CHEMICAL ENGINEERING DEPARTMENT

Program Outcomes (PO's)

Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization for the solution ofcomplex engineering problems

Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex engineeringproblems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation ofdata, and synthesis of the information to provide valid conclusions.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledgeto assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate theknowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a memberor leader in diverse teams, and in multidisciplinary settings.

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Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effectivepresentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinaryenvironments.

Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technologicalchange.

R22:

Department Vision

To become the most sought centre of excellence engaged in training and shaping students as professionals for higher education and process industries bothin India and abroad and allow the students to do R & D projects and publish samein the reputed journals.

Department Mission

- Imparting contemporary technical education and training manpower.
- To create a skilled human resource talent pool.
- To serve and manage the process industries globally with a sense of responsibility towards society and the environment.

Program Education Objectives (PEOs):

- **PEO-1:** Graduates will excel in advanced studies and research in chemical engineering and allied disciplines, will establish successful enterprises by applying their foundations of chemical engineering principles and provide innovative solutions to industry challenges.
- **PEO-2:** Graduates will possess the ability to lead, collaborate effectively, and conduct themselves ethically in professional environments. They will recognize the impact of their work on society and environment on a global scale, and will pledge to engage in actions that benefit society.
- **PEO-3:** Graduates will utilize their technical expertise and analytical abilities to enhance the design, evaluation, and optimization of products and processes. They will respond to the evolving demands of the process industries by dedicating themselves to excellence in engineering practices.

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- **PEO-4:** Graduates will engage in continuous technological advancements, enhancing their abilities through attending workshops and conferences, certification courses, and self-directed study. This will assist them in remaining pertinent and adaptable in an ever-evolving world.

Program Specific Outcomes (PSOs)

PSO-1: Undertake research activities in the area of heat & mass transfer, separation processes,

Reaction engineering, related to Green Chemical Engineering.

PSO-2: Undertake real life projects in process industries and allied fields.

R20:

Department Vision

To become the most sought center of excellence engaged in training and shaping students as professionals for higher education and process industries both in India and abroad and allow the students to do R & D projects and publish same in the reputed journals.

Department Mission

Imparting contemporary technical education and training manpower to create a skilled human resource talent pool to serve, manage the process industries globally with a sense of responsibility towards society and the environment.

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PSO-1: Undertake research activities in the area of heat & mass transfer, separation processes, Reaction engineering, related to Green Chemical Engineering.

PSO-2: Undertake real life projects in process industries and allied fields.

R18:

Department Vision

To become the most sought center of excellence engaged in training and shaping students as professionals for higher education and process industries both in India and abroad and allow the students to do R & D projects and publish same in the reputed journals.

Department Mission

Imparting contemporary technical education and training manpower to create a skilled human resource talent pool to serve, manage the process industries globally with a sense of responsibility towards society and the environment.

Program Education Objectives (PEOs):

- **PEO-1:** Graduates will excel in advanced studies and research in chemical engineering and allied disciplines, will establish successful enterprises by applying their foundations of chemical engineering principles and provide innovative solutions to industry challenges.
- **PEO-2:** Graduates will possess the ability to lead, collaborate effectively, and conduct themselves ethically in professional environments. They will recognize the impact of their work on society and environment on a global scale, and will pledge to engage in actions that benefit society.

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- **PEO-3:** Graduates will utilize their technical expertise and analytical abilities to enhance the design, evaluation, and optimization of products and processes. They will respond to the evolving demands of the process industries by dedicating themselves to excellence in engineering practices.
- **PEO-4:** Graduates will engage in continuous technological advancements, enhancing their abilities through attending workshops and conferences, certification courses, and self-directed study. This will assist them in remaining pertinent and adaptable in an ever- evolving world.

Program Specific Outcomes (PSOs)

PSO-1: Undertake research activities in the area of heat & mass transfer, separation processes, Reaction engineering, related to Green Chemical Engineering.

PSO-2: Undertake real life projects in process industries and allied fields.

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (Autonomous)

Gandipet, Hyderabad -75

Chemical Engineering Department

Course Outcome Statements for B. Tech (Chemical)

R22

SEMESTER - I			
S.NO	Subject name /CODE	COs	*After completing this course the student must be able to*
1	CALCULUS (CHEMICAL) 22MTC02	22MTC02.CO1	Apply the Matrix Methods to solve the system of linear equations
		22MTC02.CO2	Analyze the geometrical interpretation of Mean value theorems and curvature.
		22MTC02.CO3	Determine the extreme values of functions of two variables.
		22MTC02.CO4	Find the shape of the curve, surface areas and volumes of revolution.
		22MTC02.CO5	Examine the convergence and divergence of infinite Series.
2	CHEMISTRY (CHEMICAL) 22CYC01	22CYC01.CO1	Identify microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemicalreactions.
		22CYC01.CO2	Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role inbatteries and fuel cells.
		22CYC01.CO3	Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
		22CYC01.CO4	Classify the various methods used in the treatment of water for domestic and industrial use.
		22CYC01.CO5	Outline the synthesis of various Engineering materials & Drugs.
3	BASIC ELECTRICAL ENGINEERING 22EEC01	22EEC01.CO1	Understand the concepts of Kirchhoff's laws and their application various theorems to get solution of simpledc circuits.
		22EEC01.CO2	Predict the steady state response of RLC circuits with AC single phase/three phase supply.
		22EEC01.CO3	Infer the basics of single phase transformer
		22EEC01.CO4	Describe the construction, working principle of DC machine and 3-phase Induction motor
		22EEC01.CO5	Acquire the knowledge of electrical wires, cables, earthing, Electrical safety precautions to be followed inelectrical installations and electric shock and its safety and energy calculations
4	PROBLEM SOLVING AND PROGRAMMING USING PYTHON (For Other Branches) 22CSC40N	22CSC40N.CO1	Understand real world problems and Create algorithms/flowcharts/decision tables for solving those problems.
		22CSC40N.CO2	Interpret the data types, operators and tokens of Python for solving basic programming solutions
		22CSC40N.CO3	Apply the constructs like selection, repetition and functions to modularize the programs.
		22CSC40N.CO4	Analyze searching/sorting techniques to solve problems that involve finding and manipulating data.
		22CSC40N.CO5	Design and build applications with built-in modules and files.
5	CHEMISTRY LAB (CHEMICAL) 22CYC02	22CYC02.CO1	Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
		22CYC02.CO2	Estimate the amount of chemical substances by volumetric analysis.
		22CYC02.CO3	Determine the rate constants of reactions from concentration of reactants/ products as a function of time.
		22CYC02.CO4	Calculate the concentration and amount of various substances using instrumental techniques
		22CYC02.CO5	Develop the basic drug molecules and polymeric compounds.
6	COMMUNITY ENGAGEMENT 22MBC02N	22MBC02N.CO1	Gain an understanding of Rural life, Culture and Social realities.
		22MBC02N.CO2	Develop a sense of empathy and bonds of mutuality with Local Communities.
		22MBC02N.CO3	Appreciate significant contributions of Local communities to Indian Society and Economy.
		22MBC02N.CO4	Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
		22MBC02N.CO5	Utilise the opportunities provided by Rural Development Programmes.
7	PROBLEM SOLVING AND PROGRAMMING USING PYTHON LAB (For Other Branches) 22CSC41N	22CSC41N.CO1	Inspect and identify suitable programming environment to work with Python.
		22CSC41N.CO2	Choose appropriate control constructs, data structures to design and build the solutions.
		22CSC41N.CO3	Develop the solutions with modular approach using functions to enhance the code efficiency.
		22CSC41N.CO4	Analyze and debug the programs to verify and validate code.
		22CSC41N.CO5	Demonstrate use of Standard Template Libraries and modules to build file handling/Searching/Sorting applications.
8	ROBOTICS AND DRONES LAB 22MEC37N	22MEC37N.CO1	Understand mechanical structures, motors, sensors, and circuits essential for constructing robots.
		22MEC37N.CO2	Demonstrate the utilization of sensors (Ultrasonic, IR, Rotary Encoder) for Arduino interfacing, reading data, and integrating them seamlessly into robotics applications.
		22MEC37N.CO3	Demonstrate expertise in operating robot controllers, applying theory to precisely control servo and stepper motors, 2 wheel robots ensuring desired motion.
		22MEC37N.CO4	Able to apply Python and OpenCV for image processing, including RGB extraction and ROI tasks
		22MEC37N.CO5	Proficiently assemble a quadcopter drone, showcasing understanding of its classification, parts, and operational principles/ Proficiency to develop autonomous systems fostering creativity and practical application.
9	BASIC ELECTRICAL ENGINEERING LAB 22EEC02	22EEC02.CO1	Comprehend the circuit analysis techniques using various circuital laws and theorems.
		22EEC02.CO2	Analyse the parameters of the given coil and measurement of power and energy in AC circuits
		22EEC02.CO3	Determine the turns ration/performance parameters of single-phase transformer
		22EEC02.CO4	Infer the characteristics of DC shunt motor different tests.
		22EEC02.CO5	Illustrate different parts and their function of electrical components, equipment and machines.

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SEMESTER - II

S.NO	Subject name /CODE	COs	*After completing this course the student must be able to*
1	VECTOR CALCULUS AND DIFFERENTIAL EQUATIONS (CHEMICAL) 22MTC05	22MTC05.CO1	Apply the vector differential operators to Scalars and Vector functions.
		22MTC05.CO2	Solve line, surface & volume integrals by Greens, Gauss and Stoke's theorems.
		22MTC05.CO3	Calculate the solutions of first order linear differential equations.
		22MTC05.CO4	Solve higher order linear differential equations.
		22MTC05.CO5	Find solution of algebraic, transcendental and ODE by Numerical Methods.
2	PHYSICS (BIOTECH & CHEMICAL) 22PYC07	22PYC07.CO1	Demonstrate the physical properties of the light.
		22PYC07.CO2	Find the applications of lasers and optical fibers in engineering and technology.
		22PYC07.CO3	Identify different types of magnetic and dielectric materials.
		22PYC07.CO4	Recall the fundamentals of nanomaterials.
		22PYC07.CO5	Apply the ideas of quantum mechanics for related problems
3	ENGINEERING MECHANICS 22CE C01N	22CE C01N.CO1	Calculate the components and resultant of coplanar forces system and Draw free body diagrams to analyze the forces in the given structure
		22CE C01N.CO2	Understand the mechanism of friction and can solve friction problems
		22CE C01N.CO3	Analyse simple trusses for forces in various members of a truss.
		22CE C01N.CO4	Determine the centroid of plane areas, composite areas and centres of gravity of bodies.
		22CE C01N.CO5	Determine moments of inertia of plane and composite areas.
4	ENGLISH (Common to All Branches) 22EGC01N	22EGC01N.CO1	Step-up the awareness of correct usage of English grammar and vocabulary by speaking fluently and comprehensively with a grip on communication skills.
		22EGC01N.CO2	Apply effective reading techniques through critical reading exercises to enhance quality of life and to support lifelong learning.
		22EGC01N.CO3	Develop their ability to write paragraphs independently on any context with cohesion, edit essays coherently while realizing brevity through précis writing.
		22EGC01N.CO4	Construct sentences clearly and comprehensively to write effective business letters and draft emails for a better professional communication.
		22EGC01N.CO5	Advance efficiency in writing, distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports
5	PHYSICS LAB (Biotech & Chemical) 22PYC10	22PYC10.CO1	Interpret the errors in the results of an experiment.
		22PYC10.CO2	Demonstrate the wave nature of light experimentally
		22PYC10.CO3	Utilize physical properties of magnetic and dielectric materials for various applications
		22PYC10.CO4	Make use of lasers and optical fibers for engineering applications
		22PYC10.CO5	Explain light induced phenomenon and motion of electrons in electric and magnetic fields
6	ENGLISH LAB (Common to All Branches) 22EGC02N	22EGC02N.CO1	Define the speech sounds in English and understand the nuances of pronunciation in English.
		22EGC02N.CO2	Produce speech with clarity and confidence using correct word and sentence stress, and intonation.
		22EGC02N.CO3	Achieve improved ability to listen, understand, analyse, and respond to English spoken in various
		22EGC02N.CO4	Read, interpret, and review a variety of written texts, contexts, and perform appropriately in different situations.
		22EGC02N.CO5	Design effective posters collaboratively through creative decisions, give presentations, and efficiently participate in Group discussions.
7	ENGINEEERING GRAPHICS 22MEC01N	22MEC01N.CO1	Become conversant with appropriate use of CAD software for drafting and able to draw conic sections.
		22MEC01N.CO2	Understand orthographic projections of points and straight lines.
		22MEC01N.CO3	Draw the projections of planes.
		22MEC01N.CO4	Draw and analyze the internal details of solids through sectional views.
		22MEC01N.CO5	Create an isometric projections and views.
7	DIGITAL FABRICATION WORKSHOP 22MEC38N	22MEC38N.CO1	Understand safety measures to be followed in workshop to avoid accidents.
		22MEC38N.CO2	Identify various tools used in carpentry, house wiring and plumbing.
		22MEC38N.CO3	Make a given model by using workshop trades like carpentry, plumbing, House wiring and 3d modeling using solid works software for Additive Manufacturing.
		22MEC38N.CO4	Perform pre-processing operations on STL files for 3D printing, also understand reverse engineering process.
		22MEC38N.CO5	Conceptualize and produce simple device/mechanism of their choice.

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SEMESTER - III			
S.NO	Subject name /CODE	COs	*After completing this course the student must be able to*
1	PARTIAL DIFFERENTIAL EQUATIONS AND STATISTICS (CHEMICAL) 22MTC10	22MTC10.CO1	Calculate the Euler's coefficients for Fourier series expansion of a function.
		22MTC10.CO2	Solve Linear and Nonlinear PDEs.
		22MTC10.CO3	Solve One-Dimension Wave and Heat equations and Two Dimensional Laplace equations.
		22MTC10.CO4	Use the basic probability for fitting the Random phenomenon.
		22MTC10.CO5	Analyze the random fluctuations of probability distribution and Principles of Least Squares approximationsfor the given data.
2	CHEMICAL ENGINEERING THERMODYNAMICS-I 22CHC01	22CHC01.CO1	Understand the fundamental concepts of thermodynamics to engineering applications.
		22CHC01.CO2	Apply mass and energy balances to closed and open systems and study the PVT behavior of pure substances.
		22CHC01.CO3	Apply the laws of thermodynamics and estimate the heat and work requirements for Industrial Processes.
		22CHC01.CO4	Evaluate thermodynamic properties of ideal and real mixtures and the efficiency of flow processes.
		22CHC01.CO5	Analyze liquefaction, refrigeration and different power cycles.
3	CHEMICAL TECHNOLOGY 22CHC02N	22CHC02N.CO1	Differentiate between unit operation and unit processes.
		22CHC02N.CO2	Estimate the chemical industry growth and opportunities.
		22CHC02N.CO3	Develop flow diagrams of different processes.
		22CHC02N.CO4	Classify between Inorganic and Organic processes.
		22CHC02N.CO5	Design processes based on conditions space time, yield, conversion, recycle methods, temperature andpressure.
4	FLUID MECHANICS 22CHC03	22CHC03 .CO1	Distinguish different types of fluids, manometers.
		22CHC03 .CO2	Apply Shell balances to illustrate fluid flow phenomena.
		22CHC03 .CO3	Identify the concepts of incompressible flow in pipes, channels and associated frictional losses.
		22CHC03 .CO4	Explain the concept of fluidization and flow through packed beds.
		22CHC03 .CO5	Choose the types of pumps for different fluids under different conditions and Identify equipment to be usedto measure fluid flow.
5	MECHANICAL UNIT OPERATIONS 22CHC04	22CHC04.CO1	Choose the suitable size reduction and transportation equipment for solids based on their properties
		22CHC04.CO2	Select equipment for industrial application with respect to size separation techniques.
		22CHC04.CO3	Design equipment for industrial application with respect to separation of solid-fluid operations.
		22CHC04.CO4	Apply the different filtration techniques for industrial application.
		22CHC04.CO5	Identify the suitable technique for blends and mixing of liquids and solids.
6	MATERIAL ENERGY BALANCE CALCULATIONS 22CHC05	22CHC05.CO1	Convert physico-chemicalquantitiesfromonesystemofunitstoanotherandexpress composition ofsystems on different basis of calculation.
		22CHC05.CO2	Solve material balance problems without chemical reactions for single and multi-unit systems.
		22CHC05.CO3	Solve material balance problems with chemical reactions.
		22CHC05.CO4	Solve energy balance problems for non-reactive systems.
		22CHC05.CO5	Estimation heat of reaction for reactive systems.
7	FLUID MECHANICS LAB 22CHC06	22CHC06.CO1	Identify variable area flow meters and variable head flow meters
		22CHC06.CO2	Explain the fluid flow characteristics.
		22CHC06.CO3	Demonstrate the Bernoulli principle.
		22CHC06.CO4	Analyze the flow of fluids through closed conduits, open channels.
		22CHC06.CO5	Interpret the characteristics of pumps.
8	MECHANICAL UNIT OPERATIONS LAB 22CHC07	22CHC07.CO1	Assess the nature of solids, their characterization, handling and the processes involving solids
		22CHC07.CO2	Analyze the performance of size reduction equipment and calculate the power andefficiency requirements
		22CHC07.CO3	Identify the principle, construction and operation of various classification equipment
		22CHC07.CO4	Select the suitable Solid -Liquid industrial separation equipment based on settling, densityand centrifugal force
		22CHC07.CO5	Estimate the cake properties in a filtration operation

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SEMESTER - IV

S.NO	Subject name /CODE	COs	*After completing this course the student must be able to*
1	Data Structures using Python 22ITC22N	22ITC22N.CO1	Analyse the time complexity of operations on data structures.
		22ITC22N.CO2	Apply sorting techniques, search techniques and hashing.
		22ITC22N.CO3	Understand the concepts of OOPs.
		22ITC22N.CO4	Demonstrate operations on linear and nonlinear data structures.
		22ITC22N.CO5	Develop solutions to the problems using linear and nonlinear data structures.
2	CHEMICAL ENGINEERING THERMODYNAMICS – II 22CHC08	22CHC08.CO1	Evaluate Partial molar, Residual and Excess properties.
		22CHC08.CO2	Estimate Fugacity and Fugacity Coefficients for miscible binary Mixtures and also pure species.
		22CHC08.CO3	Determine the activity coefficient using various models.
		22CHC08.CO4	Analyze Bubble and Dew point calculations for Ideal and Non Ideal solutions using VLE data
		22CHC08.CO5	Predict equilibrium constant and composition of product mixture at given temperature and pressure
3	HEAT TRANSFER 22 CHC09	22 CHC09.CO1	Understand the different modes of heat transfer, conduction heat transfer through the differentgeometries under steady & unsteady state conditions
		23 CHC09.CO2	Calculate the heat transfer coefficients under the forced, natural convection and understand theconcepts of heat exchangers and its design
		24 CHC09.CO3	Analyze the heat transfer phenomena in fluids involving phase changes
		25 CHC09.CO4	Identify the type of evaporator required for a specific purpose and its design
		26 CHC09.CO5	Understand the concept of radiation, laws of radiation and the impact of radiation shields
4	INSTRUMENTATION AND MATERIAL CHARACTERIZATION 22CHC10	22CHC10.CO1	Understand the measurement techniques of different process variables
		22CHC10.CO2	Select temperature, pressure, level, and flow measuring instruments based on their operation
		22CHC10.CO3	Explain the morphological and crystallographic characterization techniques
		22CHC10.CO4	Infer the characterizations associated with spectroscopy
		22CHC10.CO5	Explain the concepts of rheology and chromatographic analysis
5	MASS TRANSFER OPERATIONS-I 22CHC11	22CHC11.CO1	Apply the concepts of diffusion mass transfer to fluids and solids
		22CHC11.CO2	Estimate the mass transfer coefficients of mixtures.
		22CHC11.CO3	Design Absorber/Stripper by equilibrium methods
		22CHC11.CO4	Design the cooling tower with the concept of humidification
		22CHC11.CO5	Interpret the drying mechanism by estimating the total drying period.
6	ENERGY ENGINEERING (Professional Elective I) 22CHE01	22CHE01.CO1	Explain the conventional and non-conventional energy sources and discuss thecharacterization and production methods of non-conventional energy sources.
		22CHE01.CO2	Illustrate the principles and applications of solar energy and photovoltaic cells.
		22CHE01.CO3	Summarize the basic principles of wind energy, hydropower and tidal Energy
		22CHE01.CO4	Explain the importance of biofuels and classify them
		22CHE01.CO5	Demonstrate the need for energy auditing and conservation, identify strategies for reducingenergy consumption and increasing efficiency
7	FOOD PROCESSING TECHNOLOGY (Professional Elective I) 22CHE02	22CHE02.CO1	Understand food demand scenario with respect to world and India
		22CHE02.CO2	Explain heat effects and food processing on sensory and nutritional characteristics of food
		22CHE02.CO3	Analyze various techniques of raw material preparation and design process equipment to achievethe desired quality of food
		22CHE02.CO4	Develop novel food processes that have a minimal effect on food quality.
		22CHE02.CO5	Know different types of packaging and packaging materials for effective food packaging.
8	PULP AND PAPER TCHNOLOGY (Professional Elective I) 22CHE03	22CHE03 .CO1	Distinguish the important wood and fiber properties that affect paper quality
		22CHE03 .CO2	Identify, formulate and solve design problems pertaining to pulp digester
		22CHE03 .CO3	Select appropriate bleaching technique for required paper quality
		22CHE03 .CO4	Evaluate different grades of paper and boards based on testing methods
		22CHE03 .CO5	Identify the factors that drive paper industry trends
9	WATER CONSERVATION AND MANAGEMENT (Professional Elective-I) 22CHE04	22CHE04.CO1	Identify with the water storage methods in practice based on available sources and supply.
		22CHE04.CO2	Understand the water quality parameters and analysis methods.
		22CHE04.CO3	Categorize the basic characteristics of water and their testing methods.
		22CHE04.CO4	Associate with the objectives of water harvesting and recycling methods.
		22CHE04.CO5	Use of water conservation methods at work place, agriculture, service and process industry.
10	INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES (BE/B.Tech - Common to all branches) 22EGM01	22EGM01 .CO1	Understand the history of framing of the Indian Constitution and its features.
		22EGM01 .CO2	Assess the realization of Fundamental Rights and Directive Principles of State Policy.
		22EGM01 .CO3	Analyze the challenges to federal system and position of the President and the Prime Minister in the Union Government.
		22EGM01 .CO4	Underline the role of the Legislature and the Judiciary in Union Government and their mutual relations.
		22EGM01 .CO5	Evolve the development of the local governments in India and assess the role of Collector in district administration.
11	DATA STRUCTURES USING PYTHON LAB 22ITC23	22ITC23.CO1	Apply sorting and search techniques.
		22ITC23.CO2	Practice the concepts of OOPs.
		22ITC23.CO3	Demonstrate standard operations on linear and nonlinear data structures.
		22ITC23.CO4	Apply hashing.
		22ITC23.CO5	Devise solutions to problems using linear and nonlinear data structures.
12	HEAT TRANSFER LAB 20CHC1	20CHC1.CO1	Evaluate the heat transfer rate through the solids and to determine thermal conductivity of different materialsof varying geometries under the steady state conditions.
		20CHC1.CO2	Estimate heat transfer coefficients and determine effectiveness of pin fin for free and forced convection
		20CHC1.CO3	Determine surface emissivity of a test plane and Stefan-Boltzmann's constant and compare with theoreticalvalues
		20CHC1.CO4	Determine critical heat flux in pool boiling.
		20CHC1.CO5	Estimate heat transfer coefficients and determine effectiveness of heat exchangers to analyze their performance.
13	INSTRUMENTATION AND MATERIAL CHARACTERIZATION LAB 22CHC13	22CHC13.CO1	Calibrate different process instruments.
		22CHC13.CO2	Analyze and calculate the dimensions of microparticle
		22CHC13.CO3	Estimate material concentrations in solutions
		22CHC13.CO4	Identify functional groups and the composition of the materials
		22CHC13.CO5	Determine viscosity and surface tension of liquids

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SEMESTER - V			
S.NO	Subject name /CODE	COs	*After completing this course the student must be able to*
1	ENGINEERING ECONOMICS AND ACCOUNTANCY 22MBC01	22MBC01.CO1	Apply fundamental knowledge of Managerial Economics concepts and tools.
		22MBC01.CO2	Analyze various aspects of Demand Analysis, Supply and Demand Forecasting.
		22MBC01.CO3	Understand Production and Cost relationships to make best use of resources available.
		22MBC01.CO4	Apply Accountancy Concepts and Conventions and preparation of Final Accounts.
		22MBC01.CO5	Evaluate Capital and Capital Budgeting decisions based on any technique.
2	CHEMICAL REACTION ENGINEERING I 22CH C 14	22CH C 14.CO1	Classify reactions, rate and forms of rate expressions.
		22CH C 14.CO2	Summarize fundamentals of kinetics and interpret the data including relationships between moles, concentration, extent of reaction and conversion.
		22CH C 14.CO3	Explain Batch, CSTR, and PFR performance equations from general material balances for homogeneous and heterogeneous reactions.
		22CH C 14.CO4	Identify the right reactor among single, multiple, recycle reactors and determine the effect of temperature on reactor performance.
		22CH C 14.CO5	Analyze the non-ideality of reactors.
3	MASS TRANSFER OPERATIONS II 22CHC15	22CHC15.CO1	Understand the Principle and application of multi component and azeotropic distillation used in the chemical industries.
		22CHC15.CO2	Understand the Principle and designing of distillation column used in the chemical industries.
		22CHC15.CO3	List situations where liquid–liquid extraction might be preferred to distillation.
		22CHC15.CO4	List the situation where solid liquid extraction might be preferred in industry
		22CHC15.CO5	Explain the concept of breakthrough in fixed-bed adsorption.
4	PROCESS MODELING AND SIMULATION 22CHC16	22CHC16.CO1	The course helps the students to understand the concepts of modeling and simulation
		22CHC16.CO2	The students will get familiar with conservation laws, continuity equations, equation of motion, and their application in mathematical model buildings
		22CHC16.CO3	The students will be familiarized with mathematical models of Reactors and Separation equipment
		22CHC16.CO4	Students will understand the basic concept for solving the developed model equations
		22CHC16.CO5	Familiarize with the flow sheet for chemical process simulation with the software packages.
5	SUSTAINABLE ENGINEERING 22CHE05	22CHE05.CO1	Understand the concept of sustainable engineering and its significance in addressing contemporary environmental challenges.
		22CHE05.CO2	Explore the 4R concept of solid waste management and examine various tools and methodologies to assess and mitigate the environmental impacts of engineering activities.
		22CHE05.CO3	To be aware of the principles and requirements of environmental management standards and their application in promoting environmental sustainability.
		22CHE05.CO4	Analyze the challenges and opportunities associated with promoting sustainable habitats such as sustainable cities, sustainable transport, sustainable sources of energy conventional and sustainable materials for green buildings
		22CHE05.CO5	Understand and evaluate the industrial processes through the principles of industrial ecology and industrial symbiosis.
6	FERTILIZER TECHNOLOGY 22CH E06	22CH E06.CO1	Identify the different nutrients and significance of feed stocks for the production of various fertilizers.
		22CH E06.CO2	Apply different manufacture methods for various nitrogenous fertilizers
		22CH E06.CO3	Explain production methods for phosphatic, potassium and mixed complex fertilizers.
		22CH E06.CO4	Explain the need, application techniques and uses of new variety of fertilizers.
		22CH E06.CO5	Summarize effluent treatment methods and impact of fertilizers on environment.
7	POLLUTION CONTROL IN PROCESS INDUSTRIES (Professional Elective II) 22CHE07	22CHE07.CO1	Differentiate the types of wastes generated in an industry, their effects on living and non-living things
		22CHE07.CO2	Understand the atmospheric dispersion of air pollutants and working principles of particulate control devices.
		22CHE07.CO3	Quantify industrial wastewater and its treatment.
		22CHE07.CO4	Analyze the hazardous and non-hazardous solid wastes and select the treatment and disposal methods.
		22CHE07.CO5	Apply environmental management systems (EMS) to an industrial activity
8	POLYMER SCIENCE AND TECHNOLOGY Professional Elective II 22CH E 08	22CH E 08.CO1	Explain the basic concepts of polymers, polymerization techniques and behaviour in polymers
		22CH E 08.CO2	Distinguish different types of polymerizations.
		22CH E 08.CO3	Determine the molecular weight of polymers by different techniques
		22CH E 08.CO4	Interpret the various processing techniques used for polymers, rubbers, fibers, polymer blends, and composites
		22CH E 08.CO5	Summarize the manufacturing and characterization of various industrially important polymers
9	PRINCIPLES OF DESIGN THINKING 22MEO01	22MEO01.CO1	Understand design thinking and its phases as a tool of innovation
		22MEO01.CO2	Empathize on the needs of the users
		22MEO01.CO3	Define the problems for stimulating ideation
		22MEO01.CO4	Ideate on problems to propose solutions by working as a design thinking team
		22MEO01.CO5	Prototype and test the proposed solutions focusing on local or global societal problems

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10	FOUNDATIONS OF DEEP LEARNING (Open Elective I) 22CAO03	22CAO03.CO1	Demonstrate a comprehensive understanding of deep learning history, key milestones, and foundational concepts.
		22CAO03.CO2	Design, develop, and optimize feedforward neural networks and understand their representation power
		22CAO03.CO3	Apply principal component analysis, singular value decomposition, and various autoencoder models for data analysis and dimensionality reduction
		22CAO03.CO4	Develop and implement convolutional neural networks (CNNs) using modern architectures and techniques.
		22CAO03.CO5	Design and utilize recurrent neural networks (RNNs) and advanced attention mechanisms for sequential data processing.
11	WASTE MANAGEMENT (Open Elective I) 22EEO06	22EEO06.CO1	Categorize the waste based on the physical and chemical properties.
		22EEO06.CO2	Explain the Hazardous Waste Management and Treatment process.
		22EEO06.CO3	Illustrate the Environmental Risk Assessment, methods, mitigation and control.
		22EEO06.CO4	Interpret the Biological Treatment of Solid and Hazardous Waste.
		22EEO06.CO5	Identify the waste disposal options, describe the design and construction, Operation, Monitoring, Closure of Landfills.
12	TECHNICAL WRITING SKILLS (Open Elective -BE/B.Tech - Common to all Branches) 20EGO01	20EGO01.CO1	Communicate effectively, without barriers and understand aspects of technical communication
		20EGO01.CO2	Differentiate between general writing and technical writing and write error free sentences using technology specific words.
		20EGO01.CO3	Apply techniques of writing in business correspondence and in writing articles.
		20EGO01.CO4	Draft technical reports and technical proposals.
		20EGO01.CO5	Prepare agenda and minutes of a meeting and demonstrate effective technical presentation skills.
13	MASS TRANSFER OPERATIONS LAB 22CHC17	22CHC17.CO1	Calculate diffusivity coefficient
		22CHC17.CO2	Separation of components by simple and steam distillation
		22CHC17.CO3	Separation components by drying
		22CHC17.CO4	Separation components by liquid- Liquid Extraction and solid-liquid extraction
		22CHC17.CO5	Calculate mass transfer coefficient in wetted wall column.
14	PROCESS MODELING AND SIMULATION LAB 22CHC18	22CHC18 .CO1	Dynamically simulate and interpret two heated tanks, using MATLAB
		22CHC18 .CO2	Dynamically simulate and analyze continuous reactors in Series using MATLAB
		22CHC18 .CO3	Adapt ASPEN software to perform steady-state simulation of valves
		22CHC18 .CO4	Apply ASPEN software for the simulation of batch distillation
		22CHC18 .CO5	Utilize ASPEN software to design Plug flow reactor

SEMESTER - VI

S.NO	Subject name /CODE	COs	*After completing this course the student must be able to*
1	CHEMICAL REACTION ENGINEERING II 22CHC19	22CHC19.O1	Identify and characterize solid catalysts.
		22CHC19.O2	Explain the kinetics for solid catalyzed reactions.
		22CHC19.O3	Interpret the kinetics of fluid and particle reactions.
		22CHC19.O4	Identify regions of mass transfer control and reaction rate control in fluid-fluid reactions
		22CHC19.O5	Apply the concepts to fluid- fluid and fluid-solid reactors.
2	PROCESS DYNAMICS AND CONTROL 22CH C20	22CH C20.CO1	Characterize and analyze the dynamic behavior of linear systems (1st and 2nd order)
		22CH C20.CO2	Understand the importance of various modes of control
		22CH C20.CO3	Construct block diagrams for simple chemical processes
		22CH C20.CO4	Analyze stability of simple feedback control systems
		22CH C20.CO5	Analyze and tune process controllers to achieve desired performance and explain control valve characteristics
3	PLANT DESIGN AND ECONOMICS 22CH C 21	22CH C 21.CO1	Understand the basic aspects of plant design and its elements
		22CH C 21.CO2	Select a suitable optimized cost-effective equipment for a given process
		22CH C 21.CO3	Learn the basics of cost accounting and perform the cost analysis of a plant.
		22CH C 21.CO4	Identify methods of estimation of depreciation and profitability studies.
		22CH C 21.CO5	Design & Optimize the cost-effective process equipment and plants
4	FUEL CELL TECHNOLOGY (Professional Elective III) 22CHE09	22CHE09.CO1	Apply know-how of thermodynamics, electrochemistry and principle of fuel cell
		22CHE09.CO2	Understand the different types of fuel cell
		22CHE09.CO3	Understand the components of hydrogen-based fuel cell
		22CHE09.CO4	Evaluate the performance of fuel cells.
		22CHE09.CO5	Explain the application of fuel cell in transport, stationary and portable sector
		22CHE09.CO6	Understand the impact of this technology in a global and societal context

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5	PETROCHEMICAL TECHNOLOGY (Professional Elective III) 22CHE10	22CHE10.CO1	Explain the composition, applications and formation theories of crude oil
		22CHE10.CO2	Summarize the refining process of crude oil and the treatment methods for upgrading products
		22CHE10.CO3	Outline Ethylene derivatives and identify their manufacturing processes.
		22CHE10.CO4	Outline Propylene and C4 derivatives and explain their manufacturing processes.
		22CHE10.CO5	Identify Aromatic derivatives sources and separation methods for aromatics.
6	PHARMACEUTICAL TECHNOLOGY Professional Elective III 22 CHE11	22 CHE11.CO1	Identify the different grades of chemicals, their impurities and limit tests
		23 CHE11.CO2	Compare the properties Pharmaceuticals and fine chemicals
		24 CHE11.CO3	Apply the testing methods for Pharmaceuticals and fine chemicals
		25 CHE11.CO4	Draw flow sheets for manufacturing common Pharmaceuticals & fine chemicals
		26 CHE11.CO5	Preparation of tablets and capsules and sterilization methods
7	SAFETY AND HAZARD ANALYSIS (Professional Elective - III) 22CHE12	22CHE12.CO1	Analyze chemical incidents and possible consequences to plant facilities, workers, and the general public.
		22CHE12.CO2	Evaluate effect of chemical hazards and risks of toxicants.
		22CHE12.CO3	Understand the safety aspects and safety audit norms for chemical process plant
		22CHE12.CO4	Analyze fire and explosion hazards.
		22CHE12.CO5	Integrate safety concepts into chemical plant design.
8	BIOCHEMICAL ENGINEERING (Professional Elective IV) 22CH E 13	22CH E 13.CO1	Describe the basic structure and function of cells & relate cell function to products and processes useful to man
		22CH E 13.CO2	Explain classification, growth concepts and various types of interactions in microbes.
		22CH E 13.CO3	Illustrate the significance of enzymes as biocatalysts and immobilized enzymes.
		22CH E 13.CO4	Identify and explain the basic features of bioreactors, separation process and down stream processes
		22CH E 13.CO5	Summarize the principles of Fermentation technology and products from Industrial biotechnology
9	CORROSION ENGINEERING Professional Elective IV 22CHE14	22CHE14.CO1	Explain and predict various corrosion mechanism based on the corrosion theories
		22CHE14.CO2	Distinguish and identify various types of corrosion
		22CHE14.CO3	Explain and apply corrosion testing methods
		22CHE14.CO4	Identify and apply various corrosion prevention techniques
		22CHE14.CO5	Apply modern theories and techniques to predict and prevent corrosion
10	NUCLEAR ENGINEERING (Professional Elective -IV) 22CHE15	22CHE15.CO1	understand radioactive elements and fission process
		22CHE15.CO2	processing and handling techniques for enrichment of fuel materials
		22CHE15.CO3	properties and radiation effects of non-fuel materials
		22CHE15.CO4	fuel source, heat removal, control and safety needs for operation of nuclear reactors
		22CHE15.CO5	techniques practiced for handling, storage and reprocessing of spent fuel
11	NANOSCIENCE AND NANOTECHNOLOGY (Professional Elective -IV) 22CHE16	22CHE16.CO1	Explain the types of nanomaterials and classify them.
		22CHE16.CO2	Understand various defects, and the effect of nano dimensions on the material behavior
		22CHE16.CO3	Discuss the bottom up and top-down synthesis of nanomaterials.
		22CHE16.CO4	Explain the characterization of nanomaterials using various techniques.
		22CHE16.CO5	Enlist and explain various applications of nanomaterials in diversified fields and areas.
12	GENDER SENSITIZATION (Open Elective II) 22EGO02	22EGO02.CO1	Understand the difference between “Sex” and “Gender” and be able to explain socially constructed theories of identity
		22EGO02.CO2	Recognize shifting definitions of “Man” and “Women” in relation to evolving notions of “Masculinity” and “Femininity”.
		22EGO02.CO3	Appreciate women’s contributions to society historically, culturally and politically.
		22EGO02.CO4	Analyze the contemporary system of privilege and oppressions, with special attention to the ways in which gender intersects with race, class, sexuality, ethnicity, ability, religion, and nationality.
		22EGO02.CO5	Demonstrate an understanding of personal life, the workplace, the community and active civic engagement through classroom learning.
13	PRINCIPLES OF INTERNET OF THINGS (Open Elective) 22ITO02	22ITO02.CO1	Comprehend the terminology, protocols and communication models of IoT
		22ITO02.CO2	Define the various IoT enabling technologies and differentiate between M2M and IoT.
		22ITO02.CO3	Acquire the basics of Python Scripting Language used in developing IoT applications.
		22ITO02.CO4	Describe the steps involved in IoT system design methodology.
		22ITO02.CO5	Design simple IoT systems using Raspberry Pi board and interfacing sensors with Raspberry Pi.
14	PRINCIPLES OF ENTREPRENEURSHIP AND STARTUPS (Open Elective II) 22MEO06	22MEO06.CO1	Understand the concept and essence of entrepreneurship.
		22MEO06.CO2	Identify business opportunities and nature of enterprise.
		22MEO06.CO3	Analyze the feasibility of new business plan.
		22MEO06.CO4	Apply project management techniques like PERT and CPM for effective planning and execution of projects.
		22MEO06.CO5	Use behavioral, leadership and time management aspects in entrepreneurial journey.
15	ENERGY MANAGEMENT SYSTEM (Open Elective II) 22EEO01	22EEO01.CO1	Know the current Energy Scenario and importance of Energy Conservation.
		22EEO01.CO2	Understand the concepts of Energy Management, Energy Auditing.
		22EEO01.CO3	Interpret the Energy Management methodology, Energy security and Energy Strategy.
		22EEO01.CO4	Identify the importance of Energy Efficiency for Engineers and explore the methods of improving Energy Efficiency in mechanical systems, Electrical Engineering systems
		22EEO01.CO5	Illustrate the Energy Efficient Technologies in Civil and Chemical engineering systems
16	CHEMICAL REACTION ENGINEERING LAB 22CHC22	22CHC22.CO1	Develop rate law for use in reactor design based on reaction data from a reactor.
		22CHC22.CO2	Find the conversion of reactants for a particular reaction in different reactors.
		22CHC22.CO3	Interpret the kinetics of an exothermic reaction.
		22CHC22.CO4	Analyze laboratory reactors through residence time distributions.
		22CHC22.CO5	Determine mass transfer coefficient of Solid-Liquid and Liquid-Liquid systems.
17	PROCESS DYNAMICS & CONTROL LAB 22CHC23	22CHC23 .CO1	Calibrate and evaluate the performance of a first and second order systems
		22CHC23 .CO2	Analyze the response of simple feedback control systems
		22CHC23 .CO3	Determine the frequency response of control systems
		22CHC23 .CO4	Analyze the behavior of a control system using different modes of controller
		22CHC23 .CO5	Estimate the tuning parameters for closed loop and open loop process

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SEMESTER - VII

S.NO	Subject name /CODE	COs	*After completing this course the student must be able to*
1	ARTIFICIAL INTELLIGENCE IN CHEMICAL ENGINEERING 22CHC25	22CHC25.CO1	Explain various phases in artificial intelligence in chemical engineering
		22CHC25.CO2	Classify and discuss the types of machine learning algorithms
		22CHC25.CO3	Understand the basic concepts of deep learning.
		22CHC25.CO4	Understand different types of evolutionary algorithms and their applications
		22CHC25.CO5	Explain the types of artificial neural networks, their classification and applications.
2	MATERIAL SCIENCE IN CHEMICAL ENGINEERING 22CHC26	22CHC26.CO1	Classify different engineering materials as ferrous and non-ferrous alloys.
		22CHC26.CO2	Compare mechanical and thermal properties of engineering materials
		22CHC26.CO3	Select materials for high and low temperature applications.
		22CHC26.CO4	Identify new or alternate materials for development and operation of the process industry.
		22CHC26.CO5	Understand the significance and applications of Biomaterials
3	TRANSPORT PHENOMENA 22 CHC27N	22 CHC27N.CO1	Identify analogy between momentum, mass and energy transport
		23 CHC27N.CO2	Develop expressions for velocity profiles using shell balances
		24 CHC27N.CO3	Develop expressions for temperature profiles using shell balances
		25 CHC27N.CO4	Develop expressions for concentration profiles using shell balances
		26 CHC27N.CO5	Apply equations of change to solve flow problems
		27 CHC27N.CO6	Understand transport mechanism in turbulent flows
4	COMPUTATIONAL FLUID DYNAMICS (Professional Elective V) 22CH E17	22CH E17.CO1	Understand and select the governing equations of fluid flow and heat transfer.
		22CH E17.CO2	Enable to solve one and two-dimensional ordinary and partial differential equations using traditional CFD tools.
		22CH E17.CO3	Make use of discretization techniques for derivatives and differential equations to solve numerically.
		22CH E17.CO4	Examine general transformation equations for grid generation.
		22CH E17.CO5	Recommend suitable explicit, implicit and semi-implicit methods of finite difference scheme for given problems.
		22CH E17.CO6	Solve fluid flow field and temperature field to design any process equipment using some popular CFD techniques.
5	DESIGN AND ANALYSIS OF EXPERIMENTS (Professional Elective V) 22CHE18	22CHE18.CO1	Demonstrate a comprehensive understanding of experimental design principles and their applications.
		22CHE18.CO2	Select and justify appropriate experimental designs based on research objectives and constraints.
		22CHE18.CO3	Proficiently conduct hypothesis tests and perform analysis of variance for different experimental designs.
		22CHE18.CO4	Interpret experimental results accurately, considering the assumptions and limitations of the chosen designs.
		22CHE18.CO5	Gain practical experience in designing experiments and interpret response surface plots statistical software.
6	OPTIMIZATION OF CHEMICAL PROCESSES (Professional Elective IV) 22 CHE19	22 CHE19.CO1	Formulate and analyze the elementary optimization problem.
		23 CHE19.CO2	Solve single variable optimization problems using different methods and can suggest a suitable technique for a given problem.
		24 CHE19.CO3	Solve multivariable optimization problems using various methods and can assess the suitability of those methods to a given problem.
		25 CHE19.CO4	Perform the optimization calculations of various unit operations.
		26 CHE19.CO5	Solve linear programming problems.
7	PROCESS INTENSIFICATION (Professional Elective V) 2CHE20	2CHE20.CO1	Identify the scope for process intensification in chemical processes.
		2CHE20.CO2	Implement methodologies for process intensification
		2CHE20.CO3	Understand scale up issues in the chemical process.
		2CHE20.CO4	Describe the impact of process intensification on heat transfer
		2CHE20.CO5	Solve process challenges using intensification technologies.
8	EMPLOYABILITY SKILLS 22EGC03	22EGC03.CO1	Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
		22EGC03.CO2	Write resumes, prepare and face interviews confidently.
		22EGC03.CO3	Be assertive and set short term and long term goals, learn to manage time effectively and deal with stress.
		22EGC03.CO4	Make the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
		22EGC03.CO5	Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.
9	ARTIFICIAL INTELLIGENCE IN CHEMICAL ENGINEERING LAB 22CHC28	22CHC28.CO1	Write the script in python programming.
		22CHC28.CO2	Apply the conditional loops in python programming.
		22CHC28.CO3	Apply modeling and optimization in the chemical reaction process.
		22CHC28.CO4	Optimize the process using python script.
		22CHC28.CO5	Apply artificial intelligence knowledge for fault diagnosis.
10	PLANT DESIGN LAB 22CHC29	22CHC29.CO1	Acquire simulation skills in Chemical Plant equipment design.
		22CHC29.CO2	Understand and apply the design concepts to various unit operations and processes.
		22CHC29.CO3	Design various Heat and mass transfer equipment.
		22CHC29.CO4	Design pumps, pressure vessels and reactors.
		22CHC29.CO5	Analyze the performance of a process plant using economic evaluation and sensitivity analysis.
		22CHC29.CO6	Perform simulation of design case studies in Aspen Plus/Aspen Hysys/DWSIM software.

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11	PROJECT: PART I 22CHC30	22CHC30.CO1	Summarize the literature review to identify and formulate engineering problems
		22CHC30.CO2	Design the experiments/ process /mathematical model by selecting the engineering tools/components for solving the identified problem
		22CHC30.CO3	Develop skills of problem solving, interpreting analysis and evaluation
		22CHC30.CO4	Illustrate written and oral communication skills through project report and presentation
		22CHC30.CO5	Demonstrate the knowledge, skills, attitude and ethics of a professional engineering graduate by working as a team.

SEMESTER - VIII

S.NO	Subject name /CODE	COs	*After completing this course the student must be able to*
1	DISASTER RISK REDUCTION AND MANAGEMENT (Open Elective III) 22CE O02	22CE O02.CO1	Explain the fundamental concepts of disaster management.
		22CE O02.CO2	Demonstrate the principles and practices of disaster risk reduction management.
		22CE O02.CO3	Identify stress and its management during disaster.
		22CE O02.CO4	Outline institutional frame work at different levels of administration.
		22CE O02.CO5	Evaluate disaster management study including data search, analysis and presentation as a case study.
2	BIOINFORMATICS (Open Elective III) 22BTO04	22BTO04 .CO1	Explain the basic concepts of biology and bioinformatics
		22BTO04 .CO2	Identify various types of biological databases used for the retrieval and analysis of the information
		22BTO04 .CO3	Explain the sequence analysis and data mining
		22BTO04 .CO4	Discuss the methods used for sequence alignment and construction of the phylogenetic tree
		22BTO04 .CO5	Describe the methods used for gene and protein structure prediction
3	DATA SCIENCE USING PYTHON (Open Elective III) 22ADO02	22ADO02.CO1	Apply advanced IPython features including shell commands, magic commands, and debugging techniques
		22ADO02.CO2	Analyze NumPy functionalities such as data types, arrays, and computations, and implement them in data manipulation tasks.
		22ADO02.CO3	Evaluate Pandas capabilities for data manipulation, aggregation, and grouping, and apply them to realworld datasets
		22ADO02.CO4	Create visualizations using Matplotlib, customize plots, and interpret various types of plots for effective data communication.
		22ADO02.CO5	Implement machine learning algorithms using Scikit-Learn, validate models, and apply them to realworld problems.
4	FUNDAMENTALS OF ELECTRIC VEHICLES (Open Elective III) 22EEO07	22EEO07.CO1	Understand the basics of electric vehicle and environmental impact.
		22EEO07.CO2	Understand the various types of Electric Vehicles and their properties
		22EEO07.CO3	Understand the functioning of BEV.
		22EEO07.CO4	Understand the difference between HEV and FCEV.
		22EEO07.CO5	Understand the various methods of energy storage.
5	TECHNICAL SEMINAR 20CHC31	20CHC31.CO1	Summarize the literature review in order to identify and formulate the engineering problem.
		20CHC31.CO2	Show preparedness to study independently and apply acquired technical skills to variety of real time problem scenarios.
		20CHC31.CO3	Develop the required critical thinking ability and analyticalskillsfor evaluation ofthe selected problem.
		20CHC31.CO4	Illustrate the written and oral communication skills through a seminar report and presentation.
		20CHC31.CO5	Demonstrate the required knowledge, skills, attitude and ethics as a professional engineering graduate by working as a team
6	PROJECT: PART II 20CH C 32	20CH C 32.CO1	Summarize the literature review to identify and formulate engineering problems
		20CH C 32.CO2	Design the experiments/ process /mathematical model by selecting the engineering tools/components for solving the identified problem
		20CH C 32.CO3	Develop skills of problem solving, interpreting analysis and evaluation
		20CH C 32.CO4	Illustrate written and oral communication skills through project report and presentation
		20CH C 32.CO5	Demonstrate the knowledge, skills, attitude and ethics of a professional engineering graduate by working as a team

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Chemical Engineering Department

Course Outcome Statements for B. Tech (Chemical)

R20

S.No	Course		Course Outcomes Statements
	Code	Name	
1.	20MT C05	Calculus	Apply the Matrix Methods to solve system of linear equations Apply the Matrix Methods to solve the system of linear equations
			Analyse the geometrical interpretation of Mean value theorems.
			Determine the extreme values of functions of two variables.
			Examine the convergence and divergence of infinite Series.
			Calculate the Euler's coefficients for Fourier series of a function
2.	20CE C01	Engineering Mechanics - I	Calculate the components and resultant of coplanar forces system.
			Understand free body diagram and apply equilibrium equations to solve for unknown forces.
			Apply concepts of friction for solving engineering problems.
			Analyse simple trusses for forces in various members of a truss
			Determine centroid for elementary, composite figures and bodies.
3.	20PY C01	Chemistry	Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
			Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role in batteries and fuel cells
			Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
			Classify the various methods used in treatment of water for domestic and industrial use.
			Outline the synthesis of various Engineering materials & Drugs.
4.	20CS C01	Programming for Problem Solving	Identify and understand the computing environments for scientific and mathematical problems.
			Formulate solutions to problems with alternate approaches and represent them using algorithms / Flowcharts.
			Choose data types and control structures to solve mathematical and scientific problem.
			Decompose a problem into modules and use functions to implement the modules.
			Apply arrays, pointers, structures, and unions to solve mathematical and scientific problems.
			Develop applications using file I/O.

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S.No	Course		Course Outcomes Statements
	Code	Name	
5	20CY C02	Chemistry Lab	Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
			Estimate the amount of chemical substances by volumetric analysis.
			Determine the rate constants of reactions from concentration of reactants/ products as a function of time.
			Calculate the concentration and amount of various substances using instrumental techniques.
			Develop the basic drug molecules and polymeric compounds.
6	20CS C02	Programming For Problem Solving Lab	Identify and setup program development environment.
			Design and test programs to solve mathematical and scientific problems.
			Identify and rectify the syntax errors and debug program for semantic errors
			Implement modular programs using functions.
			Represent data in arrays, pointers, structures and manipulate them through a program
			Create, read, and write to and from simple text files.
7	20ME C02	Workshop / Manufacturing Practice	Understand safety measures to be followed in workshop to avoid accidents.
			Identify various tools used in fitting, carpentry, tin smithy, house wiring, welding, casting and machining processes.
			Make a given model by using workshop trades including fitting, carpentry, tinsmith and House wiring.
			Perform various operations in welding, machining and casting processes.
			Conceptualize and produce simple device/mechanism of their choice.
8	20ME C03	Engineering Exploration	Understand the role of an engineer as a problem solver.
			Identify multi-disciplinary approaches in solving an engineering problem.
			Build simple systems using engineering design process.
			Analyze engineering solutions from ethical and sustainability perspectives.
			Use basics of engineering project management skills in doing projects.
9	20MT C06	Vector Calculus And Differential Equations	Calculate the areas and volumes.
			Apply the vector differential operators to Scalars and Vector functions
			Solve line, surface & volume integrals by Greens, Gauss and Stoke's theorems.
			Calculate the solutions of first order linear differential equations.
			Solve higher order linear differential equations.

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S.No	Course		Course Outcomes Statements
	Code	Name	
10	20 EG C01	English	Illustrate the nature, process and types of communication and communicate effectively without barriers.
			Construct and compose coherent paragraphs, emails and adhering to appropriate mobile etiquette.
			Apply techniques of precision to write a précis and formal letters by using acceptable grammar and appropriate vocabulary.
			Distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.
			Critique passages by applying effective reading techniques
11.	20PY C07	Physics	Demonstrate the physical properties of the light.
			Find the applications of lasers and optical fibers in engineering and technology.
			Identify different types of magnetic and dielectric materials.
			Recall the fundamentals of nanomaterials.
			Apply the ideas of quantum mechanics for related problems
12.	20EEC01	Basic Electricalengineering	Understand the concepts of Kirchhoff's laws and to apply them in superposition, Thevenin's and Norton's theorems to get the solution of simple dc circuits 2. 3. 4. 5. 6.
			Obtain the steady state response of RLC circuits with AC input and to acquire the basics, relationship between voltage and current in three phase circuits.
			Understand the principle of operation, the emf and torque equations and classification of AC and DC machines
			Explain various tests and speed control methods to determine the characteristic of DC and AC machines.
			Acquire the knowledge of electrical wiring, types of wires, cables used and Electrical safety precautions to be followed in electrical installations.
			Recognize importance of earthing, methods of earthing and various low-tension switchgear used in electrical installations
13	20EG C02	English Lab	Define the speech sounds in English and understand the nuances of pronunciation in English.
			Apply stress correctly and speak with the proper tone, intonation and rhythm.
			Analyze IELTS and TOEFL listening comprehension texts to enhance their listening skills.
			Determine the context and speak appropriately in various situations.
			Design and present effective posters while working in teams, and discuss and participate in Group discussions.
14	20PY C10	Physics Lab	Interpret the errors in the results of an experiment.
			Demonstrate the wave nature of light experimentally
			Utilize physical properties of magnetic and dielectric materials for various applications
			Make use of lasers and optical fibers for engineering applications
			Explain light induced phenomenon and motion of electrons in electric and magnetic fields

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S.No	Course		Course Outcomes Statements
	Code	Name	
15.	20EEC02	Basic Electrical Engineering Lab	Get an exposure to common electrical components, their ratings and basic electrical measuring equipment.
			Make electrical connections by wires of appropriate ratings and able to measure electric power and energy.
			Comprehend the circuit analysis techniques using various circuital laws and theorems.
			Determine the parameters of the given coil and calculate the time response of RL & RC series circuits.
			Recognize the basic characteristics of transformer and components of switchgear.
			Understand the basic characteristics of dc and ac machine by conducting different types of tests on them.
16.	20ME C01	CAD And Drafting	Become conversant with appropriate use of CAD software for drafting.
			Recognize BIS, ISO Standards and conventions in Engineering Drafting.
			Construct the projections of points, lines, planes, solids
			Analyse the internal details of solids through sectional views
			Create an isometric projections and views
17.	20MBC02	Community Engagement	Gain an understanding of Rural life, Culture and Social realities.
			Develop a sense of empathy and bonds of mutuality with Local Communities
			Appreciate significant contributions of Local communities to Indian Society and Economy.
			Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
			Utilise the opportunities provided by Rural Development Programmes
18.	20MTC08	Partial Differential Equations And Statistics	Find solution of initial value problems of ODE by Numerical Method.
			Solve Linear and Non-Linear PDE"s.
			Solve One-Dimension Wave and Heat equations and Two Dimension Laplace equation
			Use the basic probability for fitting the Random phenomenon.
			Analyze the random fluctuations of probability distribution and Principles of Least Squares approximations for the given data.
19	20CSC06	Basics Of Data Structures	Identify various data structures, searching & sorting techniques and their applications.
			Describe the linear and non-linear data structures, searching and sorting techniques.
			Apply suitable data structures to solve problems.
			Analyze various searching and sorting techniques.
			Evaluate the linear and non-linear data structures.

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SNo	Course		Course Outcomes Statements
	Code	Name	
20.	20CHC01	CHEMICAL ENGINEERING THERMODYNAMICS-I	Understand the fundamental concepts of thermodynamics to engineering applications.
			Understand the relation between the measurable nature of P, V, T and the un-measurable nature of H,U,A, G
			Calculate the thermodynamic properties of real gases by using EOS.
			Understand and analyze the various thermodynamic processes involving ideal gases.
			Analyze the power cycles; refrigeration cycles, and liquefaction processes.
			Apply the energy balance equations to Open and Closed systems and also to evaluate the thermodynamic efficiency of nozzles, turbines and compressors.
21.	20CHC02	FLUID MECHANICS	Distinguish different types of fluids, manometers
			Apply Shell balances to illustrate fluid flow phenomena
			Identify the concepts of incompressible flow in pipes, channels and associated frictional losses
			Explain the concept of fluidization and flow through packed beds.
			Choose the types of pumps for different fluids under different conditions such as toxic, acidic, slurry type.
			Identify equipment to be used to measure fluid flow based on their properties
22.	20CHC03	MATERIAL ENERGY BALANCE CALCULATIONS	Convert physico-chemical quantities from one system of units to another and identify basis of calculation
			Solve material balance problems without chemical reactions.
			Solve material balance problems with chemical reactions
			Solve material balance problems with recycle, purge and bypass
			Analyze the ideal and real behavior of gases, vapors and liquids
			Solve energy balance problems with and without chemical reaction
23.	20CHC04	MECHANICAL UNIT OPERATIONS	Decide the transport of solids based on their properties.
			Select equipment for industrial application with respect to size reduction.
			Design equipment for industrial application with respect to separation of solids.
			Decide the necessary equipment to screen different particles based on their properties
			Apply different filtration techniques for industrial application
			Identify the suitable technique for blending and mixing of liquids and solids.
24	20CSC07	Basics of Data Structures Lab	Implement the abstract data type.
			Demonstrate the operations on stacks, queues using arrays and linked lists
			Apply the suitable data structures including stacks, queues to solve problems
			Analyze various searching and sorting techniques.
			Choose proper data structures, sorting and searching techniques to solve real world problems
25	20CHC05	FLUID MECHANICS LAB	Identify variable area flow meters and variable head flow meters
			Explain the fluid flow characteristics.
			Demonstrate the Bernoulli principle
			Analyze the flow of fluids through closed conduits, open channels
			Interpret the characteristics of pumps 6. Analyze the flow in packed beds.

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SNo	Course		Course Outcomes Statements
	Code	Name	
26.	20CHC06	MECHANICAL UNIT OPERATIONS LAB	Understand mechanical unit operations and their role in process industries.
			Understand the nature of solids, their characterization, handling and the processes involving solids.
			Analyze the performance of size reduction equipment and calculate the power and efficiency requirements.
			Understand the principle, construction and operation of various classification equipment.
			Analyze Solid liquid separation in industrial equipment based on settling, density and centrifugal force.
			Design and operate filtration equipment.
27.	20CHC07	CHEMICAL REACTION ENGINEERING-I	Classify reactions, rate and forms of rate expressions.
			Summarize fundamentals of kinetics and interpret the data including relationships between moles, Concentration, extent of reaction and conversion.
			Explain Batch, CSTR, and PFR performance equations from general material balances for homogeneous and heterogeneous reactions.
			Identify the right reactor among single, multiple, recycle reactors etc
			Determine the effect of temperature on reactor performance for adiabatic and non-adiabatic operation.
			Analyze the non-ideality of reactors.
28.	20CHC08	CHEMICAL TECHNOLOGY	Estimate the chemical industry growth and opportunities.
			Differentiate between unit operation and unit processes.
			Develop flow diagrams of different processes.
			Classify between Inorganic and Organic processes.
			Design processes based on conditions space time, yield, conversion, recycle methods, temperature and pressure.
			Predict the process limitations and propose a model to overcome the limitations.
29.	20CHC09	HEAT TRANSFER	Distinguish between different types of heat transfer
			Calculate heat transfer coefficients for forced and natural convection
			Analyze and understand the concepts of Heat exchangers
			Analyze the heat transfer phenomena in fluids involving phase changes
			Identify the type of evaporator required for a specific purpose and design it
			Explain the impact of radiation shields and laws of radiation.
30	20CHC10	MASS TRASFER OPERATIONS - I	Apply the concepts of diffusion mass transfer to fluids and solids
			Write the rate equations for mass transfer operations
			Estimate the mass transfer coefficients of mixtures
			Design Absorber/Stripper by equilibrium methods
			Design the cooling tower with the concept of humidification.
			Interpret the drying mechanism by estimating total drying period

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S.No	Course		Course Outcomes Statements
	Code	Name	
31.	20EGM01	INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES	Understand the making of the Indian Constitution and its features.
			Identify the difference among Right To equality, Right To freedom and Right to Liberty.
			Analyze the structuring of the Indian Union and differentiate the powers between Union and States.
			Distinguish between the functioning of Lok Sabha and Rajya Sabha while appreciating the importance of Judiciary.
			Differentiate between the functions underlying Municipalities, Panchayats and Co-operative Societies.
32.	20EEM01	INDIAN TRADITIONAL KNOWELDGE	Understand philosophy of Indian culture
			Distinguish the Indian languages and literature
			Learn the philosophy of ancient, medieval and modern India
			Acquire the information about the fine arts in India
			Know the contribution of scientists of different eras.
33.	20CEM01	ENVIRONMENTAL SCIENCE	Identify the natural resources and realize the importance of water, food, forest, mineral, energy, land resources and effects of over utilization.
			Understand the concept of ecosystems and realize the importance of interlinking of food chains.
			Contribute for the conservation of bio-diversity.
			Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
			Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.
34.	20CHE01	ENERGY ENGINEERING	Classify and explain energy sources
			Summarize the basic principles and fundamentals of non-conventional energy sources
			Summarize the basic principles and fundamentals of conventional energy sources
			Outline the production and future perspectives of bio fuels
			Relate the importance of future energy resources
			Demonstrate the need for energy auditing and conservation
35	20CHE02	FOOD PROCESSING TECHNOLOGY	Understand food demand scenario with respect to world and India
			Explain techniques in food processing
			Design process equipment to achieve the desired quality of food.
			Develop novel food processes that have a minimal effect on food quality
			Select control strategies to maintain food quality
			Apply the scientific method to food science problems

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SNo	Course		Course Outcomes Statements
	Code	Name	
36.	20CHE03	MATERIAL SCIENCE FOR CHEMICAL ENGINEERS	Classify different engineering materials as ferrous and non-ferrous alloys.
			Select materials for design and fabrication of process equipment.
			Understand the significance of mechanical, thermal and optical properties of engineering materials
			Select materials for high and low temperature applications.
			Identify new or alternate materials for development and operation of process industry.
			Characterize material using different experimental techniques.
37.	20CHE04	PULP AND PAPER TECHNOLOGY	Design the operation, maintenance and safety aspects for paper making
			Identify the factors that drive industry trends
			Evaluate different grades of paper and boards based on testing methods
			Select appropriate bleaching technique for required paper quality
			Distinguish the important wood and fiber properties that affect paper quality
			Identify, formulate and solve design problems pertaining to pulp digester
38.	20CHC11	CHEMICAL REACTION ENGINEERING LAB	Compare the performance of ideal reactors.
			Develop rate law for use in reactor design based on reaction data from a reactor.
			Find the conversion of reactants for a particular reaction in different reactors.
			Interpret the kinetics of an exothermic reaction.
			Analyze laboratory reactors through residence time distributions.
			Determine mass transfer coefficient of Solid-Liquid and Liquid-Liquid systems.
39.	20CHC12	HEAT TRANSFER LAB	Demonstrate and evaluate heat transfer by conduction in solids for steady state conditions
			Determine thermal conductivity of different materials of varying geometries
			Estimate heat transfer coefficients and determine effectiveness of pin fin for free and forced convection
			Determine surface emissivity of a test plane and Stefan-Boltzmann's constant and compare with theoretical values
			Determine critical heat flux in pool boiling
			Estimate heat transfer coefficients and determine effectiveness of heat exchangers to analyze their performance

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (Autonomous)

Gandipet, Hyderabad -75

Chemical Engineering Department

Course Outcome Statements for B. Tech (Chemical)-R18

SNo	Course		Course Outcomes Statements
	Code	Name	
1.	18MT CO1	MATHEMATICS– I	Solve system of linear equations and identify the Eigen values and Eigen vectors in engineering problems.
			Check the series convergence.
			Find the evolutes of the given curves.
			Expand and find extreme values of functions of two variables.
			Understanding the significance of gradient, divergence and curl.
			An ability to solve the problems and interpret in geometrical approach.
2.	18PY C05	PHYSICS	Demonstrate the wave nature of the light and describe the types of lasers and optical fibres and their applications
			Develop the concepts related to electromagnetic behavior
			Demonstrate the important concepts of Quantum Mechanics
3.	18CS C01	Programming for Problem Solving	Identify the computing environments.
			Formulate solutions to problems and represent them using algorithms/ Flowcharts.
			Choose proper control statements and data structures to implement the algorithms.
			Trace the Decompose a problem into modules and use functions to implement the modules programs with test the program solution.
			Develop applications using file I/O.
4.	18EG C01	ENGLISH	The students will understand the nature, process and types of communication and will communicate effectively without barriers.
			The students will write correct sentences and coherent paragraphs.
			The students will know how to condense passages by writing précis and write essays by using accurate grammar and appropriate vocabulary.
			The students will demonstrate advanced writing skills by drafting formal reports.
			The students will apply their reading techniques and analyze reading comprehension passages.
			The students will become effective communicators and will display their advanced skills of reading and writing and use correct grammar and appropriate vocabulary in all contexts.

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SNo	Course		Course Outcomes Statements
	Code	Name	
5	18PY C08	PHYSICS LABORATORY	Understand the concept of errors and find the ways to minimize the errors.
			Demonstrate interference and diffraction phenomena experimentally.
			Understand the applications of magnetic and dielectric materials.
			Know the working of lasers and optical fibres.
			Distinguish between polarized and unpolarized light.
6	18CS C02	Programming for Problem Solving	Identify and setup program development environment.
			Implement the algorithms using C programming language constructs.
			Identify and rectify the syntax errors and debug program for semantic errors.
			Analyze the results to evaluate the solutions of the problems.
			Solve problems in a modular approach using functions.
			Implement file operations with simple text data.
7	18ME C02	WORKSHOP/ MANUFACTURING PRACTICE	Fabricate components with their own hands.
			Get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
			Assembling different components, student will be able to produce small mechanisms/devices of their interest.
			Gain practical skills of carpentry, tinsmith, fitting, house wiring
			Gain knowledge of different Engineering Materials and Manufacturing Methods.
			Understand trades and techniques used in Workshop and chooses the best material/ manufacturing process for the application
8	18EG C02	ENGLISH LAB	The students will differentiate the speech sounds in English.
			The students will interact with the software and understand the nuances of pronunciation in English.
			The students will speak with the proper tone, intonation and rhythm and apply stress correctly.
			The students will demonstrate their listening skills by analyzing the IELTS and TOEFL listening comprehension texts.
			The students will speak with clarity and confidence.
			The students will work in teams and discuss various topics and demonstrate their presentation skills through posters.
9	18MT CO3	MATHEMATICS– II	Find the areas, volumes and surface of solids revolution.
			Use Greens, Gauss and Stoke's theorems to find the surface and volume integrals.
			Able to solve solutions of differential equations with initial and boundary value problems.
			Solve the problems on analytic functions, Cauchy's theorem and Cauchy's integral formula.
			Real and complex integrals by using Cauchy's theorems.
			Solve physical and engineering problems.

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SNo	Course		Course Outcomes Statements
	Code	Name	
10	18CY C01	CHEMISTRY	Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
			Rationalize bulk properties and processes using thermodynamic considerations & Ionic Equilibria.
			List major chemical reactions that are used in the synthesis of molecules.
			Apply the various methods used in treatment of water for domestic and industrial use.
			Discuss the various Engineering materials & Drug synthesis & their applications.
11.	18CE C01	ENGINEERING MECHANICS	Solve problems dealing with forces in plane and space force systems, draw free body diagrams to analyze various problems in equilibrium, for smooth and frictional surface.
			Determine centroid and moment of inertia for elementary, composite areas and bodies.
			Analyze simple trusses for forces in various members of a truss.
			Solve problem in kinematics and kinetics of particles and rigid bodies.
			Analyze body motion using work energy principles, impulse and momentum approach and able to apply the concepts of simple harmonic motion and free vibrations in dynamics.
12.	18ME C01	ENGINEERIN G GRAPHICS AND DESIGN	Introduction to engineering design and its place in society.
			Exposure to the visual aspects of engineering design.
			To become familiar with engineering graphics standards.
			Exposure to solid modelling.
			Exposure to computer-aided geometric design.
			Exposure to creating working drawings.
			Exposure to engineering communication.
13	18EE C01	BASIC ELECTRICAL ENGINEERING	Acquire the concepts of Kirchhoff's laws and network theorems and able to get the solution of simple dc circuits.
			Obtain the steady state response of RLC circuits and also determine the different powers in AC circuits.
			Acquire the concepts of principle of operation of Transformers and DC machines.
			Acquire the concepts of principle of operation of DC machines and AC machines.
			Acquire the knowledge of electrical wiring and cables and electrical safety precautions.
			Recognize importance of earthing and methods of earthing and electrical installations.
14	18EE C02	BASIC ELECTRICAL ENGINEERING LAB	Get an exposure to common electrical components and their ratings.
			Make electrical connections by wires of appropriate ratings.
			Understand the circuit analysis techniques.
			Determine the parameters of the given coil.
			Understand the basic characteristics of transformer.
			Understand the basic characteristics of dc and ac machines

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SNo	Course		Course Outcomes Statements
	Code	Name	
15	18CY C02	CHEMISTRY LAB	Estimate rate constants of reactions from concentration of reactants/ products as a function of time
			Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
			Synthesize a small drug molecule and Identify the organic compounds.
			Understand importance of analytical instrumentation for different chemical analysis.
			Perform interdisciplinary research such that the findings benefit the common man.
16.	20MTC08	PARTIAL DIFFERENTIAL EQUATIONS AND STATISTICS	Find solution of initial value problems of ODE by Numerical Method.
			Solve Linear and Non-Linear PDE‟s.
			Solve One-Dimension Wave and Heat equations and Two Dimension Laplace equation.
			Use the basic probability for fitting the Random phenomenon.
			Analyze the random fluctuations of probability distribution and Principles of Least Squares approximations for the given data.
17.	20CSC06	BASICS OF DATA STRUCTURES	Identify various data structures, searching & sorting techniques and their applications.
			Describe the linear and non-linear data structures, searching and sorting techniques.
			Apply suitable data structures
			Analyze various searching and sorting techniques.to solve problems.
			Evaluate the linear and non-linear data structures.
18	20CHC01	CHEMICAL ENGINEERING THERMODYNAMICS-I	Understand the fundamental concepts of thermodynamics to engineering applications.
			Understand the relation between the measurable nature of P, V, T and the un-measurable nature of H,U,A, G
			Calculate the thermodynamic properties of real gases by using EOS.
			Understand and analyze the various thermodynamic processes involving ideal gases.
			Analyze the power cycles; refrigeration cycles, and liquefaction processes.
			Apply the energy balance equations to Open and Closed systems and also to evaluate the thermodynamic efficiency of nozzles, turbines and compressors.
19	20CHC02	FLUID MECHANICS	Distinguish different types of fluids, manometers
			Apply Shell balances to illustrate fluid flow phenomena
			Identify the concepts of incompressible flow in pipes, channels and associated frictional losses
			Explain the concept of fluidization and flow through packed beds.
			Choose the types of pumps for different fluids under different conditions such as toxic, acidic, slurry type.
			Identify equipment to be used to measure fluid flow based on their properties

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SNo	Course		Course Outcomes Statements
	Code	Name	
20	20CHC03	MATERIAL ENERGY BALANCE CALCULATIONS	Convert physico-chemical quantities from one system of units to another and identify basis of calculation
			Solve material balance problems without chemical reactions.
			Solve material balance problems with chemical reactions
			Solve material balance problems with recycle, purge and bypass
			Analyze the ideal and real behavior of gases, vapors and liquids
			Solve energy balance problems with and without chemical reaction
21.	20CHC04	MECHANICAL UNIT OPERATIONS	Decide the transport of solids based on their properties.
			Select equipment for industrial application with respect to size reduction.
			Design equipment for industrial application with respect to separation of solids.
			Decide the necessary equipment to screen different particles based on their properties
			Apply different filtration techniques for industrial application
			Identify the suitable technique for blending and mixing of liquids and solids.
22.	20CSC07	Basics of Data Structures Lab	Implement the abstract data type.
			Demonstrate the operations on stacks, queues using arrays and linked lists
			Apply the suitable data structures including stacks, queues to solve problems
			Analyze various searching and sorting techniques.
			Choose proper data structures, sorting and searching techniques to solve real world problems
23	20CHC05	FLUID MECHANICS LAB	Identify variable area flow meters and variable head flow meters
			Explain the fluid flow characteristics.
			Demonstrate the Bernoulli principle
			Analyze the flow of fluids through closed conduits, open channels
			Interpret the characteristics of pumps 6. Analyze the flow in packed beds.
24	20CHC06	MECHANICAL UNIT OPERATIONS LAB	Understand mechanical unit operations and their role in process industries.
			Understand the nature of solids, their characterization, handling and the processes involving solids.
			Analyze the performance of size reduction equipment and calculate the power and efficiency requirements.
			Understand the principle, construction and operation of various classification equipment.
			Analyze Solid liquid separation in industrial equipment based on settling, density and centrifugal force.
			Design and operate filtration equipment.

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SNo	Course		Course Outcomes Statements
	Code	Name	
25	20CHC07	CHEMICAL REACTION ENGINEERING-I	Classify reactions, rate and forms of rate expressions.
			Summarize fundamentals of kinetics and interpret the data including relationships between moles, Concentration, extent of reaction and conversion.
			Explain Batch, CSTR, and PFR performance equations from general material balances for homogeneous and heterogeneous reactions.
			Identify the right reactor among single, multiple, recycle reactors etc
			Determine the effect of temperature on reactor performance for adiabatic and non-adiabatic operation.
			Analyze the non-ideality of reactors.
26	20CHC08	CHEMICAL TECHNOLOGY	Estimate the chemical industry growth and opportunities.
			Differentiate between unit operation and unit processes.
			Develop flow diagrams of different processes.
			Classify between Inorganic and Organic processes.
			Design processes based on conditions space time, yield, conversion, recycle methods, temperature and pressure.
			Predict the process limitations and propose a model to overcome the limitations
27.	20CHC09	HEAT TRANSFER	Distinguish between different types of heat transfer
			Analyze and understand the concepts of Heat exchangers
			Analyze the heat transfer phenomena in fluids involving phase changes
			Identify the type of evaporator required for a specific purpose and design it
			Explain the impact of radiation shields and laws of radiation Calculate heat transfer coefficients for forced and natural convection.
28	20CHC10	MASS TRASFER OPERATIONS - I	Apply the concepts of diffusion mass transfer to fluids and solids
			Write the rate equations for mass transfer operations
			Estimate the mass transfer coefficients of mixtures
			Design Absorber/Stripper by equilibrium methods
			Design the cooling tower with the concept of humidification.
			Interpret the drying mechanism by estimating total drying period
29	20EGM01	INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES	Understand the making of the Indian Constitution and its features.
			Identify the difference among Right To equality, Right To freedom and Right to Liberty.
			Analyze the structuring of the Indian Union and differentiate the powers between Union and States.
			Distinguish between the functioning of Lok Sabha and Rajya Sabha while appreciating the importance of Judiciary.
			Differentiate between the functions underlying Municipalities, Panchayats and Co-operative Societies.

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SNo	Course		Course Outcomes Statements
	Code	Name	
30	20EEM01	INDIAN TRADITIONAL KNOWELDGE	Understand philosophy of Indian culture 2. 3. 4. 5.
			Distinguish the Indian languages and literature
			Learn the philosophy of ancient, medieval and modern India
			Acquire the information about the fine arts in India
			Know the contribution of scientists of different eras
31	20CEM01	ENVIRONMENTAL SCIENCE	Identify the natural resources and realize the importance of water, food, forest, mineral, energy, land resources and affects of over utilization.
			Understand the concept of ecosystems and realise the importance of interlinking of food chains.
			Contribute for the conservation of bio-diversity.
			Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
			Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.
32	20CHE01	ENERGY ENGINEERIN G	Classify and explain energy sources
			Summarize the basic principles and fundamentals of non-conventional energy sources
			Summarize the basic principles and fundamentals of conventional energy sources
			Outline the production and future perspectives of bio fuels
			Relate the importance of future energy resources
			Demonstrate the need for energy auditing and conservation
33	20CHE02	FOOD PROCESSING TECHNOLOGY	Understand food demand scenario with respect to world and India
			Explain techniques in food processing
			Design process equipment to achieve the desired quality of food.
			Develop novel food processes that have a minimal effect on food quality
			Select control strategies to maintain food quality
			Apply the scientific method to food science problems.
34	20CHE03	MATERIAL SCIENCE FOR CHEMICAL ENGINEERS	Classify different engineering materials as ferrous and non-ferrous alloys.
			Select materials for design and fabrication of process equipment.
			Understand the significance of mechanical, thermal and optical properties of engineering materials
			Select materials for high and low temperature applications.
			Identify new or alternate materials for development and operation of process industry.
			Characterize material using different experimental techniques.

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SNo	Course		Course Outcomes Statements
	Code	Name	
35	20CHE04	PULP AND PAPER TECHNOLOGY	Design the operation, maintenance and safety aspects for paper making
			Evaluate different grades of paper and boards based on testing methods
			Select appropriate bleaching technique for required paper quality
			Distinguish the important wood and fiber properties that affect paper quality
			Identify, formulate and solve design problems Identify the factors that drive industry trends pertaining to pulp digester
36	20CHC11	CHEMICAL REACTION ENGINEERING LAB	Compare the performance of ideal reactors.
			Develop rate law for use in reactor design based on reaction data from a reactor.
			Find the conversion of reactants for a particular reaction in different reactors.
			Interpret the kinetics of an exothermic reaction.
			Analyze laboratory reactors through residence time distributions.
			Determine mass transfer coefficient of Solid-Liquid and Liquid-Liquid systems.
37	20CHC12	HEAT TRANSFER LAB	Demonstrate and evaluate heat transfer by conduction in solids for steady state conditions
			Determine thermal conductivity of different materials of varying geometries
			Estimate heat transfer coefficients and determine effectiveness of pin fin for free and forced convection
			Determine surface emissivity of a test plane and Stefan-Boltzmann's constant and compare with theoretical values
			Determine critical heat flux in pool boiling
			Estimate heat transfer coefficients and determine effectiveness of heat exchangers to analyze their performance
38	18CH C10	CHEMICAL REACTION ENGINEERING I	Classify reactions, rate and forms of rate expressions.
			Summarize fundamentals of kinetics and interpret the data including relationships between moles, Concentration, extent of reaction and conversion.
			Explain Batch, CSTR, and PFR performance equations from general material balances for homogeneous and heterogeneous reactions.
			Identify the right reactor among single, multiple, recycle reactors etc.
			Apply the concepts of heat effects on reactions.
			Analyze the non-ideality of reactors.
39	18CH C11	MASS TRANSFER I	Apply the concepts of diffusion mass transfer to liquids and solids.
			Estimate the mass transfer coefficients.
			Design gas absorber by equilibrium method to find the number of theoretical stages.
			Estimate the number of theoretical stages of distillation column using McCabe- Thiele and PonchanSavarit methods.
			Explain extractive distillation and azeotropic distillation.

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SNo	Course		Course Outcomes Statements
	Code	Name	
40	18CH C 12	HEAT TRANSFER	Distinguish between different types of heat transfer
			Analyze and understand the concepts of Heat exchangers
			Calculate the rate of heat transfer with and without change of phase
			Identify the type of evaporator required for a specific purpose and design it
			Explain the impact of radiation shields and design aspects of furnaces.
41	18CH C 13	PARTICLE AND FLUID-PARTICLE PROCESSING	Identify and describe fluid-particle systems in terms of their basic physical properties
			Explain size reduction energy requirements, estimate performance of equipment, selection and sizing of equipment.
			Find drag force and terminal settling velocity for single particles.
			Determine pressure drop in fixed and fluidized beds.
			Apply separation techniques sedimentation, flocculation to separate a solid fluid mixtures
			Analyze filtration data and select systems based on requirements, estimate filtration area for given requirements, understand filter aids and their usage
42	18CH E 01	WATER CONSERVATION AND MANAGEMENT (Core Elective I)	Identify the water storage methods in practice based on available sources and supply.
			Understand the water quality parameters and analysis methods.
			Classify the basic characteristics of water and their testing methods.
			Explain the objectives of water harvesting and recycling methods.
			Make use of water conservation methods at work place, agriculture, service and process industry.
43	18CH E 02	RENEWABLE ENERGY (Core Elective I)	Describe the environmental aspects of non-conventional energy resources compared with various conventional energy systems, their prospects and limitations.
			Explain the use of solar energy and the various components used in the energy production with respect to applications.
			Find out the need of Wind Energy and the various components used in energy generation and know the classifications.
			Understand the concept of Biomass energy resources and their classification, types of biogas Plants applications
			Summarize the knowledge of Ocean energy, tidal energy, Geothermal energy.
			Understand the Fuel cells principles and applications.
44	18CH E 03	EXPERIMENTAL AND ANALYTICAL TECHNIQUES (Core Elective I)	Build basic knowledge of analytical techniques
			Distinguish the applicability of Microscopy techniques
			Identify the suitable spectroscopy methods
			Select the electro-analytical techniques
			Infer the role of different separation techniques

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SNo	Course		Course Outcomes Statements
	Code	Name	
45	18CH E 04	POLYMER SCIENCE AND TECHNOLOGY (Core Elective II)	Explain the basic concepts of polymers, polymerization techniques and behavior in polymers
			Distinguish different types of polymerization.
			Determine the molecular weight of polymers by different techniques
			Familiarize with various processing techniques for polymers, rubbers and fibers
			Summarize the manufacturing and characterization of various industrially important polymers
46	18CH E 05	GREEN TECHNOLOGY (Core Elective II)	Describe the principles of green chemistry
			Identify manufacturing processes for waste minimization
			Identify technologies to reduce the level of emissions
			Understand the importance of eco-friendly solvents
			Apply principles of green chemistry to design greener processes
47	18CH E 06	CATALYSIS (Core Elective II)	Explain the basic concepts of catalysis
			Summarize the methods of preparation and characterization of catalysts
			Analyze the role of heat and mass transfer in the catalytic reactor design
			Distinguish the performance of catalytic reactors
			Identify the role of catalysts in the environmental protection
			Explain the commercial aspects of catalytic reactors
48	18CH C16	CHEMICAL REACTION ENGINEERING – II	Identify and characterize solid catalysts
			Explain the kinetics for solid catalyzed reactions
			Interpret the kinetics of fluid and particle reactions
			Identify regions of mass transfer control and reaction rate control in fluid-fluid reactions
			Apply the concepts to Gas fluid and catalytic reactors
49	18CH C17	MASS TRANSFERS- II	Understand the concept of different mass-transfer operations and their concerned equipment used in the chemical industries.
			Interpret the importance and the role of liquid–liquid extraction and leaching in Separation Process
			Articulate the process of adsorption and the equipment used in chemical industry
			Calculate the enthalpies and interpret psychometric charts and design of cooling towers and drying equipment.
			Distinguish among micro-filtration, ultra-filtration, nano-filtration, and reverse osmosis
50	18CH C 18	PROCESS CONTROL	Characterize and analyze the dynamic behavior of linear systems (First and Second order)
			Build block diagrams for simple chemical processes
			Analyze stability, speed of response, frequency response, of simple feedback control systems
			Analyze and tune process controllers
			Empirically identify process dynamics

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SNo	Course		Course Outcomes Statements
	Code	Name	
51	18CH E07	FLUIDIZATION ENGINEERING (Core Elective III)	Determine the minimum fluidization velocity and optimum operating fluidization velocity.
			Design the fluidized bed in terms of pressure drop across the bed
			Construct the distributors, TDH, height, diameter, power consumption of compressor for air.
			Distinguish between boiler and furnaces, methods of starting up.
			Estimate the amount of chemicals required to control the emission like SO2.
52	18CH E 08	PETROCHEMICAL TECHNOLOGIES (Core Elective III)	Explain the composition, applications and formation theories of crude
			Summarize the refining process of crude oil.
			Classify Ethylene derivatives and summarize their manufacturing processes.
			Outline Propylene and C4 derivatives and explain their manufacture processes.
			Classify higher paraffin derivatives and outline manufacturing processes.
			Identify Aromatic derivatives sources and separation methods for aromatics.
53	18CH E 09	BIOCHEMICAL ENGINEERING (Core Elective III)	Describe the basic structure and function of cells & relate cell function to products and processes useful to man
			Explain classification, growth concepts and various types of interactions in microbes
			Illustrate the significance of enzymes as biocatalysts and immobilized enzymes.
			Identify and explain the basic features of bioreactors
			Describe the principles of the various separation procedures involved in the downstream processing of products
			Summarize the principles of Fermentation technology and products from Industrial biotechnology
54	18CH E10	SUGAR TECHNOLOGY (Core Elective IV)	Apply Principles and skills of work in sugar cane milling, processing and refining in practical settings.
			Determine the composition of different types of sugars by volumetric and gravimetric methods.
			Explain the unit operations for effective processing of cane juice, Batch and continuous methods
			Identify the concepts of quality assurance and control in industry as per Indian regulations and practices.
			Summarize the methods to reclaim by-products.
55	18CH E11	PULP AND PAPER TECHNOLOGY (Core Elective IV)	Design the operation, maintenance and safety aspects for paper making.
			Identify grade paper and boards based on different testing methods.
			Select appropriate bleaching technique for required paper quality.
			Differentiate the important wood and fibre properties that affect paper quality.
			Identify, formulate and solve design problems pertaining to pulp digesters.

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SNo	Course		Course Outcomes Statements
	Code	Name	
56	18CH E 12	FOOD TECHNOLOGY (Core Elective IV)	Explain techniques in food processing
			Design process equipment to achieve the desired quality of food.
			Develop novel food processes that have a minimal effect on food quality
			Select control strategies to maintain food quality.
			Apply the scientific method to food science problems
57	18EEO 05	WASTE MANAGEMENT (Open Elective I)	Understand the various processes involved in allied disciplines of engineering
			Infer the regulations of governance in managing the waste
			Distinguish the nature of waste materials concerned to the particular branch of engineering
			Explore the ways and means of disposal of waste material
			Identify the remedies for the disposal of a selected hazardous waste material
58	18ME O04	ENTREPRENEURSHIP (Open Elective I)	Understand the concept and essence of entrepreneurship.
			Identify business opportunities and nature of enterprise.
			Analyze the feasibility of new business plan.
			Apply project management techniques like PERT and CPM for effective planning and execution of Projects
			Use behavioral, leadership and time management aspects in entrepreneurial journey
59	18ME O06	NANO MATERIALS AND TECHNOLOGY (Open Elective I)	Understand the basic concepts, developments and challenges in nanotechnology.
			Describe the methods of evaluating magnetic and electronic properties, microstructure by SPM and atomic force microscopy
			Apply heterogeneous methods and characterization techniques of zero & one dimensional nanostructure
			Evaluate various Nano material fabrication techniques.
			Analyze Nano materials and Nano biomaterials for obtaining solutions to societal problems.
60	18ME O07	INTELLECTUAL PROPERTY RIGHTS (Open Elective I)	Understand the evolution of IP, working of organization's at global level to protect and promote IP
			Familiarize with the patent filing process at national and international level.
			Draw the logical conclusion of research, innovation and patent filing.
			Compare different kinds of IP and their patenting system.
			Understand the techno-legal-business angle of IP, infringement and enforcement mechanisms for protection.
61	18CSO 09	BASICS OF ARTIFICIAL INTELLIGENCE (Open Elective I)	Identify various search strategies to solve problems
			Compare and contrast knowledge representation schemes
			Apply Bayesian Networks and Dempster Shafer theory for reasoning.
			Explain the role of agents and interaction with the environment.
			Determine different learning paradigms
			Explain robotic architectures and expert systems.

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SNo	Course		Course Outcomes Statements
	Code	Name	
62	18CH C 21	TRANSPORT PHENOMENA	Develop expressions for velocity, temperature and concentration profiles using shell balances
			Identify analogy between momentum, mass and energy transport
			Formulate and solve one-dimensional transport problems by using the conservation equations
			Apply equations of change to solve flow problems
			Understand transport phenomena in turbulent flows
63	18CH C 22	PROCESS TECHNOLOGY AND ECONOMICS	Explain various sources and processes of manufacture of various industrially important chemicals
			Apply unit operations to draw block diagrams/ process flow diagrams of the processes used for manufacture of industrially important chemicals
			Find out energy sources, requirement of raw materials and operating conditions of petrochemicals
			Outline the application of industry relevant fuels
			Apply various economic equations to evaluate project viability
64	18CH C 23	PROCESS INSTRUMEN TATION	Identify instruments required in process industry based on their purpose and function
			Compare the range of operation and working of different temperature measuring instruments
			Interpret the different pressure measuring instruments based on their application
			Select the required flow and level measuring instruments for process industry
			Apply the different methods of composition analysis for industrial analysis
65	18CH E 13	MINERAL PROCESSING TECHNOLOGY (Core Elective V)	Explain the principles governing a range of processes applied in the mineral industry
			Identify typical unit processes and flow-sheets for production of a number of metals
			Apply basic engineering principles to the design of mineral processes
			Develop conceptual designs for simple extraction processes Summarize the operation of beneficiation units for coal and mineral
66	18CH E 14	CORROSION ENGINEERING (Core Elective V)	Explain and predict various corrosion mechanism based on the corrosion theories.
			Distinguish and identify various types of corrosion
			Explain and apply corrosion testing methods
			Identify and apply various corrosion prevention techniques
			Apply modern theories and techniques to predict and prevent corrosion
67	18CH E 15	SCALE-UP METHODS (Core Elective V)	Explain principles of scale-up
			Apply dimensional analysis technique for scale up problems
			Deduce the scale up of mixers and heat exchangers
			Outline the scale up of chemical reactors
			Design the distillation columns and packed towers scale up process

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SNo	Course		Course Outcomes Statements
	Code	Name	
68	18ME O 11	MODERN MANUFACTURING PROCESSES (Open Elective II)	Understand the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits.
			Apply the concept, architecture and process of digital manufacturing.
			Evaluate real-life scenarios and recommend the appropriate use of 3Dprintingtechnoloy
			Compare various non-traditional machining processes.
			Demonstrate the procedure for the fabrication of micro-Electronic devices.
69	18EE O 02	ENERGY MANAGEMENT SYSTEMS (Open Elective II)	Know the current energy scenario and importance of energy conservation.
			Understand the concepts of energy management.
			Evaluate the performance of existing engineering systems
			Explore the methods of improving energy efficiency in different engineering systems
			Design different energy efficient devices.
70	18ME O 03	RESEARCH METHODOLOGIES (Open Elective II)	Define research problem.
			Review and assess the quality of literature from various sources.
			Understand and develop various research designs.
			Analyze problem by statistical techniques: ANOVA, F-test, Chi-square.
			Improve the style and format of writing a report for technical paper/Journal report.
71	18CE O 02	DISASTER MITIGATION AND MANAGEMENT (Open Elective-II)	Identify and understand the fundamental terminologies in disaster management.
			Distinguish between the Hydro-meteorological disasters and apply the concepts of structural and nonstructural mitigation measures.
			Categorize different Geographical Disasters and apply the knowledge in utilizing the early warning systems.
			Analyze various mechanisms and consequences of human induced disasters.
			Develop an awareness of disaster management phases and formulating effective disaster management plans, ability to understand various participatory roles of stakeholders- Central and State Government bodies at different levels.
72	18CS O 10	MACHINE LEARNING USING PYTHON (Open Elective II)	Define the basic concepts related to Python and Machine Learning.
			Apply Python packages for data visualization.
			Text and time series data analysis using NLP toolkit.
			Evaluate and interpret the results of the various machine learning techniques.
			Solve real world problems using deep learning Describe the feature engineering methods, regression techniques and classification methods. framework
73	18CH C 24	PROCESS INSTRUMENTATION AND CONTROL LAB	Evaluate the performance of a U-tube manometer
			Assess the discharge efficiency of an orifice meter
			Analyze step response of simple feedback control systems
			Determine frequency response of control systems

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			Analyze the behavior of a control system using different modes of control when subjected to a permanent disturbance
			Apply closed loop and open loop techniques to tune process controllers

SNo	Course		Course Outcomes Statements
	Code	Name	
74	18CH C 25	PROCESS MODELING AND SIMULATION LAB	Develop chemical engineering process models based on fundamental laws of mass and energy transfer
			Dynamically simulate and interpret two heated tanks, using MATLAB
			Dynamically simulate and analyze continuous reactors in Series
			Apply ASPEN software for simulation of batch Distillation using MATLAB
			Adapt ASPEN software to perform steady state simulation of valves
			Utilize ASPEN software to design Plug flow reactor
75	18CH C 26	PROJECT: PART I	Summarize the literature review to identify and formulate engineering problems
			Design the experiments/ process /mathematical model by selecting the engineering tools/components for solving the identified problem
			Develop skills of problem solving, interpreting analysis and evaluation
			Illustrate written and oral communication skills through project report and presentation
			Demonstrate the knowledge, skills, attitude and ethics of a professional engineering graduate
			Adapt to the working environment of Industry/Institute by working as a team
76	18CH E 16	CHEMICAL PROCESS SAFETY (Core Elective VI)	Evaluate effect of chemical hazards and risks of toxicants.
			Analyze chemical incidents and possible consequences to plant facilities, workers, and the general public.
			Integrate safety concepts into chemical plant design.
			Analyze fire and explosion hazards.
			Apply ethics during process plant operation
77	18CH E 17	FERTILIZER TECHNOLOGY (Core Elective VI)	Identify the different nutrients and significance of feed stocks for the production of various nitrogenous fertilizers.
			Apply different manufacture methods for various phosphorous fertilizers.
			Explain production methods for potassium and mixed complex fertilizers
			Explain the need, application techniques and uses of new variety of fertilizers.
			Summarize effluent treatment methods and impact of fertilizers on environment.
78	18CH E 18	CHEMICAL PROCESS SYNTHESIS (Core Elective VI)	Analyze alternative processes and equipment
			Synthesize a chemical process flow sheet that would approximate the real process
			Design best process flow sheet for a given product
			Perform economic analysis related to process design

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			Evaluate project profitability
79	18 PY O 01	HISTORIES OF SCIENCE AND TECHNOLOGY (Open Elective III)	Demonstrate the process of beginning of science and civilization, knowledge acquisition and philosophical approach of science and its advancements in the Stone Ages and Antiquity period.
			Illustrate the advancements in science and technology in the medieval period across Asia and Arab countries and decline and revival of science in Europe.
			Explain the scientific approach and its advances of the Europeans and how the role of engineer during the industrial revolution and the major advancements.
			Make use of the advancements in the field of science and technology by adopting new philosophies of 19th and first half of 20th century in finding ethical solutions to the societal problems.
			Interpret the changes in specializations of science and the technology and build the relation between information and society from second half of 20th century onwards.
S No	**Course**		**Course Outcomes Statements**
	Code	**Name**	
80	18ME O 11	MODERN MANUFACTURING PROCESSES (Open Elective II)	Understand the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits.
			Apply the concept, architecture and process of digital manufacturing.
			Evaluate real-life scenarios and recommend the appropriate use of 3Dprintingtechnoloy
			Compare various non-traditional machining processes.
			Demonstrate the procedure for the fabrication of micro-Electronic devices.
81	18EE O 02	ENERGY MANAGEMENT SYSTEMS (Open Elective II)	Know the current energy scenario and importance of energy conservation.
			Understand the concepts of energy management.
			Evaluate the performance of existing engineering systems
			Explore the methods of improving energy efficiency in different engineering systems
			Design different energy efficient devices.
82	18ME O 03	RESEARCH METHODOLOGIES (Open Elective II)	Define research problem.
			Review and assess the quality of literature from various sources.
			Understand and develop various research designs.
			Analyze problem by statistical techniques: ANOVA, F-test, Chi-square.
			Improve the style and format of writing a report for technical paper/Journal report.
83	18CE O 02	DISASTER MITIGATION AND MANAGEMENT (Open Elective-II)	Identify and understand the fundamental terminologies in disaster management.
			Distinguish between the Hydro-meteorological disasters and apply the concepts of structural and nonstructural mitigation measures.
			Categorize different Geographical Disasters and apply the knowledge in utilizing the early warning systems.
			Analyze various mechanisms and consequences of human induced disasters.
			Develop an awareness of disaster management phases and formulating effective disaster management plans, ability to understand various participatory roles of stakeholders- Central

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			and State Government bodies at different levels.
84	18CS O 10	MACHINE LEARNING USING PYTHON (Open Elective II)	Define the basic concepts related to Python and Machine Learning.
			Apply Python packages for data visualization.
			Text and time series data analysis using NLP toolkit.
			Evaluate and interpret the results of the various machine learning techniques.
			Solve real world problems using deep learning Describe the feature engineering methods, regression techniques and classification methods. framework
85	18CH C 24	PROCESS INSTRUMENTATION AND CONTROL LAB	Evaluate the performance of a U-tube manometer
			Assess the discharge efficiency of an orifice meter
			Evaluate the performance of a U-tube manometer
			Assess the discharge efficiency of an orifice meter
			Analyze step response of simple feedback control systems
			Determine frequency response of control systems
			Analyze the behaviour of a control system using different modes of control when subjected to a permanent disturbance
			Apply closed loop and open loop techniques to tune process controllers
SNo	**Course**		**Course Outcomes Statements**
	Code	**Name**	
86	18EG O 02	GENDER SENSITIZATIO N (Open Elective III)	Understand the difference between "Sex" and "Gender" and be able to explain socially constructed theories of identity.
			Recognize shifting definitions of "Man" and "Women" in relation to evolving notions of "Masculinity" and "Femininity".
			Appreciate women's contributions to society historically, culturally and politically.
			Analyze the contemporary system of privilege and oppressions, with special attention to the ways gender intersects with race, class, sexuality, ethnicity, ability, religion, and nationality.
			Demonstrate an understanding of personal life, the workplace, the community and active civic engagement through classroom learning.
87	18EG O 01	TECHNICAL WRITING SKILLS (Open Elective III)	Understand the channels of communication and define nature and aspects of Technical communication
			Compare and contrast technical communication to that of general communication while constructing error free sentences applying features of technical writing.
			Analyze data, draw inferences to write Journal articles and conference papers and to compose business letters.
			Evaluate data to draft technical reports and technical proposals
			Design a technical presentation by understanding the nuances of presentation skills and also transfer data from verbal to graphic and vice versa.
88	18CSO 03	IoT AND APPLICATIO NS (Open	Understand Internet of Things and its hardware and software components.
			Interface I/O devices, sensors & communication module.

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		Elective III)	Hypothesizing real time IoT based projects.
			Remotely monitor data and control devices.
			Advance towards research based IoT in the field of biotechnology
89	18CSO 04	BASICS OF DATA SCIENCE USING R (Open Elective III)	Summarize the basics of R and in-built data visualization packages. 2. 3. 4. 5. 6.
			Describe the data analysis using Bayesian and stochastic modeling.
			Relate Gibbs, Z- sampling distributions and compare the binomial, chi-square, wilcoxon and Fisher's exact tests in hypothesis testing.
			Explore the ANOVA in Regression analysis and classify the multivariate data.
			Experiment with the biological data using R tool and apply clustering algorithms to biological data.
			Identify R commands for data manipulation and database technologies for datasets of bioinformatics
90	18CH C 27	TECHNICAL SEMINAR	Summarize the literature review in order to identify and formulate the engineering problem
			Show preparedness to study independently and apply acquired technical skills to variety of real time problem scenarios
			Develop the required critical thinking ability and analytical skills for evaluation of the selected problem
			Illustrate the written and oral communication skills through a seminar report and presentation
			Demonstrate the required knowledge, skills, attitude and ethics as a professional engineering graduate
			Work in a team by adapting to the working environment

SNo	**Course**		**Course Outcomes Statements**
	Code	**Name**	
91	18CH C 28	PROJECT: PART II	Summarize the literature review to identify and formulate engineering problems
			Design the experiments/ process /mathematical model by selecting the engineering tools/components for solving the identified problem
			Develop skills of problem solving, interpreting analysis and Illustrate written and oral communication skills through project report and presentation evaluation
			Demonstrate the knowledge, skills, attitude and ethics of a professional engineering graduate
			Adapt to the working environment of Industry/Institute by working as a team
92	18CH O 01	NUCLEAR ENGINEERING	Identify the radioactive elements as nuclear fuel.
			Illustrate techniques for enrichment of fuel materials.
			Outline properties and irradiation effects on materials for design of cladding and other incore structures.
			Understand concepts of heat removal, control and safety needs
			Summarize safe handling, storage and reprocessing of spent fuel for operation of nuclear reactors.
93	18CH O 02	PAINT TECHNOLOG Y	Identify the suitable paints for domestic and industry purpose
			Study more about specific paint manufactures.
			Outline main ingredients of paints, their manufacture and properties.

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			Explain the usage of different types of solvents for both industrial paints and domestic paints and also about paint solid structures (Resins).
			Identify the suitable application methods for powder and liquid paints.
94	18CH O 03	PHARMACEUTICAL TECHNOLOGY	Outline the grades of chemicals, identify the Impurities & limit tests.
			Summarize the preparation, tests, properties of Pharmaceuticals & fine Chemicals.
			Develop flow sheets for Manufacturing Pharmaceuticals.
			Develop flow sheets for Manufacturing Chemicals.
			Demonstrate theoretical knowledge about tablet & Capsule making.
			Know various sterilization methods.

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