higher differential equation and apply the concept of differential equation to real world problems **CO3:**Evaluate the multiple integrals and apply the concept to find areas, volumes, centre of mass and Gravity for cubes, sphere and rectangular parallelopiped **CO4:**Evaluate the line, surface and volume integrals and converting them from one to another
CH102BS/CH202BS	Chemistry	**At the end of this course, each student should beable to:** **CO1:**The knowledge of atomic, molecular and electronic changes, band theory related to conductivity. **CO2:**The required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments. **CO3:**The required skills to get clear concepts on basic spectroscopy and application to medical and other fields. **CO4:**The knowledge of configurational and conformational analysis of molecules and reaction mechanisms
ME203ES	Engineering Mechanics	**At the end of this course, each student should beable to:** **CO1:**Determine resultant of forces acting on a body and analyse equilibrium of a body subjected to a system of forces. **CO1:**Solve problem of bodies subjected to friction. **CO2:**Find the location of centroid and calculate moment of inertia of a given section. **CO3:**Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, rotator

		motion and rigid body motion. **CO4:**Solve problems using work energy equations for translation, fixed axis rotation and plane motion and solve problems of vibration.
ME105ES/ME 205ES	Engineering Workshop	**At the end of this course, each student should beable to:** **CO1:**Study and practice on machine tools and their operations Practice on manufacturing of components using workshop trades including **CO2:**Pluming, fitting, carpentry, foundry, house wiring and welding. **CO3:**Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling. **CO4:**Apply basic electrical engineering knowledge for house wiring practice.
EN105HS/EN2 05HS	English	**At the end of this course, each student should beable to:** **CO1:**Use English Language effectively in spoken and written forms. **CO2:**Comprehend the given texts and respond appropriately. Communicate confidently in various contexts and different cultures. **CO3:**Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
CH106BS/CH2 06BS	Engineering Chemistry Lab	**The experiments will make the student gain skills on:** **CO1:**Determination of parameters like hardness and chloride content in water. **CO2:**Estimation of rate constant of a reaction from concentration – time relationships. **CO3:**Determination of physical properties like adsorption and viscosity. **CO4:**Calculation of Rf values of some organic molecules by TLC technique.
EN107HS/EN2 07HS	English Language And Communication Skills Lab	**Students will be able to attain:** **CO1:**Better understanding of nuances of English language through audio- visual experience and group activities **CO2:**Neutralization of accent for intelligibility **CO3:**Speaking skills with clarity and confidence which in turn enhances their employability skills

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Course Code	Course Title / Name	Course Outcomes
MA301BS	Probability and Statistics& Complex Variables	**At the end of this course, each student should beable to:** **CO1:** Formulate and solve problems involving random variables and apply statistical methodsfor analysing experimental data. **CO2:** Analyse the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems. **CO3:** Taylor's and Laurent's series expansions of complex function.
ME302PC	Mechanics of Solids	**At the end of this course, each student should beable to:** **CO1:** Analyze the behavior of the solid bodies subjected to various types of loading; **CO2:** Apply knowledge of materials and structural elements to the analysis of simple structures; **CO3:** Undertake problem identification, formulation and solution using a range of analytical methods; **CO4:** Analyze and interpret laboratory data relatingto behavior of structures and the materials they are made of, and undertake associated laboratory work individually and in teams. **CO5:** Expectation and capacity to undertake lifelong Learning

ME303PC	Material Science and Metallurgy	**At the end of this course, each student should beable to:** **CO1:** Analyze the Structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, APF (Atomic Packing Factor), Co-ordination Number etc. **CO2:** Understand concept of mechanical behavior of materials and calculations of same using appropriate equations. **CO3:** Explain the concept of phase & phase diagram& understand the basic terminologies associated with metallurgy. Construction and identification of phase diagrams and reactions **CO4:** Understand and suggest the heat treatment process & types. Significance of properties Vs microstructure. Surface hardening & its types. Introduce the concept of hardenability & demonstrate the test used to find hardenabilityof steels **CO5:** Explain features, classification, applications of newer class materials like smart materials, piezoelectric materials, biomaterials, composite materials etc
ME304PC	Production Technology	**At the end of this course, each student should beable to:** **CO1:** Understand the idea for selecting materials for patterns. **CO2:** Know Types and allowances of patterns used in casting and analyze the components of moulds. **CO3:** Design core, core print and gating system in metal casting processes **CO4:** Understand the arc, gas, solid state andresistance welding processes. **CO5:** Develop process-maps for metal forming processes using plasticity principles. **CO6:** Identify the effect of process variables to manufacture defect free products.

ME305PC	Thermodynamics	**At the end of this course, each student should beable to:** At the end of the course, the student should be able to Understand and differentiate between different thermodynamic systems and processes. Understand and apply the laws of Thermodynamics to different types of systems undergoing various processes and to perform thermodynamic analysis. Understand and analyze the Thermodynamic cycles and evaluate performance parameters.
ME306PC	Production Technology Lab	**At the end of this course, each student should beable to:** Understanding the properties of moulding sands and pattern making. Fabricate joints using gas welding and arc welding. Evaluate the quality of welded joints. Basic idea of press working tools and performs moulding studies on plastics.
ME307PC	Machine Drawing Practice	**At the end of this course, each student should beable to:** **CO1:** Preparation of engineering and working drawings with dimensions and bill of material during design and development. Developing assembly drawings using part drawings of machine components. **CO2:** Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs. **CO3:** Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned. **CO4:** Methods of dimensioning, general rules for sizes and placement of dimensions for holes,centers, curved and tapered features. **CO5:** Title boxes, their size, location and details - common abbreviations and their liberal usage **CO6:** Types of Drawings – working drawings for machine parts.

ME308PC	Material Science and Mechanics of Solids Lab	**At the end of this course, each student should beable to:** The Primary focus of the Metallurgy and Material science program is to provide undergraduates with a fundamental knowledge based associated materials properties, and their selection and application. Upon graduation, students would have acquired and developed the necessary background and skills for successful careers in the materials-related industries. Furthermore, after completing the program, the student should be well prepared for management positions in industry or continued education toward a graduate degree.
*MC309	Constitution of India	**At the end of this course, each student should beable to:** **CO1 :** Able to understand historical background of the constitutional making and its importance for building a democratic India, the structureof Indian government, the structure of state government, the local Administration. **CO2:** Able to apply the knowledge on directive principle of state policy, the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy. **CO3:** Able to analyze the History, features of Indian constitution, the role Governor and Chief Minister, role of state election commission, the decentralization of power between central, state and local self-government. **CO4:** Able to evaluate Preamble, Fundamental Rights and Duties, Zilla Panchayat, block level organization, various commissions of viz SC/ST/OBC and women.

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Course Code	Course Title / Name	Course Outcomes
EE401ES	Basic Electrical and Electronics Engineering	**At the end of this course, each student should beable to:** **CO1:** To analyze and solve electrical circuits using network laws and theorems. **CO2:** To understand and analyze basic Electric and Magnetic circuits **CO3:** To study the working principles of Electrical Machines **CO4:** To introduce components of Low Voltage Electrical Installations **CO5:** To identify and characterize diodes and various types of transistors.
ME402PC	Kinematics of Machinery	**At the end of this course, each student should beable to:** The main purpose is to give an idea about the relative motions obtained in all the above type of components used in mechanical Engineering.
ME403PC	Thermal Engineering - I	**At the end of this course, each student should beable to:** At the end of the course, the student should be able to evaluate the performance of IC engines and compressors under the given operating conditions. Apply the laws of Thermodynamics to evaluate the performance of Refrigeration and air-conditioning cycles. Understand the functionality of the major components of the IC Engines and effects of operating conditions on their performance
ME404PC	Fluid Mechanics and Hydraulic Machines	**At the end of this course, each student should beable to:** **CO1:** Able to explain the effect of fluid properties ona flow system. **CO2:** Able to identify type of fluid flow patterns and describe continuity equation. **CO3:** To analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanics principles in design.

		CO4: To select and analyze an appropriate turbinewith reference to given situation in power plants. **CO5:** To estimate performance parameters of a given Centrifugal and Reciprocating pump. **CO6:** Able to demonstrate boundary layer concepts.
ME405PC	Instrumentation and Control Systems	**At the end of this course, each student should beable to:** **CO1:** To identify various elements and their purposein typical instruments, to identify various errors that would occur in instruments. **CO2:** Analysis of errors so as to determine correction factors for each instrument. **CO3:** To understand static and dynamic characteristics of instrument and should be able to determine loading response time. **CO4:** For given range of displacement should be able to specify transducer, it accurate and loading time of that transducer.
ME406PC	Basic Electrical and Electronics Engineering Lab	**At the end of this course, each student should beable to:** **CO1:** To analyze and solve electrical circuits using network laws and theorems. **CO2:** To understand and analyze basic Electric and Magnetic circuits **CO3:** To study the working principles of Electrical Machines **CO4:** To introduce components of Low Voltage Electrical Installations **CO5:** To identify and characterize diodes and various types of transistors.
ME407PC	Fluid Mechanics and Hydraulic Machines Lab	**At the end of this course, each student should beable to:** **CO1:** Able to explain the effect of fluid properties ona flow system. **CO2:** Able to identify type of fluid flow patterns and describe continuity equation. **CO3:** To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics

		principles in design. **CO4:** To select and analyze an appropriate turbinewith reference to given situation in power plants. **CO5:** To estimate performance parameters of a given Centrifugal and Reciprocating pump. **CO6:** Able to demonstrate boundary layer concepts
ME408PC	Instrumentation and Control Systems Lab	**At the end of this course, each student should beable to:** At the end of the course, the student will be able to Characterize and calibrate measuring devices. Identify and analyze errors in measurement. Analyze measured data using regression analysis. Calibration of Pressure Gauges, temperature, LVDT, capacitive transducer, rotameter.
*MC409	Gender Sensitization Lab	**At the end of this course, each student should beable to:** **At the end of this course, each student should beable to:** **CO1:** Students will have developed a better understanding of important issues related to gender in contemporary India. **CO2:** Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film. **CO3:** Students will attain a finer grasp of how gender discrimination works in our society and how to counter it. **CO4:** Students will acquire insight into the gendered division of labour and its relation topolitics and economics. **CO5:** Men and women students and professionals will be better equipped to work and live together as equals. **CO6:** Students will develop a sense of appreciation of women in all walks of life.

		CO7: Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence

B.Tech. III Year I Sem R18 Syllabus Mechanical Engineering

Course Code	Course Title / Name	Course Outcomes
ME501PC	Dynamics of Machinery	**At the end of this course, each student should beable to:** The study of KOM & DOM are necessary to have an idea while designing the various machine members like shafts, bearings, gears, belts & chains and various I.C. Engine Components & Machine tool parts.
ME502PC	Design of Machine Members-I	**At the end of this course, each student should beable to:** **CO1:** The student acquires the knowledge about the principles of design, material selection, component behavior subjected to loads, and criteria of failure. **CO2:** Understands the concepts of principal stresses, stress concentration in machine members and fatigue loading. **CO3:** Design on the basis of strength and rigidity and analyze the stresses and strains induced in a machine element.
ME503PC	Metrology & Machine Tools	**At the end of this course, each student should beable to:** **CO1:** Identify techniques to minimize the errors in measurement. **CO2:** Identify methods and devices for measurementof length, angle, gear & thread parameters, surface roughness and geometric features of parts. **CO3:** Understand working of lathe, shaper, planer, drilling, milling and grinding machines. **CO4:** Comprehend speed and feed mechanisms of machine tools. **CO5:** Estimate machining times for machining operations on machine tools
SM504MS	Business Economics & Financial Analysis	**At the end of this course, each student should beable to:** The students will understand the various Forms of Business and the impact of economic variables on

		the Business. The Demand, Supply, Production, Cost, Market Structure, Pricing aspects are learnt. The Students can study the firm's financial position by analysing the Financial Statements of a Company.
ME505PC	Thermal Engineering-II	**At the end of this course, each student should beable to:** **CO1:** Develop state – space diagrams based on the schematic diagrams of process flow of steam and gas turbine plants **CO2:** Apply the laws of Thermodynamics to analyze thermodynamic cycles **CO3:** Differentiate between vapour power cycles and gas power cycles **CO4:** Infer from property charts and tables and to apply the data for the evaluation of performance parameters of the steam and gas turbine plants **CO5:** Understand the functionality of major components of steam and gas turbine plantsand to do the analysis of these components
ME506PC	Operations Research	**At the end of this course, each student should beable to:** Understanding the problem, identifying variables & constants, Formulation of optimization model and applying appropriate optimization technique
ME507PC	Thermal Engineering Lab	**At the end of this course, each student should beable to:** **CO1:** Appreciate the practical ways to find calorific values of fuel. **CO2:** Understand the various components and mechanisms of I. C. Engines. Appreciate the Mechanism of ports /Valves functioning in 2-stroke petrol /Diesel engine. **CO3:** Evaluating the performance characteristics of single cylinder petrol engine at different loads and single cylinder diesel engine at different loads and draw the heat balance sheet. **CO4:** Understand the method of finding the indicated power of individual cylinders of an engine by

		using morse test. **CO5:** Understand the method of evaluating the co efficient of performance of refrigerator. **CO6:** Understand the method of finding the thermal conductivity of material.
ME508PC	Metrology & Machine Tools Lab	**At the end of this course, each student should beable to:** **CO1:** Perform plain turning, step turning and Grooving on a circular rod **CO2:** Perform the step turning and taper turning on a circular rod **CO3:** Perform thread cutting and knurling on a circular C.S rod and using the lathe machine **CO4:** Drill a hole and perform tapping once givenwork piece. **CO5:** Slotting operation on a given specimen **CO6:** Surface finish of given work piece **CO7:** Shaping of square block, V- groove **CO8:** Measure the length and diameter using vernier calipers **CO9:** Determine angle of given specimen
ME509PC	Kinematics & Dynamics Lab	**At the end of this course, each student should beable to:** **CO1:** Understand types of motion **CO2:** Analyze forces and torques of components in linkages **CO3:** Understand static and dynamic balance **CO4:** Understand forward and inverse kinematics of open-loop mechanisms
*MC510	Intellectual Property Rights	**At the end of this course, each student should beable to:** **CO1:** Identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP. **CO2:** Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development.

		CO3: Identify activities and constitute IP infringements and the remedies available to the IP owner and describe the precautious steps to be taken to prevent infringement of proprietary rights in products and technologydevelopment. **CO4:** Be familiar with the processes of Intellectual Property Management (IPM) and various approaches for IPM and conducting IP and IPM auditing and explain how IP can be managed as a strategic resource and suggestIPM strategy. **CO5:** Be able to anticipate and subject to critical analysis arguments relating to the development and reform of intellectual property right institutions and their likely impact on creativity and innovation. **CO6:** Be able to demonstrate a capacity to identify, apply and assess ownership rights and marketing protection under intellectual property law as applicable to information, ideas, new products and product marketing;

B.Tech. III Year II Sem R18 Syllabus Mechanical Engineering

Course Code	Course Title / Name	Course Outcomes
ME601PC	Design of Machine Members-II	**At the end of this course, each student should beable to:** **CO1:** Knowledge about journal bearing design using different empirical relations. **CO2:** Estimation of life of rolling element bearings and their selection for given service conditions. **CO3:** Acquaintance with design of the components asper the standard, recommended procedures which is essential in design and development of machinery in industry.
ME602PC	Heat Transfer	**At the end of this course, each student should beable to:** **CO1:** Understand the basic modes of heat transfer **CO2:** Compute one dimensional steady state heat transfer with and without heat generation **CO3:** Understand and analyze heat transfer through extended surfaces **CO4:** Understand one dimensional transient conduction heat transfer **CO5:** Understand concepts of continuity, momentum and energy equations **CO6:** Interpret and analyze forced and free convective heat transfer **CO7:** Understand the principles of boiling, condensation and radiation heat transfer **CO8:** Design of heat exchangers using LMTD and NTU methods
ME603PC	CAD & CAM	**At the end of this course, each student should beable to:** Understand geometric transformation techniques in CAD. Develop mathematical models to represent curves and surfaces. Model engineering components using solid modeling techniques. Develop programs for CNC to manufacture industrial components. To understand the application of computers in various

		aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.
ME611PE	Professional Elective – I Unconventional Machining Processes	**At the end of this course, each student should beable to:** **CO1:** Understand the basic techniques of Unconventional Machining processes modeling **CO1:** Estimate the material removal rate and cutting force, in an industrially useful manner, for Unconventional Machining processes.
ME612PE	Professional Elective – I Machine Tool Design	**At the end of this course, each student should beable to:** At the end of the course, the student will be able to, understand basic motions involved in a machine tool, design machine tool structures, design and analyze systems for specified speeds and feeds, select subsystems for achieving high accuracy in machining, understand control strategies for machine tool operations and apply appropriate quality tests for quality assurance.
ME613PE	Professional Elective – I Production Planning & Control	**At the end of this course, each student should beable to:** At the end of the course, the student will be able to understand production systems and their characteristics. Evaluate MRP and JIT systems against traditional inventory control systems. Understand basics of variability and its role in the performance of a production system. Analyze aggregate planning strategies. Apply forecasting and scheduling techniques to production systems. Understand theory of constraints for effective management of production systems.
	Open Elective - I	
ME604PC	Finite Element Methods	**At the end of this course, each student should beable to:** At the end of the course, the student will be able to, Apply finite element method to solve problems in solid mechanics, fluid mechanics and heat transfer. Formulate and solve problems in one dimensional

		structures including trusses, beams and frames. Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axisymmetric and plate bending problems. ANSYS, ABAQUS, NASTRAN, etc.
ME605PC	Heat Transfer Lab	**At the end of this course, each student should beable to:** **CO1:** Perform steady state conduction experimentsto estimate thermal conductivity of different materials **CO2:** Perform transient heat conduction experiment **CO3:** Estimate heat transfer coefficients in forced convection, free convection, condensation and correlate with theoretical values **CO4:** Obtain variation of temperature along the length of the pin fin under forced and free convection **CO5:** Perform radiation experiments: Determine surface emissivity of a test plate and Stefan-Boltzmann's constant and compare with theoretical value
ME606PC	CAD & CAM Lab	**At the end of this course, each student should beable to:** To understand the analysis of various aspects in of manufacturing design
EN608HS	Advanced Communication Skills lab	**At the end of this course, each student should beable to:** **CO1:** To improve fluency in English through a well developed vocabulary and enable them to listen at normal conservational speed by educated English speakers and respond appropriately in different socio cultural and professional context **CO2:** Further, they would be required to communicate their ideas relevantly and coherently in writing **CO3:** To prepare all the students for their placements **CO4:** Learn to overcome stage fear and make

		presentations with ease **CO5:** Learn how to pronounce words using the rules they have been taught
*MC609	Environmental Science	**At the end of this course, each student should beable to:** Based on this course, the Engineering graduate will understand /evaluate / develop technologies on thebasis of ecological principles and environmental regulations which in turn helps in sustainable development

B.Tech. IV Year I Sem R18 Syllabus Mechanical Engineering

Course Code	Course Title / Name	Course Outcomes
ME701PC	Refrigeration And Air Conditioning	**At the end of this course, each student should beable to:** Differentiate between different types of refrigeration systems with respect to application as well as conventional and unconventional refrigeration systems. Thermodynamically analyse refrigeration and air conditioning systems and evaluate performance parameters. Apply the principles of Psychometrics to design the air conditioning loads for the industrial applications.
ME711PE	**Professional Elective – II** Additive Manufacturing	**At the end of this course, each student should beable to:** **CO1:**Describe various CAD issues for 3D printing and rapid prototyping and related operations for STL model manipulation. **CO2:**Formulate and solve typical problems on reverse engineering for surface reconstruction from physical prototype models through digitizing and spline-based surface fitting. **CO3:**Formulate and solve typical problems on reverse engineering for surface reconstruction from digitized mesh models through topological modelling and subdivision surface fitting. **CO4:**Explain and summarize the principles and key characteristics of additive manufacturing technologies and commonly used 3D printing and additive manufacturing systems. **CO5:**Explain and summarize typical rapid tooling processes for quick batch production of plastic and metal parts.

ME712PE/MT821PE	**Professional Elective – II** Automation In Manufacturing	**At the end of this course, each student should beable to:**
ME713PE	**Professional Elective – II** MEMS	**CO1:**Students will be able to understand working principles of currently available micro sensors, actuators, and motors, valves, pumps, and fluidics used in Microsystems. **CO2:**Students will be able to apply scaling laws that are used extensively in the conceptual design of micro devices and systems. **CO3:**Students will be able to differentiate between the positive and negative consequences of scaling down certain physical quantities that are pertinent to Microsystems. **CO4:**Students will be able to use materials for common micro components and devices. **CO5:**Students will be able to choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process. Students will be able to understand the basic principles and applications of micro-fabrication processes, such as photolithography, ion implantation, diffusion, oxidation, CVD, PVD, and etching. **CO6:**Students will be able to consider recent advancements in the field of MEMS and devices. **CO7:**Students will be able communicate their results and findings orally via formal presentations and in writing through reports.

ME721PE	**Professional Elective– III** Power Plant Engineering	**At the end of this course, each student should beable to:** **CO1:**Understand the concept of Rankine cycle. **CO2:**Understand working of boilers including water tube, fire tube and high pressure boilers and determine efficiencies. **CO3:**Analyze the flow of steam through nozzles Evaluate the performance of condensers and steam turbines **CO4:**Evaluate the performance of gas turbines
MT701PC/ME722PE	**Professional Elective– III** Automobile Engineering	**At the end of this course, each student should beable to:**
ME723PE	**Professional Elective– III** Renewable Energy Sources	**At the end of this course, each student should beable to:** **CO1:**Understanding of renewable energy sources **CO2:**Knowledge of working principle of various energy systems **CO3:**Capability to carry out basic design of renewable energy systems
ME731PE	**Professional Elective– IV** Computational Fluid Dynamics	**At the end of this course, each student should beable to:** **CO1:**Differentiate between different types of Partial Differential Equations and to know and understand appropriate numerical techniques. **CO2:**Solve the simple heat transfer and fluid flow problems using different numerical techniques, viz., FDM. **CO3:**Understand and to appreciate the need for validation of numerical solution

ME732PE	**Professional Elective– IV** Turbo Machinery	**At the end of this course, each student should beable to:** **CO1:**Ability to design and calculate different parameters for turbo machines **CO2:**Prerequisite to CFD and Industrial fluid power courses **CO3:**Ability to formulate design criteria **CO4:**Ability to understand thermodynamics and kinematics behind turbo machines
ME733PE	**Professional Elective– IV** Fluid Power Systems	**At the end of this course, each student should beable to:** **CO1:**Understand the Properties of fluids, Fluids for hydraulic systems, governing laws. distribution of fluid power, Design and analysis of typical hydraulic circuits. **CO2:**Know accessories used in fluid power system, Filtration systems and maintenance of system.
	Open Elective-II	Please Refer to ANNEXURE-I
ME702PC	**Industrial Oriented Mini Project/ Summer Internship**	**At the end of this course, each student should beable to:** **CO1:**Formulate a real world problem and develop its Requirements. **CO2:**Student will be exposed to industrial Awareness **CO3:**Self learning technologies, methods and/or techniques that contribute to the software solution of the project.
ME703PC	**Seminar**	**At the end of this course, each student should be able to:** **CO1:**Ability to work in actual working environment. **CO2:**Ability to utilize technical resources **CO3:**Ability to write technical documents and give oral presentations related to the work completed
ME704PC	**Project Stage - I**	**At the end of this course, each student should beable to:** **CO1:**Formulate a real world problem and develop its Requirements. **CO2:**Student will be exposed to industrial awareness **CO3:**Self learning technologies, methods and/or techniques that contribute to the software solution of the project.

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Course Code	Course Title / Name	Course Outcomes
ME811PE	**Professional Elective–V** Industrial Robotics	**At the end of this course, each student should beable to:** **CO1:**Understand the basic components of robots **CO2:**Differentiate types of robots and robot grippers. **CO3:**Model forward and inverse kinematics of robot manipulators. **CO4:**Analyze forces in links and joints of a robot. Programme a robot to perform tasks in industrial applications. **CO5:**Design intelligent robots using sensors.
ME812PE	**Professional Elective–V** Mechanical Vibrations	**At the end of this course, each student should beable to:** **CO1:**Understand the causes and effects of vibration in mechanical systems. **CO2:**Develop schematic models for physical systems and formulate governing equations of motion. **CO3:**Understand the role of damping, stiffness and inertia in mechanical systems Analyze rotating and reciprocating systems and compute critical speeds. **CO4:**Analyze and design machine supporting structures, vibration isolators and absorbers.
MM813PE:	**Professional Elective–V** Composite Materials	**At the end of this course, each student should beable to:** **CO1:**:Knowledge of the crystal structures of a wide range of ceramic materials and glasses. **CO2:**Able to explain how common fibers are produced and how the properties of the fibers are related to the internal structure. **CO3:**Able to select matrices for composite materials in different applications. **CO4:**Able to describe key processing methods for fabricating composites.
ME821PE:	**Professional Elective–VI** Industrial Management	**At the end of this course, each student should beable to:** **CO1:**Able to apply principles of management

		CO2: Able to design the organization structure **CO3:**Able to apply techniques for plant location, design plant layout and value analysis **CO4:**Able to carry out work study to find the best method for doing the work and establish standard time for a given method **CO5:**Able to apply various quality control techniques and sampling plans **CO6:**Able to do job evaluation and network analysis.
ME822PE	**Professional Elective–VI** Production And Operations Management	**At the end of this course, each student should beable to:** **CO1:**Able to execute operations management functions **CO2:**Able to carry out value analysis **CO3:**Able to carry out aggregate planning and Implement MRP Or JIT **CO4:**Able to schedule the jobs so as to complete them in minimum make span time **CO5:**Able to carry out network analysis
ME833PE	**Professional Elective–VI** Tribology	**At the end of this course, each student should beable to:** **CO1:**Understanding friction characteristics in journal bearings. **CO2:**Knowledge about different theories of lubrication to reduce friction and wear.
	Open Elective-III	Please Refer to ANNEXURE-I
ME801PC	**Project Stage – II**	**At the end of this course, each student should beable to:** **CO1:**Formulate a real world problem and develop its Requirements. **CO2:**Student will be exposed to industrial awareness **CO3:**Self learning technologies, methods and/or techniques that contribute to the software solution of the project.

Annexure-I

Open Elective –I

(Common for EEE, ECE, CSE, IT, ME)

Course Code	Course Title / Name	Course Outcomes
CE600OE	**Open Elective –I** Disaster Preparedness &Planning Management	**At the end of this course, each student should beable to:** **CO1:**The application of Disaster Concepts to Management **CO2:**Analyzing Relationship between Development and Disasters. **CO3:**Ability to understand Categories of Disasters **CO4:**Realization of the responsibilities to society
CS600OE	**Open Elective –I** Entrepreneurship	**At the end of this course, each student should beable to:** It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.
CS601OE	**Open Elective –I** Fundamentals of Management for Engineers	**At the end of this course, each student should beable to:** The students understand the significance of Management in their Profession. The various Management Functions like Planning, Organizing, Staffing, Leading, Motivation and Control aspects are learnt in this course. The students can explore the Management Practices in their domain area.
CS602OE	**Open Elective –I** Cyber Law & Ethics	**At the end of this course, each student should beable to:** **CO1:**The students will understand the importance of professional practice, Law and Ethics in their personal lives and professional careers. **CO2:**The students will learn the rights and responsibilities as an employee, team member and a global citizen
EC600OE	**Open Elective –I** Fundamentals of Internet of Things	**At the end of this course, each student should beable to:** **CO1:** Known basic protocols in sensor networks. **CO2:**Program and configure Arduino boards for various designs.

		CO3: Python programming and interfacing for Raspberry Pi. **CO4:** Design IoT applications in different domains
EE600OE	**Open Elective –I** Reliability Engineering	**At the end of this course, each student should beable to:** **CO1:**Model various systems applying reliability networks **CO2:**Evaluate the reliability of simple and complex systems **CO3:**Estimate the limiting state probabilities of repairable systems **CO4:**Apply various mathematical models for evaluating reliability of irreparable systems
EE601OE	**Open Elective –I** Renewable Energy Sources	**At the end of this course, each student should beable to:** **CO1:**Understand the principles of wind power and solar photovoltaic power generation, fuel cells. **CO2:**Assess the cost of generation for conventional and renewable energy plants **CO3:**Design suitable power controller for wind and solar applications **CO4:**Analyze the issues involved in the integration of renewable energy sources to the grid
ME600OE	**Open Elective –I** Quantitative Analysis for Business Decisions	**At the end of this course, each student should beable to:** **CO1:**Familiar with issues that would crop up in business **CO2:**Able to formulate Mathematical Model to resolve the issue **CO3:**Able to select technique for solving the formulated Mathematical Model **CO4:**Able to analyze the results obtained through the selected technique for implementation.

Open Elective –II

(Common for EEE, ECE, CSE, IT, ME)

Course Code	Course Title / Name	Course Outcomes
CS700OE	**Open Elective –II** Data Structures	**At the end of this course, each student should beable to:** **CO1:**Ability to select the data structures that efficiently model the information in a problem. **CO2:**Ability to assess efficiency trade-offs among different data structure implementations or combinations. **CO3:**Implement and know the application of algorithms for sorting and pattern matching. **CO4:**Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and AVL-trees.
CS701OE	**Open Elective –II** Artificial Intelligence	**At the end of this course, each student should beable to:** **CO1:**Ability to formulate an efficient problem space for a problem expressed in natural language. **CO2:**Select a search algorithm for a problem and estimate its time and space complexities. **CO3:**Possess the skill for representing knowledge using the appropriate technique for a given problem. **CO4:**Possess the ability to apply AI techniques to solve problems of game playing, and machine learning.
CS702OE	**Open Elective –II** Python Programming	**At the end of this course, each student should beable to:** **CO1:**Examine Python syntax and semantics and be fluent in the use of Python flow control and functions. **CO2:**Demonstrate proficiency in handling Strings and File Systems. **CO3:**Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions. **CO4:**Interpret the concepts of Object-Oriented

		Programming as used in Python. **CO5:**Implement exemplary applications related to Network Programming, Web Services and Databases in Python.
CS703OE	**Open Elective –II** Java Programming	**At the end of this course, each student should beable to:** **CO1:**Develop Programs with reusability Develop programs to handle multitasking **CO2:**Develop programs to handle exceptions **CO3:**Develop applications for a range of problems using object-oriented programming techniques **CO4:**Design simple Graphical User Interface Applications
EC700OE	**Open Elective –II** Electronic Sensors	**At the end of this course, each student should beable to:** **CO1:**Learn about sensor Principle, Classification and Characterization. **CO2:**Explore the working of Electromechanical, Thermal, Magnetic, radiation and Electro analytic sensors Understand the basic concepts of Smart Sensors **CO3:**Design a system with sensors **CO4:**UNIT - I Sensors / Transducers: Principles, Classification, Parameters, Characteristics, Environ
EE700OE	**Open Elective –II** Utilization Of Electrical Energy	**At the end of this course, each student should beable to:** **CO1:**Understand basic principles of electric heating and welding. **CO2:**Determine the lighting requirements for flood lighting, household and industrial needs. **CO3:**Calculate heat developed in induction furnace. **CO4:**Evaluate speed time curves for traction
EE701OE	**Open Elective –II** Electric Drives And Control	**At the end of this course, each student should beable to:** **CO1:**Understand the various drive mechanisms and methods for energy conservation. **CO2:**Apply power electronic converters to control the speed of DC motors and induction motors. **CO3:**Evaluate the motor and power converter for a

		specific application. **CO4:**Develop closed loop control strategies of drives
ME700OE	**Open Elective –II** Basic Mechanical Engineering	**At the end of this course, each student should beable to:** **CO1:** To understand the mechanical equipment for usage at engineering systems. **CO2:**To familiarize with the general principles and requirements for refrigeration, manufacturing, **C03:** To realize the techniques employed to engineering systems.

Open Elective –III

(Common for EEE, ECE, CSE, IT, ME)

Course Code	Course Title / Name	Course Outcomes
CE800OE	**Open Elective – III** Environmental Impact Assessment	**At the end of this course, each student should beable to:** **CO1:**Identify the environmental attributes to be considered for the EIA study **CO2:**Formulate objectives of the EIA studies **CO3:**Identify the methodology to prepare rapid EIA **CO4:**Prepare EIA reports and environmental management plans
CS800OE	**Open Elective – III** Machine Learning	**At the end of this course, each student should beable to:** **CO1:**Understand the concepts of computational intelligence like machine learning **CO2:**Ability to get the skill to apply machine learning techniques to address the real time problems in different areas **CO3:**Understand the Neural Networks and its usage in machine learning application.
CS801OE	**Open Elective – III** Mobile Application Development	**At the end of this course, each student should beable to:** **CO1:**Student understands the working of Android OS Practically. **CO2:**Student will be able to develop Android user interfaces **CO3:**Student will be able to develop, deploy and maintain the Android Applications.

CS802OE	**Open Elective – III** Scripting Languages	**At the end of this course, each student should beable to:** **CO1:**Comprehend the differences between typical scripting languages and typical system and application programming languages. **CO2:**Gain knowledge of the strengths and weakness of Perl, TCL and Ruby; and select an appropriate language for solving a given problem. **CO3:**Acquire programming skills in scripting language
CS803OE	**Open Elective – III** Database Management Systems	**At the end of this course, each student should beable to:** **CO1:**Gain knowledge of fundamentals of DBMS, database design and normal forms **CO2:**Master the basics of SQL for retrieval and management of data. **CO3:**Be acquainted with the basics of transaction processing and concurrency control. **CO4:**Familiarity with database storage structures and access technique
EC800OE	**Open Elective – III** Measuring Instruments	**At the end of this course, each student should beable to:** **CO1:**Able to identify suitable sensors and transducers for real time applications. **CO2:**Able to translate theoretical concepts into working models. Able to understand the basic of measuring device and use them in relevant situation.
EE800OE	**Open Elective – III** Basics Of Power Plant Engineering	Upon completion of the course, the students can understand the principles of operation for different power plants and their economics

EE801OE	**Open Elective – III** Energy Sources And Applications	**At the end of this course, each student should beable to:** **CO1:**List and generally explain the main sources of energy and their primary applications nationally and internationally Understand the energy sources and scientific concepts/principles behind them **CO2:**Understand effect of using these sources on the environment and climate **CO3:**Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the impact on the environment. **CO4:**List and describe the primary renewable energy resources and technologies. **CO5:**To quantify energy demands and make comparisons among energy uses, resources, and technologies. **CO6:**Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation. **CO7:**Understand the Engineering involved in projects utilizing these sources
ME800OE	**Open Elective – III** Non-Conventional Sources Of Energy	**At the end of this course, each student should beable to:** **CO1:**Identify renewable energy sources and their utilization. Understand the basic concepts of solar radiation and analyze the working of solar and thermal systems. Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas and hydrogen. **CO2:**Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator. **CO3:**Identify methods of energy storage for specific Applications