R20 COURSE OUTCOMES

COURSE CODE	COURSE		COURSE OUTCOME DESCRIPTION
111	Mathematics-I	1	Examine the convergence of series and apply mean value theorem to real life problem.
111		2	Solve the Differential Equations of first and higher order related to various engineering applications.
111		3	Apply the partial differentiation technique to solve physical problem
111		4	Apply double and triple integrals to find areas and volumes.
112	Engineering Physics	1	Apply the knowledge of different phenomena of light in daily life.
112		2	Distinguish between laser sources and conventional sources and study the propagation of light through optical fibres.
112		3	Summarize magnetic & dielectric material properties and recognize their need in engineering applications.
112		4	Improve the acoustic quality of concert halls and apply Ultrasonic waves concept in Non Destructive Testing.
112		5	Study the structures and properties of solid state materials, apply this knowledge to estimate the structure of the materials
113	Programming for Problem Solving Using C	1	Apply the basic concepts of C Programming for problem-solving and different number systems.
113		2	To use different operators, write programs that use control statements for a given problem.
113		3	Illustrate the concepts of Homogeneous and heterogeneous data types, pointers and file system for solving mathematical and engineering problems.
113		4	Decompose a given problem into functions and to develop modular reusable code.
114	ENGLISH	1	Apply the four languages learning skills-listening, speaking, reading, writing (LSRW) for professional success.
114		2	Employ knowledge of grammatical structures and vocabulary in speech and writing.
114		3	Apply effective communication skills to enhance professional possibilities.
114		4	Develop acceptable personality traits suitable for chosen profession.
115	Engineering Drawing	1	Construct polygons, scales and draw curves used in engineering applications
115		2	Apply concept of orthographic projection to project Points, St. lines inclined to one and both reference planes.

115		3	Produce orthographic projections of planes inclined to both the reference planes.
115		4	Produce orthographic projections of regular solids inclined to both the reference planes.
115		5	Construct isometric view from orthographic views and vice versa.
115		6	Drawing practice on AUTO-CAD
116	Engineering Physics Lab	1	Apply the knowledge of different phenomena of light like interference, diffraction and handle various optical measuring instruments.
116		2	Analyze various electronic circuits and its components and verify the laws of stretched string.
116		3	Apply the knowledge of phenomena like LASER diffraction and resonance in sound waves
117	Programming for Problem Solving Using C Lab	1	Describe the basics of computer and understand the problem-solving aspect.
117		2	Design and develop C program to evaluate simple expressions and logical operations.
117		3	Develop & Implement C programs with suitable modules to solve the given problem.
117		4	Demonstrate the concept of pointer and perform I/O operations in files.
118	English - Communication Skills Lab	1	Recognize the sounds of English with the help of audio visual aids
118		2	Build confidence and overcome inhibitions while speaking in English.
118		3	Demonstrate acquired language skills in performing the designated activity.
119	ENVIRONMENTAL SCIENCE	1	Overall understanding of the natural resources.
119		2	Basic understanding of the ecosystem and its diversity.
119		3	Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
119		4	An understanding of the environmental impact of developmental activities.
119		5	Awareness on the social issues, environmental legislation and global treaties.
121	M-II	1	Solve system of linear algebraic equations and apply Eigen value computation techniques to reduce a given quadratic to canonical form
121		2	Solve algebraic and Transcendental equations by using Numerical methods
121		3	Apply Newton's forward and backward interpolation and Lagrange's formula for equal and unequal intervals.
121		4	Compute numerical solutions of differential equations.
122	Engineering Chemistry	1	Identify the advantages and limitations of plastic materials, elastomers and their use in day to day life.
122		2	Select the suitable methods of corrosion control and gain the knowledge of applications of batteries.

122		3	Recognize the need of nano materials, liquid crystals, semiconductors and super conductors.
122		4	Obtain the knowledge of computational chemistry and molecular machines
122		5	Obtain the knowledge of generation of electricity from various Non-Conventional energy sources.
123	Engineering Mechanics	1	Analyze the system of forces acting on rigid bodies by FBD's
123		2	Apply laws of friction to find friction forces acting on the rigid bodies
123		3	Find Moment of Inertia of plane laminas by locating its Centroid and Analyze the frames and trusses to find internal forces in rigid members
123		4	Analyze motion parameters of bodies both in translation and rotation(D Alembert's Principle)
123		5	Apply work- Energy and Impulse-momentum methods to find motion parameters of a moving bodies
124	Basic Electrical and Electronics Engineering	1	Analyze various electrical networks.
124		2	Understand the operation of DC & AC Machines, machine testing procedures for evolution of performance.
124		3	Analyze operation of half wave, full wave bridge rectifiers and OP-AMPs.
124		4	Understanding operations of CE amplifier and basic concept of feedback amplifier
125	Thermodynamics	1	Explain the basic concepts of thermodynamic systems in the energy perspective; distinguish the point function and the path function with respect to energy, work and heat.
125		2	Apply the knowledge of thermodynamic systems while learning the first law of thermodynamics and apply the steady flow steady state energy equation on several mechanical devices also understand the concept of equality of temperature, temperature measuring devices.
125		3	Apply second law statements of thermodynamics on heat engines and heat pumps and analyze the concept of Carnot cycle, entropy, availability and irreversibility and understand the use of Maxwell's relations and thermodynamic functions.
125		4	Demonstrate the process of steam formation and related properties and related steam utilizing mechanical devices with the help of appropriate property relations, steam tables and charts.
126	Workshop Practice Lab	1	Apply working knowledge in making simple wood joints and fitting joints and simple sheet metal works
126		2	Apply electrical working knowledge in making simple wirings
126		3	Apply knowledge for computer assembling and software installation and how to solve the trouble

			shooting problems.
127		1	Obtain the knowledge of acid-base titrations to determine the strength of acid and base solutions.
127		2	Gain the knowledge of Redox titrations to determine the concentration of samples such as Ores, KMnO4 and Copper using different indicators.
127	Engineering Chemistry Laboratory	3	Obtain the knowledge of complexometry titrations to determine the hardness of given water sample by EDTA method.
127		4	Gain the knowledge of commonly used instruments such as pH meter, Conductivity meter and Potentiometer to determine the strength of given acid solutions.
128		1	Estimate the performance of the different machines by the computation of efficiency and regulation.
128	Basic Electrical and Electronics Engineering Lab	2	Examining the performance characteristics of DC &AC machines.
128		3	Measuring various losses in DC machines & Transformers by conducting suitable tests.
128		4	Summarize the characteristics & applications of different electronics devices.
129		1	Know the role of Election Commission apply knowledge
129	Constitution of India	2	Contrast and compare the role of Chief Election commissioner and Commissionerate
129		3	Analyze role of state election commission
129		4	Evaluate various commissions of viz SC/ST/OBC and women
211		1	Apply the concepts of vector calculus to the problems of work done by a force, circulation and flux
211		2	Apply Laplace Transforms to solve the ordinary differential equations
211	Vector Calculus & Fourier Transforms and PDE	3	Compute Fourier series of the periodic function and Apply Fourier transform to a range of non-periodic function.
211		4	Solve the first and higher order partial differential equations and apply to various physical problems
212		1	Solve problems on simple stresses and strains including thermal concept and relate elastic constants.
212		2	Analyze shear force and bending moment diagram for beams with different loading conditions.
212	Mechanics of Solids	3	Calculate bending and shear stresses in beams of different cross sections.
212		4	Calculate slope and deflections in beams using Macaulay's and moment area methods and Analyze members subjected to torsion.

212		5	Design thin, thick cylindrical vessels and spherical vessels and solve columns and struts.
213	Fluid Mechanics & Hydraulic Machines	1	Familiarize the concepts of continuum, properties of fluid, pressure variation and measurement, pressure on submerged bodies.
213		2	Understand various flow lines, types of flows, fluid kinematics, equations of functions.
213		3	Apply conservation laws to fluid flow problems in engineering applications.
213		4	Calculate and solve flow problems.
213		5	Design the working proportions of hydraulic machines.
214	Production Technology	1	Discuss basic manufacturing concepts like product cycle, types of production and casting process.
214		2	Explain the importance and principle of metal forming fabrication Processes.
214		3	Explain the principle of sheet metal operations.
214		4	Explain welding processes, soldering & brazing and analyze their defects.
215	Kinematics of Machinery	1	Understand various Mechanisms, Inversion mechanisms and mobility of mechanisms
215		2	Analyze the velocity, accelerations of various mechanisms.
215		3	Design the cam profiles for different follower motions.
		4	Design various power transmission devises like Belt, Chain and Gear drives
216	Computer Aided Engineering Drawing Practice	1	Exposed on working of sheet metal with help of development of surfaces
216		2	Understands how to know the hidden details of machine components with the help of sections and interpenetrations of solids.
216		3	Exposed to modeling commands for generating 2D and 3D objects using computer aided drafting tools which are useful to create machine elements for computer aided analysis.
217	Fluid Mechanics & Hydraulic Machines Lab	1	Apply the basic concepts of continuum, properties of fluid, pressure measurement, hydrostatic forces on the surfaces, buoyancy & floatation in fluid flow problems
217		2	Solve problems on kinematics & dynamics of fluid flow in engineering applications with the help of Euler and Bernoulli's equations.
217		3	Analyze the boundary layer theory, apply flow through pipes and flow on free surface concepts in solving real life flow problems
217		4	Solve the problems of hydraulic machines like turbines, pumps and other fluid machines.
218	Production Technology	1	Prepare sand moulds in foundry using appropriate foundry shop hand tools.

218	Lab	2	Produce different welding joints at variable voltage sources.
218		3	Find moulding sand properties
218		4	Prepare patterns, produce mould cavities for manufacturing castings.
219	Drafting and Modeling Lab	1	Explain the graphic devices, geometric modeling and drafting devices.
219		2	Analyze the design procedure & CAD packages
219		3	Determine the Finite Element problems
219		4	Explain basics of ANSYS, NASTRAN, NISA-II, Artificial Intelligence
2110	Essence of Indian Traditional Knowledge	1	Understand the concept of Traditional knowledge and its importance.
2110		2	Know the need and importance of protecting traditional knowledge.
2110		3	Know the various enactments related to the protection of traditional knowledge.
2110		4	Understand the concepts of Intellectual property to protect the traditional knowledge.
221	Material Science & Metallurgy	1	Understand the crystalline structure of different metals and study the stability of phases in different alloy systems.
221		2	Study the behavior of ferrous and non ferrous metals and alloys and their application in different domains.
221		3	Able to understand the effect of heat treatment, addition of alloying elements on properties of ferrous metals.
221		4	Grasp the methods of making of metal powders and applications of powder metallurgy.
221		5	Comprehend the properties and applications of ceramic, composites and other advanced materials.
222	Complex Variables & Statistical Methods	1	Apply the concepts of analytic functions, sequences and series of the complex functions.
222		2	Apply various probability distributions for both descret and continuous random variable.
222		3	Apply the terms of the sampling distribution and test the hypothesis for small samples.
222		4	Apply the terms of the sampling distribution and test the hypothesis for large samples.
223	Dynamics of Machinery	1	Compute the frictional losses, torque transmission of mechanical systems.
223		2	Analyze dynamic force analysis of slider crank mechanism and design of flywheel.
223		3	Analyze stabilization of sea vehicles, aircrafts and automobile vehicles.
223		4	Analyze the speed regulation of various types of governors.
223		5	Understand the balancing of reciprocating and rotary masses.
223		6	Determine the natural frequencies of continuous systems starting from the general equation of displacement.
224	Thermal Engineering - I	1	Compare the Air Standard Cycles, Fuel Air Cycles and Actual Cycles.

224		2	Explain working of internal combustion engines, IC engine systems and combustion phenomenon.
224		3	Apply concept of Air Standard Cycles to Calculate performance parameters of IC engines.
224		4	Explain working of gas turbines, jet propulsion engines and rockets.
224		5	Solve problems on gas turbines and jet propulsion engines.
225	Industrial Engineering & Management	1	Distinguish industrial engineering and production management, with a basis of through knowledge on the applications and quantitative measurement tools and understand the concepts and importance as given by F.W.Taylor and Fayol's principles and functions of management.
225		2	Summarize the various types of plant layouts based on the techniques of design and their maintenance.
225		3	Identify the applications of work study and various recording techniques and their comparisons.
225		4	Outline the applications of various statistical quality control tools, methods and charts, which should help him/her understand the concepts of total quality management like quality circles, zero defect, ISO Quality systems and six-sigma.
225		5	Analyze the importance of personnel management and industrial relations, based on the concepts of human resource management like job evaluation, merit rating, etc and Value Analysis.
226	Mechanics of Solids & Metallurgy Lab	1	Find mechanical properties of different materials using universal testing machine
226		2	Find shear modulus of given material using torsion test rig
226		3	Calculate Impact resistance of a given material using impact testing machine
226		4	Determine the hardness of different materials using vickers, rockwell and brinell hardness testing machines
227	Machine Drawing Practice	1	Sketch conventional representation of mechanical components.
227		2	Draw orthographic projections, sectional views of the mechanical components
227		3	Draw various types of screw fasteners, Riveted and welding joints.
227		4	Draw various types of shaft couplings, bearings and pipe joints.
227		5	Draw assemblies of engine parts, machine parts.
228	Theory of Machines Lab	1	Apply fundamentals of four bar mechanism, governors, cam and follower motions, gears, screw jack.

228		2	Analyze the single slider crank chain, gyroscope apparatus, static and dynamic balancing, various cam and follower systems
228		3	Determine the gyroscopic couple, coefficient of friction between belt and pulley, moment of inertia of flywheel, frequency of damped and undamped spring mass system
229	Python Programming Lab	1	Solve the different methods for linear, non-linear and differential equations
229		2	Learn the PYTHON Programming language
229		3	Familiar with the strings and matrices in PYTHON
229		4	Write the Program scripts and functions in PYTHON to solve the methods
311	Thermal Engineering-II	1	Explain the concept of combustion of fuels, working of Boilers, boiler mountings and accessories.
311		2	Explain the functionality and working of Steam nozzles, Steam turbines and Steam condensers.
311		3	Calculate performance parameters of Rankine cycle, Boilers, Steam nozzles, Steam Turbines and Steam Condensers.
311		4	Explain working of reciprocating and rotary compressors.
311		5	Calculate various performance parameters on reciprocating and rotary compressors.
312	Design of Machine Members -I	1	Apply the design procedure to select suitable materials by considering technical and manufacturing constraints.
312		2	Design of machine elements for failure of materials under fluctuating stress, fatigue.
312		3	Design of Riveted joints, Welded joints and Bolted joints.
312		4	Design different machine elements such as fasteners, shafts, keys etc.
312		5	Design different machine elements such as couplings.
312		6	Design different machine elements such as axially loaded joints, Springs etc.
313	Machining, Machine Tools & Metrology	1	Discuss the concepts of machining processes
313		2	Apply the principles of lathe, shaping, slotting and planing machines
313		3	Apply the principles of drilling, milling and boring processes
313		4	Analyze the concepts of finishing processes and the system of limits and fits
313		5	Demonstrate the concepts of surface roughness and optical measuring instruments.
314	Operations Research	1	Apply linear programming model to domain specific situations.
314		2	Describe the various methods under transportation and queuing theory mode and apply them for testing the closeness of their results to optimal results.

314		3	Analyze the concepts of replacement and game theory and apply them for arriving at optimal decisions.
314		4	Apply the concepts of PERT and CPM for decision making and optimally managing projects.
314		5	Explain the concepts of dynamic programming into real time applications.
315	Advanced Materials	1	Justify knowledge about metals and alloys and their utility in different environments.
315		2	Judge about polymers and ceramics and their applications.
315		3	Aanalyze composite materials along with reinforcements and their applications.
315		4	Utilize shape memory alloys and functionary graded materials for different applications.
315		5	Justify about the nano materials and their applications.
316	Machine Tools Lab	1	Apply operating principles to perform different operations of lathe
316		2	Apply operating principles required to get different shapes of products on machine tools
316		3	Operate different machine tools with understanding of work holders.
316		4	Apply the mechanics of metal cutting to produce tool angles for a single point cutting tool
317	Thermal Engineering Lab	1	Analyze the performance characteristics of an internal combustion engines
317		2	Draw the Heat balance sheet for diesel engine
317		3	Analyze the characteristics of air compressor.
317		4	Determine the properties of a given sample of fuel.
317		5	Explain different boilers models, mountings and their accessories
318	Advanced Communication Skills Lab	1	Acquire vocabulary and use it contextually
318		2	Listen and speak effectively
318		3	Develop proficiency in academic reading and writing
318		4	Increase possibilities of job prospects
318		5	Communicate confidently in formal and informal contexts
319	Professional Ethics and Human Values	1	Judge the concepts of human values.
319		2	Justify knowledge about the principles of engineering ethics.
319		3	Interpret engineering as social experimentation.
319		4	Realize engineers' responsibility for safety and risk.
319		5	Learn about the engineers' rights and responsibilities.
321	Heat Transfer	1	Explain and estimate the heat transfer rate in different cross sections under steady heat conduction and unsteady state heat conduction.
321		2	Relate, identify and solve the correlations for free and forced convection.

321		3	Explain and compute heat transfer rate in boiling and condensation processes.
321		4	Classify and Design parallel and counter flow heat exchangers.
321		5	Explain the principles of black body radiation and mass transfer
322	Design of Machine Members–II	1	Apply knowledge about the design of bearings.
322		2	Design various Engine parts.
322		3	Design curved beams and power screws.
322		4	Design power transmission systems and to design pulleys and gear drives.
322		5	Design various machine tool elements.
323	Introduction to Artificial Intelligence and Machine Learning	1	Discuss basic concepts of artificial intelligence, neural networks and genetic algorithms.
323		2	Apply the principles of knowledge representation and reasoning.
323		3	Learn about Bayesian and computational learning and machine learning.
323		4	Utilize various machine learning techniques.
323		5	Apply the machine learning analytics and deep learning techniques.
324	Statistical Quality Control	1	Discuss the concepts of quality systems and quality engineering in design and processes.
324		2	Utilize knowledge about the statistical process control charts and sampling techniques.
324		3	Analyze the loss function and quality function deployment.
324		4	Judge the models of reliability engineering.
324		5	Apply knowledge about the concepts of complex system and reliability engineering techniques.
325	Introduction to Automobile Engineering	1	Discuss various components of four wheeler automobile.
325		2	Apply the knowledge of different parts of transmission system.
325		3	Judge about steering and suspension systems.
325		4	Justify the braking system and electrical system used in automobiles.
325		5	Analyze the concepts about engine specifications and service, safety and electronic system used in automobiles.
326	Heat Transfer Lab	1	Perform steady state conduction experiments to estimate the thermal conductivity of a solid and overall heat transfer coefficient of a composite wall
326		2	Perform the heat transfer experiment on a Pin fin and obtain variation of temperature along the length of the Pin fin
326		3	Estimate the heat transfer coefficients in free and forced convection environments
326		4	Perform Radiation experiments to determine Stephen Boltzman constant and emissivity of a test plate

326		5	Estimate condensation heat transfer coefficients and to determine critical heat flux values in boiling
327	CAE/CAM Lab	1	Experiment with trusses and beams to determine stress, deflection, natural frequencies, harmonic analysis, HT analysis and buckling analysis.
327		2	Create part programmes using FANUC controller.
327		3	Apply G-codes for automated tool path using CAM software.
327		4	Analyze about rapid prototyping machine and to print simple parts.
327		5	Experiment with virtual 3D printing simulation using Vlabs.
328	Measurements & Metrology Lab	1	Demonstrate the use of instruments for measuring linear (internal and external), angular dimensions and surface roughness.
328		2	Perform alignment tests on various machine tools.
328		3	Demonstrate the use of instruments for measuring pressure, flow, speed, displacement and temperature
328		4	Calibrate the Bourdon tube pressure gauge
329	Artificial Intelligence and Machine Learning Lab	1	apply the knowledge of artificial intelligence and machine learning models along with image classifiers and automatic facial recognition using various software tools.
3210	Research Methodology and IPR	1	Understand objectives and characteristics of a research problem.
3210		2	Analyze research related information and to follow research ethics
3210		3	Understand the types of intellectual property rights.
3210		4	Learn about the scope of IPR.
3210		5	Understand the new developments in IPR.
411	Unconventional Machining Processes	1	Compare non-traditional machining, classification, material applications in material removal process
411		2	Summarize the principle and processes of ECM
411		3	Illustrate the principle and processes of ultrasonic machining
411		4	Apply the principles and procedure of thermal metal removal processes
411		5	Understand the principles, processes and applications of Plasma Machining, EBM and LBM
412	Power Plant Engineering	1	Explain the Layout and working of Steam Power Plants
412		2	Explain the Layout and working of Diesel, Gas turbine Power Plants
412		3	Explain the working of Nuclear and hydro Power plants, identification of Nuclear Hazards and

			disposal of radioactive waste
412		4	Explain the combined operations of different power plants and there Instrumentation and Control
412		5	Estimate the loads on power plants by considering various factors and the impact of pollutants on environment and methods of pollution control
413	Mechatronics	1	Describe the integrative nature of Mechatronics.
413		2	Apply the knowledge of Solid state electronics and analog signal conditioning circuits used in the development of mechatronics system.
413		3	Apply the knowledge of various sensors, actuators and controllers in the development of indigenous mechatronics system.
413		4	Explain the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O in development of data acquisition system.
414	Finite Element Methods	1	Apply finite element method to solve problems in solid mechanics.
414		2	Formulate and solve problems in one dimensional structures including trusses, beams and frames.
414		3	Formulate FE characteristic equations for two dimensional elements and analyze plane stress, plane strain, axi-symmetric problems and higher order elements such as quadratic bar element, 6-node triangle, 4,8,9-node quadrilateral elements
414		4	Apply numerical Integration for finding stiffness matrix of different elements.
415	Operations Management	1	Describe the scope of operations management and forecast the demand for products as well as services for a given organization.
415		2	Analyze managerial problems related to plant location and layout for a given organization.
415		3	Apply appropriate material control techniques and material requirement plans to manage the materials effectively.
415		4	Develop aggregate planning and Master production schedules in operation environment.
415		5	Apply Deterministic models and Contemporary management techniques to the service sector as well as manufacturing firms.
416	Universal Human Values	1	Understand and analyse the essentials of human values and skills, self exploration, happiness and prosperity.
416		2	Identify and evaluate the role of harmony in family, society and universal order.
416		3	Understand and associate the holistic perception of harmony at all levels of existence.
416		4	Develop appropriate technologies and management patterns to create harmony in professional and personal lives.

417	Mechatronics Lab	1	Measure load, displacement and temperature using analogue and digital sensors.
417		2	Develop PLC programs for control of traffic lights, water level, lifts and conveyor belts.
417		3	Simulate and analyse PID controllers for a physical system using MATLAB.
417		4	Develop pneumatic and hydraulic circuits using Automaton studio.
421	Major Project	1	Identify complex engineering problems relevant to the society and industry.
421		2	Apply modern technologies, tools and systems in the field of mechanical Engineering to analyze the identified problem.
421		3	Design and implement a viable solution to the problem.
421		4	Apply communication, report writing skills & Presentation skills.
421		5	Develop team work and leadership skills with professional and ethical values.