2019-20

COURSE	Course outcomes
SEMESTER-I	**SEMESTER-I**
MATHEMATICS-I	CO1: To test the behavior of infinite series. Operate vectors and convert line integral to surface integral to volume integral. CO2: Analyze functions of several variables and their applications. CO3: Evaluate multiple integrals and apply them to practical problems. CO4: To study cylinders and cones and understand applying cylindrical and polar coordinates. Formulate and solve linear differential equations.
PHYSICS	CO1: Understand Bragg's law and introduced to the principles of lasers, types of lasers and applications. CO2: Various terms related to properties of materials such as permeability, polarization etc. CO3: Basic knowledge of structural properties, crystal structure and X ray diffraction analysis. CO4: Basic knowledge of magnetic, superconducting, dielectric properties of materials. CO5: Knowledge of nanomaterials, nanotechnology and its application.
CHEMISTRY (INORGANIC)	CO1: Understanding the basics of wave mechanics and chemical bonding in inorganic chemistry. CO2: Understanding the relation between structure and reactions of various complex compounds. CO3: Understanding the mechanism of various reaction and the ways to control them. CO4: Identifying the elements hazardous to nature and means to control them.
COMMUNICATION SKILLS	CO1: Gain proficiency in English language as medium for communication in both professional and personal life CO2: Increase in employment prospective of students by developing technical aspects of communication. CO3: Personality development of students by thorough knowledge of effective and enhanced communication skills
ENGINEERING GRAPHICS	CO1: Understand the use of different drawing tools, types of lines, dimensioning rotation of planes and types of projections. CO2: Projection of points, lines and planes. Visualization of solid objects through projection of solids and assembly drawing. CO3: Understand the importance of development of surfaces, isometric projection and computer graphics.
ENGINEERING WORKSHOP	CO1: Identify basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail join, Bridle joint, and Mitre joint. CO2: Recognize and differentiate between the use of arc welding and gas welding in making different types of welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint. CO3: Describe the various fabrication processes in Machine shop, use of machine tools and materials, introduction to working of lathe, shapper, milling and drilling machines, power hacksaw, shearing machine and grinding wheel. CO4: Recognize the wiring techniques in link clip and casting and causing wiring of lights with switches in parallels, series and with 2 ways switches, Connecting energy meter, main switch and distribution board, testing a wiring installation for insulation resistance.
PHYSICS LAB.	CO1: Proficiency in technical aspects of performing the experiments. CO2: State various laws which they have studied through experiments. CO3: Experimental data observations and analysis. CO4 Proficiency in designing scientific projects and reporting
CHEMISTRY (INORGANIC) LAB.	CO1: getting hands on training in handling various equipment. CO2: understanding practically all theoretical concepts CO3: working with discipline and as a team with co-operation.

COURSE	Course outcomes
COMMUNICATION SKILLS LAB.	CO1: English Speaking skills of students will be enhanced. CO2: Students will become self confident in handling both professional and personal meetings/discussions. CO3: Students will be able to demonstrate improved technical writing skills. CO4: Overall personality of students as well as their communication skills will be developed.
SEMESTER-II	
MATHEMATICS-II	CO1: Expand functions in terms of Fourier series and introduction of harmonic analysis. CO2: Formulate and solve various partial differential equations. Solve partial differential equations of engineering interest by the method of separation of variables. CO3: Find Laplace transforms, inverse transforms and apply these to solve various differential equations. CO4: Evaluate complex integrals and apply these to various problems.
CHEMISTRY (ORGANIC)	CO1: Understand and explain the different nature and behaviour of organic compounds CO2: Understand the concept of stereochemistry CO3: Learn and identify organic reaction intermediate and explain the mechanism including the free radical substitution , electrophilic addition, electrophilic aromatic substitution and nucleophilic reactions. CO4: Identify important organic reactions and their application for syntheses.
ELECTRICAL & ELECTRONICS ENGINEERING	CO1: The student will understand how various loads are connected in circuits and difference between single and three phase system. CO2: The students will know the principles and working of different types of electrical machines used in industry CO3: The students will have the basic knowledge of digitalization and conversion of physical quantity to digital quantity.
MATERIAL & ENERGY BALANCE	CO1: To convert units and dimensions and modify equations from one system to another, CO2: To integrate the data and formulate the material and energy balance problems, CO3: To apply material and energy balance in different chemical processes (with and without reactions), including problems involving recycle, bypass and purge streams, CO4: To use steam tables and psychrometric charts.
COMPUTER PROGRAMMING FOR PROBLEM SOLVING	CO1: The student will demonstrate proficiency in C++ programming language. CO2: The student will be able to solve basic engineering computation problems using C++
ELECTRICAL & ELECTRONICS ENGINEERING LAB.	CO1: The student will understand how various loads are connected in circuits and difference between single and three phase system. CO2: The students will know the principles and working of different types of electrical machines used in industry. CO3: The students will have the basic knowledge of digitalization and conversion of physical quantity to digital quantity.
CHEMISTRY (ORGANIC) LAB.	CO1: Practise analytical skills and recognize various aspects of lab safety. CO2: Learn and apply basic technique used in the organic laboratory for preparation ,purification, and identification of oganic compound. CO3: Outline the synthesis of Benzamide and Asprin, and carry out the purification and percentage yield of compound. CO4: Identify important functional groups by a study of their properties and reaction.
COMPUTER LAB.	CO1: The students will be able to demonstrate proficiency in C++ CO2: The student will become confident in solving any computation problem using his programming skills.
SEMESTER-III	**SEMESTER-III**

COURSE	Course outcomes
PHYSICAL CHEMISTRY	CO1: The students will be able to derive and apply laws related to ideal and non- ideal solutions, CO2: will develop basic understanding of slow and fast reactions CO3: will be able to apply different adsorption models on various adsorption processes and develop an understanding of enzyme catalysis CO4: will be able to solve numerical based on faradays laws and will develop a deep understanding of electrochemical processes.
PHYSICAL CHEMISTRY LAB.(PRACTICAL)	CO1: Getting hands on training in handling various equipment. CO2: Understand practically all theoretical concepts. CO3: Working with discipline and as a team with co-operation.
FLUID FLOW	CO1 Define types of fluids, describe boundary layer, define turbulence and apply Basic Equations of Fluid Flow. CO2 Describe fluid statics, pressure and Forces on Submerged bodies, Flow of Incompressible Fluids, pipes and fittings, economic pipe diameter. CO3 Employ Dimensional analysis, describe Compressible flow and examine flow through nozzles. CO4 Classify Flow Measurement equipments, Classification and Performance of Pumps, Turbines, Compressors, and Blowers, Selection and Specification, Net positive Suction Head.
FLUID FLOW (PRACTICAL)	CO1: Verify Bernoulli's theorem. CO2: Evaluate discharge coefficient for various flow measurement devices and understand their industrial applications. CO3: Identify various types of flow, valves and fittings and evaluate the frictional losses associated with them. CO4: Calibrate a given flow meter. CO5: Understand the characteristics of pumps. CO6: Verify $f=16/Re$ for laminar flow through a straight tube.
PROCESS PLANT MATERIAL AND ENERGY BALANCE	CO1: To convert units and dimensions and modify equations from one system to another, CO2: To integrate the data and formulate the material and energy balance problems, CO3: To apply material and energy balance in different chemical processes (with and without reactions), including problems involving recycle, bypass and purge streams, CO4: To use steam tables and psychrometric charts.
ENGINEERING MATERIALS	CO1: Demonstrate an understanding of crystal structure, Space lattice, Miller Indices CO2: Describe and analyse imperfections in atomic arrangement, explain diffusion phenomenon in solids and perform simple diffusion problems CO3: Describe and analyse binary phase diagrams, TTT diagrams, demonstrate an understanding of phase transformations CO4: Classify types of materials, describe properties of materials and application in engineering and corrosion.
STRENGTH OF MATERIALS	CO1: Identify various types of Stressers and Strains, define Hooke's law, modulus of dlasticity and modulus of rigidity, calculate stresses under impact loads and sudden applied loads under varying conditions. CO2: Apply the theory to solve numerical problems based on Shearing force, bending moment, types of load on beams, types of supports, Concentrated loads and uniformly distributed loads. CO3: Define different types of Struts and Columns, Explain Euler theory and its limitations, describe Rankine-Gordon formula and its applications to numerical problems. CO4: Describe Stresses and Strains in Thin Shells and in springs, Strain Energy and Theories of Elastic Failure and numerical problems.
PROCESS EQUIPMENT DESIGN	CO1: Understand general design consideration, codes and specifications for pressure vessels. CO2: Design of thin-walled vessels under internal as well as external pressure.

COURSE	Course outcomes
	CO3: Design of foundation, supports and various joints.
SEMESTER-IV	**SEMESTER-IV**
MATHEMATICS-III	CO1: Find Rank of a matrix & find matrix inverse using Cayley-Hamilton theorem. Learn to solve difference equations with constant coefficients. CO2: Find Z-transforms and inverse Z-transforms using various methods and apply these to solve difference equations. CO3: Apply the series solution method to solve Bessel and Legendre differential equations. CO4: Apply various probability distributions, test of significance for Large samples and their comparison and goodness of fit.
HEAT TRANSFER	Capability CO1: To understand conduction, convection and radiation modes of heat transfer and to estimate heat transfer rates, CO2: To understand boiling and condensation phenomena CO3: To carryout thermal analysis of heat exchanger using LMTD and effectiveness method, CO4: To estimate steam economy, capacity of single and multiple-effect evaporators. CO5: To apply engineering judgment including an appreciation of cost and safety.
HEAT TRANSFER (PRACTICAL)	CO1: Determination of heat transfer coefficient for different types of heat transfer equipment and Unsteady state heat transfer in jacketed vessels. CO2: Correlation of instantaneous heat transfer coefficients with time study deposition of scale on a heating surface & heat losses for insulated pipes. Study of double pipe heat exchanger and 1, 2 - shell and tube heat exchanger. CO3: Study and operation of long tube, forced circulation and multiple effect evaporators, Duhring plot for solutions involving nonvolatile solutes
CHEMICAL ENGINEERING THERMODYNAMICS	CO1: Understand the First and Second Laws of Thermodynamics apply it to open and closed systems, steady and unsteady state processes, isothermal and adiabatic processes and solve related engineering problems. CO2: Estimate the thermodynamic properties of pure substances, especially fluids. Knowledge of various PVT equations of state including Principle of corresponding states and heat capacities to evaluate thermodynamic properties of fluids. CO3: Explain the underline principles of phase equilibrium and evaluate the thermodynamic properties in two-component and multi-component systems CO4: To develop and ability to envisage intermolecular potential and excess property behaviour of multi-component systems CO5: Impart ability to apply the concepts of phase equilibrium to vapour liquid equilibrium (VLE), separation processes and chemical reaction equilibrium
ORGANIC CHEMISTRY	CO1: Understand and explain the different nature and behaviour of organic compounds CO2: Understand the concept of stereochemistry CO3: Learn and identify organic reaction intermediate and explain the mechanism including the free radical substitution , electrophilic addition, electrophilic aromatic substitution and nucleophilic reactions. CO4: Identify important organic reactions and their application for syntheses.
ORGANIC CHEMISTRY (PRACTICAL)	CO1: Practise analytical skills and recognize various aspects of lab safety. CO2: Learn and apply basic technique used in the organic laboratory for preparation ,purification, and identification of oganic compound. CO3: Outline the synthesis of Benzamide and Asprin, and carry out the purification and percentage yield of compound.

COURSE	Course outcomes
	CO4: Identify important functional groups by a study of their properties and reaction.
MECHANICAL OPERATIONS	CO1: Understand and determine various properties of solids, specific surface area, average particle sizes of particles in mixtures, sphericity and laws of crushing. Classification of SR equipments, power consumption of various machines, description and working of Size reduction equipments and their applications CO2: Understand various screening techniques and equipments, capacity and effectiveness of screens, standard screens CO3: Understand and apply knowledge of Filtration Processes , constant pressure and constant volume filtration and various filtration equipments, their types and applications CO4: Understanding and applying concepts of Flow around a single particle, drag force and drag coefficient, settling velocity of particles in a fluid, hindered and free settling of particles, thickening and gravity separation, types of settling devices. CO5: analyzing flow through a bed of particles, applications of fluidization & fluidized bed, conditions for fluidization, minimum fluidization velocity, types and applications of fluidization. CO6: Understand and applying concepts of Handling, Storage and Transportation of Solids , Agitation of liquids, axial flow impellers, radial flow impellers, design of agitators, velocity and power consumption of agitated vessels, blending & mixing.
MECHANICAL OPERATIONS (PRACTICAL)	CO1: Understand the grinding operation and evaluate critical speed of a ball mill. CO2: Analyze particle size distribution and evaluate screen effectiveness. CO3: Understand pressure drop behavior for the flow of Newtonian fluid flowing though fixed and fluidized beds. CO4: Understand the process of filtration and apply the basic equations of filtration. CO5: Understand settling rate and behavior of particles falling in quiescent liquid.
COMPREHENSIVE VIVA	CO1: Demonstrate technical knowledge of theory and practical subjects taught during first to fourth semesters. CO2: Demonstration of professional aptitude, learning ability and communication skills.
SEMESTER-V	**SEMESTER-V**
NUMERICAL METHODS IN CHEMICAL ENGINEERING	CO1: Learn evaluating error in calculations, use of numerical methods for solving algebraic and transcendental equations and using various methods to carry out numerical differentiation and numerical integration. CO2: Understanding the concept of Finite Differences and Learn to use this for Interpolation and Inverse Interpolation with equispaced and unequispaced data. Learn to use Least Square Curve Fitting Procedure. CO3: Solve numerically ordinary differential equations of First and Higher order/Simultaneous differential equations using different methods. CO4: To Find the solution of linear system of equations by Direct and Iterative methods. Learn to solve partial differential equations using Finite difference approximation method.
ENERGY TECHNOLOGY	CO1: Have knowledge of solid fuels, their analysis, cleaning methods, carbonization process and synthetic fuels from coal CO2: Have knowledge of liquid fuels and manufacturing processes of gaseous fuels CO3: Be able to describe various furnaces, draught and furnace atmosphere and solve combustion problems CO4: Have in-depth knowledge of various renewable sources of energy, their scope and technologies in use
CHEMICAL REACTION	CO1: To understand the mechanism of chemical kinetics for different types

COURSE	Course outcomes
ENGINEERING–I	of reactions. CO2: To design batch and flow reactors for single homogeneous reactions. CO3: To understand the factors affecting the conversion, yield and selectivity in multiple reactions. CO4: To understand the concepts of non-ideal reaction.
CHEMICAL REACTION ENGINEERING–I LAB.	CO1: Describe the kinetics of a batch and semi batch and adiabatic batch reactor CO2: To understand and demonstrate kinetics of CSTR and PFR CO3: Perform RTD studies in a CSTR
MASS TRANSFER – I	CO1: Classify mass transfer operations and laws of mass transfer. CO2: Evaluation of molecular diffusion in gases, liquids and solids. CO3: Discuss diffusion coefficient/Mass transfer coefficient, interphase mass transfer and estimation of number of stages. CO4: Evaluation of humidification operations, design of cooling tower and working of gas-liquid contacting equipments. CO5: Analysis of drying and discuss the working of different types of dryers.
CHEMICAL TECHNOLOGY (INORGANIC)	CO1: Identify the application of basic chemistry concepts to process industries like Chlor-Alkali Industry, Manufacture of soda ash and caustic soda and Sulphuric Acid. CO2: Recognize current issues and trends in process industries with a Study of manufacture of Cement and Glass and identify the importance of safety, health, and the environment in process industries. CO3: Understanding the basic history and manufacture of industrial gases, and Manufacture of different types of paints and Course outcomes outline the guiding principles of quality in the process industries. CO4: Understanding the manufacture of various fertilizers and processes involved and recognize the safety aspects.
CHEMICAL TECHNOLOGY (INORGANIC) LAB.	CO1: Experimental determination of NPK Values and micronutrients in different fertilizers. CO2: Estimation of Mg, Ca, Fe in cement and Loss of ignition, silica and insolubles. CO3: To determine the %age of chlorine in given sample of bleaching powder.
PROCESS PLANT DESIGN –I	CO1: Design and specifications of pipes, pumps, fans and blowers. CO2: Design and specifications Dor thickeners, dust chambers, cyclone separators and centrifuges. CO3: Design of agitated vessels, impellers and Conveyor system for solids.
CHEMICAL ENGINEERING COMPUTATION LAB. (PRACTICAL)	CO1: Determination of solution of linear and non-linear algebraic and transcendental equations using computer programs or MATLAB. CO2: To carryout Numerical differentiation & integration using computer programs. CO3: To find solution of Ordinary and partial differential equations using computer programs. CO4: Carryout Interpolation and least squares approximation using computer programs.
SEMESTER-VI	**SEMESTER-VI**
CHEMICAL REACTION ENGINEERING-II	CO1: Describe Heterogeneous catalyses, catalytic specificity. Preparation testing and characterisation of catalysts, catalyst poisoning and catalyst regeneration CO2: To understand and analyse the external and internal transport in catalytic reaction systems. CO3: Describe Fluid Solid catalytic reactions, reaction & diffusion within porous catalysts and effectiveness factors. CO4: Describe Fluid Solid non-catalytic reactors rate equations and their application to the design of reactors. CO5: Analysis of rate data design outline and selection of fixed bed, fluid bed and slurry reactions
MASS TRANSFER-II	CO1: To understand the concepts of mass transfer equilibria for vapour-liquid and to generate operating line for various mass transfer systems

COURSE	Course outcomes
	like absorption, distillation, liquid-liquid extraction. Leaching, adsorption and principles of crystallization. CO2: The students are able to comprehend the concepts of co current & counter current processes, cascades and concept of Ideal stage and stage efficiencies, continuous contact equipments, number of transfer units and height of a transfer unit (NTU & HTU) concepts, packed column for absorption, equipment for gas absorption CO3: The students will get acquaintance about McCabe–Thiele methods & Ponchon Savarit method to calculate the number of stages for distillation column and able to design the column. CO4: The students will be able to understand the working of different equipments used for various mass transfer operations such as leaching, crystallization, etc.
MASS TRANSFER II LAB.	CO1: Application of different mass transfer equipments, Determination of mass transfer coefficients for naphthalene-air system. To determine drying rate curves for different wet solids in a batch drier. CO2: Verification of Rayleigh's equation for differential distillation, Determination of flooding velocities in packed columns. CO3: Determination of HETP for packed distillation columns, flooding velocities in packed columns. CO4: Practice operation of a pilot sized distillation column under total reflux, Fractional approach to equilibrium for liquid-liquid extraction from single drop.
PROCESS DYNAMICS & CONTROL	CO1: Develop the output-input relationship in terms of transfer function for first and higher order systems and evaluate their response to various inputs. CO2: Analyse the stability characteristics of control systems and apply Root locus technique to evaluate control system's response. CO3: Understand the control system; various control configurations along with various controllers and their characteristics. CO4: Design the PID controllers using frequency response technique and understand the concepts of Bode plots. CO5: Understand closed loop transfer function, block diagram, transient response along with the basics of various advanced control techniques.
PROCESS DYNAMICS & CONTROL LAB.	CO1: To plot the response curve for a given input to a U-tube manometer and to determine the transfer function from the response CO2: To study the dynamics of the given thermometer and compare the theoretical value of its time constant with the experimental value. CO3: Determine Experimentally characteristics of of control valves and liquid level measurement systems. CO4: Experimental studies on temperature and pressure control systems.
CHEMICAL TECHNOLOGY (ORGANIC)	CO1: Identify the processes and the concepts involved in the Extraction and refining of oils & fats, hydrogenation of oils and Manufacture of soap and detergents. CO2: Understand the various water treatment processes for desalination as well as Water softening; using Lime soda, Ion exchange methods CO3: Recognized the different Manufacturing processes of pulp, paper and sugar. CO4: Understand the manufacture of activated carbon and carbon technology, synthesis of nano particle by plasma process.
CHEMICAL TECHNOLOGY (ORGANIC) LAB.	COI Ability to understand the significance of Acid Vaiue,Iodine Value and Saponification Value. CO2 Ability to understand the concept of Reducing and Non Reducing sugars using (i) Pavys Method (ii) Fehlings Method and the difference between the two methods CO3 To identify the nature of soap by determining the free and combined alkali,total fatty matter and moisture content
SEMESTER-VII	**SEMESTER-VII**
TRANSPORT	CO1: Ability to understand the chemical and physical transport processes

COURSE	Course outcomes
PHENOMENA	and their mechanism of heat, mass and momentum transfer analysis CO2: analyse any transport related problem mathematically and predict the physical behaviour of the process CO3: formulate problems along with appropriate boundary conditions and develop steady and time dependent solutions.
ENVIRONMENTAL ENGINEERING	CO1: Describe principal air pollutants, their sources and effects. CO2: Discuss atmospheric dispersion of air pollutants and estimate concentration of air pollutants. CO3: Demonstrate the construction, working and theory of equipments used for the control of air pollution. CO4: Classify water pollutants, their sources and effects and calculation of water quality parameters. CO5: Application and design of physical/ chemical/ biological treatment methods for small communities/municipal sewage/industrial water/ waste water treatment. CO6: Classify solid wastes, their sources, effects and methods of disposal of solid wastes.
ENVIRONMENTAL ENGINEERING LAB.	CO1: Calculate BOD, COD, TSS & TDS of wastewater samples. CO2: Determination of chromium separation, phenol content of water sample & To find the biodegradation constant (K) and the effect of timing on it CO3: Practice and apply electro dialysis apparatus and reverse osmosis set up for waste water analysis. CO4: To use stack monitoring kit to find: Efficiency of a cyclone & Dust sampling.
PROCESS MODELLING & SIMULATION	CO1: Describe fundamentals of modelling and simulation, formulate mathematical models and perform degree of freedom analysis. CO2: Derive the mathematical models for chemical engineering systems and solve them using any one of the softwares Polymath/C/C++/Matlab. CO3: Apply simulation to get the output for the models of heat exchangers, distillation columns, reactor and process equipment.
PROCESS PLANT DESIGN-II	CO1: Design and specifications of double pipe heat exchanger, shell and tube heat exchanger, plate type heat exchanger, condenser and reboiler. CO2: Design of distillation column, calculation of number of plates, height and design of fractionator internals- sieve tray. CO3: Design aspects of fixed bed reactors and fluidized bed reactors.
SEMESTER-VIII	**SEMESTER-VIII**
PROCESS INSTRUMENTATION	CO1: Classify elements and types of instruments, static and dynamic characteristics of instruments. CO2: Illustrate the different methods for the measurement of temperature and their useful applications. CO3: Elucidate the construction and working of various industrial devices used to measure pressure and vacuum. CO4: Explicate the construction and working of various industrial devices used to measure level. CO5: Discuss methods for measurement of viscosity, conductivity, humidity, density, weight and pH. CO6: Describe recording/indicating/signalling instruments and Control Centre. CO7: Construct Instrumentation diagrams.
PROCESS ENGINEERING ECONOMICS	CO1: Formulate and apply interest factors to real life engineering problems CO2: Perform economic analysis for process to calculate equipment cost CO3: Develop and apply mathematical models describing real life cash flows and time value of money CO4: Evaluate engineering alternatives and profitability for process CO5: Perform breakeven analysis and optimum and plant design of a process.
PROJECT WORK	CO1: Apply the knowledge of chemical engineering and basic sciences to design or fabricate a system/unit/plant.

COURSE	Course outcomes
	CO2: Apply knowledge of chemical engineering to solve energy and material balance and design efficient process. CO3: Analyze the process components and perform the coat analysis and efficiency of the process.
COMPREHENSIVE VIVA	CO1: Demonstrate technical knowledge of theory and practical subjects taught during whole degree course. CO2: Demonstration of professional aptitude, learning ability and communication skills, originality and capacity for application of this profession to service of mankind. CO3: Strive for lifelong learning, exhibiting professionalism and ethical behaviour and service of the nation, discipline and society.
LITERATURE SURVEY, REPORT WRITING & SEMINAR	CO1: Survey of scientific, technical and commercial literature in engineering/technology and defining problem statement. CO2: Critical analysis and evaluation of literature CO3: Demonstrate effective public speaking and impromptu discussions CO4: Write technical report in a coherent and concise manner.
OPEN ELECTIVES	**Open Electives**
FUEL CELL TECHNOLOGY	CO1: Knowledge and concept of fuel cell technology and various types. CO2: Knowledge of thermodynamics, chemical reaction engineering, transport processes and electrochemical engineering perspectives. CO3: Knowledge of fuel cell modeling and characterization techniques. CO4: Knowledge of hydrogen energy, its generation and storage with safety issues
NANO TECHNOLOGY	CO1: Understand the basis of nanotechnology in terms of bonding, types of nanomaterials. CO2 : Explain methods of synthesis and fabricating nanostructures (top down- bottom up). CO3: Relate the unique properties of nanomaterials to the reduced dimensionality of the material through characterisation. CO4 : Discuss applications of nanomaterials in various fields.
POLYMER SCIENCE AND ENGINEERING	CO1: Describe chemistry of polymers, classification of polymers, addition and condensation polymersation, coplymerization, polymerization techniques. CO2: Characterization of polymers, concept of average molecular weight and types, polymer crystallinity, analysis of polymers using IR, XRD, DSC, DMTA, TGA etc techniques. CO3: Define Polymer compounding, different compounding ingredients for rubber and plastics, crosslinking and vulcanization. CO4: Applications of Polymer processing techniques, injection molding, blow molding, calendaring, rotational molding, thermoforming, rubber processing etc.
OPERATIONS RESEARCH	CO1: Define and apply Linear Programming methods, describe problem formulation, graphical method, simplex method, duality sensitivity analysis and Transportation model based problems. CO2: Describe Theory of Games, Algebraic, Graphical & Linear programming methods. Queuing Theory, elementary queuing system; single & multiple channel queuing model, , Poisson arrivals and Erlang service distribution; benefits and limitations of queuing theory.
PROJECT MANAGEMENT AND ENTREPRENEURSHIP	CO1: To consider the legal and financial conditions for starting a business venture To evaluate the effectiveness of different entrepreneurial strategies CO2: To understand the nature of entrepreneurship and functions of the successful entrepreneur. To identify personal attributes that enable best use of entrepreneurial opportunities CO3: Explain the concept and attributes of projects, project management system, process and its principles, and various stages of a project. Perform technical feasibility, marketing feasibility and commercial viability using NPV, and further to understand tax and legal aspects of a project.

COURSE	Course outcomes
	CO4: Analyse project appraisal in public & private sector and estimate shadow prices and social discount rate. Examine project risk and performance assessment. Evaluate project management techniques using case studies.
DEPARTMENTAL ELECTIVE	**DEPARTMENTAL ELECTIVE**
PETROLEUM PROCESSING ENGINEERING	CO1: Define Origin, exploration & drilling of petroleum crude, Crude pretreatment: Refining and distillation of petroleum crude, composition and classification of petroleum crude. CO2: Describe Properties and specifications of petroleum products such as LPG, gasoline, naphtha, kerosene, diesel, lubricating oils and waxes. CO3: Illustrate separation processes, Describe Solvent extraction processes and solvent dewaxing. CO4: Describe Conversion Processes, cracking and refining, alkylation, polymerization, isomerisation and hydroprocessing, Safety and pollution considerations in refineries.
PETROLEUM PROCESSING ENGINEERING LAB.	CO1: Determine Flash point (Closed – cup) and smoke point for kerosene, ASTM distillation curve for gasoline, diesel oil. CO2: Determine Aniline point, Diesel Index, pour point and cloud point and cetane number for diesel oil. CO3: Determine viscosity at different temperatures using Ostwald viscometer for hydrocarbon solvents, viscosity index of lubricating oil by Redwood viscometer. CO4: Determine water content in petroleum products by Dean and Starks method.
INDUSTRIAL SAFETY & HAZARDS	CO1: Identify the various types of hazards in work-place environment, protective and preventive measures in hazard control, Toxic Chemicals, maximum allowable concentrations and other standards. Biological threshold limit values. CO2: Recognize Mechanical and Electrical hazards, Explosives and inflammable substances, radioactive hazards CO3: Select appropriate Personal protective equipments and effective control strategies for Fire prevention. Good housekeeping in industrial environment. CO4: Understand Standard safety procedures and disaster control, OSHAS, OHSMS and OSHA. Current amendments in Indian Legislation on safety and prevention of hazards and safety code: ISO 14000, ISO9000. CO5: Describe Environmental impact assessment. Case studies of typical hazardous industries. CO6: Select proper control strategies for hazardous wastes.
PLANT UTILITIES	CO1: Understand the selection of different utilities to run process plant. CO2: Analyze the use of compressed air through air compressore and vacuum pumps. CO3: Analyse of use of steam and or boiler. CO4: To analyse the power generation through IC engines and turbines. CO5: Understand the importance refrigeration and water resources.
BIOCHEMICAL ENGINEERING	CO1: Gaining knowledge about metabolic pathways and cell growth. CO2: Understanding the concept of enzyme kinetics and their applications. CO3: Designing and creating new processes and fermented products that are better economically and technologically. CO4: Understanding the basic calculations for heat and mass transfer and yield of product.