Department of Chemical Engineering

OFFERED PROGRAMMES

Department of Chemical Engineering offers three programs that are affiliated to C.S.J.M.University, Kanpur and recognized by AICTE:

- **Bachelor of Technology Degree in Chemical Engineering.**

Programme Specific Objectives

1. Impart education and training of Chemical Engineering to the students and to eventually make them competent and well qualified Chemical Engineers.
2. Provide best knowledge of the Chemical Engineering to the students and nurture their creative talent by motivating them to work on various challenging problems of Chemical Engineering.
3. Acquire high end industry centric skills in the field of Chemical Engineering.
4. Knowledge of the software used in the field of Chemical Engineering.
5. To prepare Professional Engineer with ethical, social and moral values.

Program Outcomes (POs):

1. To make the students ready for successful career leading to higher education and /or in industry related domains of design, research and development, testing and manufacturing.
2. To solve diverse real-life engineering problems equipped with a solid foundation in mathematical, scientific and chemical engineering principles.
3. To motivate and encourage the students to adopt professionalism, teamwork, leadership, communication skills, ethical approach.
4. To provide learning opportunity in a broad spectrum of multidisciplinary field.

Program Specific Outcomes (PSOs)

PSO1 . Apply the knowledge of basic science, mathematics and fundamentals of engineering with specialization to solve the complex problems of engineering.

PSO2 Identify and formulate for the analysis of the engineering problems considering the knowledge of engineering mathematics, natural and engineering sciences and review of the research articles for substantial conclusions.

PSO3 Demonstrate and develop the appropriate solutions of the complex level of chemical engineering design based problems to meet the specified needs and overall sustainability of the processes, considering the necessary approaches of safety, health hazards, societal and environmental factors.

PSO4 Investigate, demonstrate and conduct the design based complex problems using research based knowledge and methodologies, experimental studies, subsequent analysis and interpretation of data to prepare the valid technical reports.

PSO5 Understand and demonstrate the impact of relevant professional engineering solutions and knowledge for the sustainable development of society and environment.

PSO6 Apply suitably the norms and responsibilities of engineering practices towards the commitment following the principles of engineering ethics.

PSO7 Work effectively as an individual or in diversified and multidisciplinary environments showing the team solidarity.

PSO8 Ability to communicate efficiently with the engineering community, society and able to represent and explain the design documentation effectively with clear instructions.

PSO9 Demonstrate the knowledge and principles of engineering, management, cost and feasibility studies for the desired projects as an individual, a member or leader in a team of multidisciplinary settings.

PSO10 Possess the attitude of lifelong independent learning as per the need of wider context of technological changes and can pursue higher education for careers in academics, research and development

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Basic Thermodynamics **(ESC-S202)**	**Course Outcomes (COs):** • Upon successful completion of the course, students will be able to: • Use thermodynamic terminology correctly. • Explain fundamental thermodynamic properties. • Derive and discuss the zeroth, first, second, and third laws of thermodynamics. • Solve problems using the properties and relationships of thermodynamic fluids. • Analyze basic thermodynamic cycles. • Students must have understanding of thermodynamic fundamentals before studying their application in other related course works.
Process Calculations **(CHE-S201)**	**Course outcomes (CO):** • Demonstrate comprehensive understanding of material and energy balance equations for open and closed systems. • Select appropriate basis and conduct degree of freedom analysis before solving material and energy balance problems. • Make elementary flow-sheets and perform material and energy balance calculations without and with chemical reactions, and involving concepts like recycle, bypass and purge. • Perform process calculations utilizing psychrometric charts and steam tables. • Apply simultaneous material and energy balance calculations for steady state continuous flow systems and unsteady state systems.
Fluid mechanics **(CHE-S202)**	**Course outcomes (CO):** After completing the course students should be able to • Distinguish pressure distribution in static and flowing fluid in closed and open channels • Apply the basic law of fluid statics to fluid bodies in stationery and flowing fluid • Write the general and energy balance equations for unsteady state and steady state conditions • Apply the Bernoulli's equation of Engineering for simple situations of fluid flow in pipe, pump, compressor and various pipe fittings • Understand the working principle of pressure and measuring devices and fluid machines
Chemical Engineering Thermodynamics **(CHE-S203)**	**Course outcomes (CO):** After completing the course students should be able to • Appreciate the scope of the subject as a fundamental subject to calculate thermodynamic properties of substances • Apply the first law of thermodynamics to closed and open systems • Understand implications of second law of thermodynamics to chemical engineering systems to calculate efficiency

	• Understand and apply the criteria of equilibrium conditions in case of phase and reaction equilibria • Calculate the important thermodynamic properties of ideal and non-ideal solutions
Heat transfer **(CHE-S204)**	**Course outcomes (CO):** • Understanding the difference between thermodynamics and heat transfer and the general principles of conduction, convection and radiation • Understanding steady state conductive heat transfer through simple geometries • Understanding combined heat transfer mechanisms through composite geometries and extended surfaces • Understanding the fundamentals of convective heat transfer process and evaluating heat transfer coefficients for natural and forced convection • Understanding the types of heat exchangers, their detailed construction, operation and design • Understanding the types of heat exchangers, their detailed construction, operation and design • Understanding heat transfer with phase change (boiling and condensation) • Understanding the process of evaporation and analyzing the functioning and design of evaporators • Understanding the principles of radiation, the radiation laws and calculation of radiative heat transfer between black and gray bodies
Chemical Process Industries **(CHE-S205)**	**Course outcomes (CO):** • Understand the role of chemical process engineer in chemical industry identify different unit operations and unit processes in a given process flow diagram • Demonstrate thorough understanding of some important process industries (chloro-alkali, fertilizers, soaps and detergents, sugar manufacture, petroleum, paper and fermentation etc.) • Identify and solve engineering problems during manufacturing of the above mentioned products. • Identify process industry and make a presentation related to present scenario.
Mechanical Operations **(CHE-S206)**	**Course outcomes (CO):** • Calculate drag force and terminal settling velocity for single particles. • Explain the significance and usage of different particulate characterization parameters, and equipment to estimate them. • Describe Size reduction energy requirements, estimate performance of equipment, selection and sizing of equipment. • Select appropriate filter and filter aid for given separation and design a filtration unit for constant pressure and constant flow operation. • Estimate the various operating parameters for fixed bed , fluidized bed ,agitation process and continuous thickener units.
Mass Transfer Operations – I	**Course outcomes (CO):** • To understand the phenomena of mass transfer on macro level.

(CHE-S301)	• The concept of Equilibrium in all separation operations should be clear. • Able to design the Distillation, Extraction, Leaching, Adsorption column by using • different methods • Able to find out optimum conditions for component separation • To do the design by graphical and analytical method.
Numerical methods for chemical engineering **(CHE-S302)**	**Course outcomes (CO):** • Solve problems of algebraic equations • Solve problems of differential equations and simultaneous equation. • Solve problems of partial differential equations. • Analyze Stirred-tank Reactor System, Distillation in a Plate Column and Unsteady-state Operation by solving differential equations. • Assess reasonableness of solutions, and select appropriate levels of solution sophistication
Chemical Reaction Engineering - I **(CHE-S304)**	**Course outcomes:** • To find out the rate expression for various elementary and non-elementary reactions and corresponding the reaction mechanism. • Do the kinetic study for various batch and flow reactors for single and multiple reactions. • To determine the best combination of mixed and plug flow reactors on basis of size comparison. • To learn the use of recycle reactor, Auto catalytic reactors. • To analyse the effect of temperature and pressure on reaction corresponding to various type of reactor. • To understand the non-ideal flow behaviour inside the reactor and various model to describe this phenomena.
Petroleum Engineering **(CHE-S503)**	**Course outcomes (CO):** • Understanding the role of petroleum as energy source amidst world energy scenario • Demonstrate comprehensive understanding of design and operation of petro refineries and petrochemical complexes • Identify and suggest safe practices in operations of refineries and petrochemical complexes • Identify challenges, energy security issues and environmental issues • Perform techno-economic analysis & trouble shooting
Mass transfer operations - II **(CHE-S305)**	**Course outcomes (CO):** • To understand the fundamentals of Mass transfer on micro level. • To understand the application of the principles used for diffusion; mass transfer coefficients and interphase mass transfer including various theories • To study the mass transfer between the gas –liquid phase and various equipments used for the mass transfer operation like Absorption and Humidification. • Do analysis of Packed bed equipments to find out HTU, HETP, NTU and height of the column required. • To find the rate of drying, moisture content, time required for drying and various type of drying equipments.
Instrumentation and process control	**Course outcomes (CO):** • To estimate the mathematical modelling of the control system. • To calculate the solution of linear differential equation using Laplace transform,

(CHE-S306)	• Transfer function and input–output model, Poles & zeros of system. • Study of interacting &noninteracting response, Inverse response, • Multicapacity process, overdamped, critically damped, underdamped response their characteri • Able to use different types of controller, on-off, P, PI, PID controller, introduction to measuring sensors. • To study the criteria for stability, characteristic equation, Routh –Hurwitz criteria of stal Root-Locus analysis, Frequency response analysis of linear processes. • To Design the controllers by Simple performance criteria, Time Integral • performance criteria, Ziegler Nichols tuning technique, Cohen –coon tuning technique
Chemical engineering Design –I **(CHE-S307)**	**Course outcomes (CO):** • Knowledge of General overall design considerations, design steps for chemical processes; types of projects. • Development of design database; process creation; types of process design; • Feasibility survey; flow sheet presentation – PFD, PID, utility and safety diagrams. • To do the cost estimation by cash flow for industrial operations, factors affecting investment and production costs, capital investment – fixed capital and working capital investment, cost indices. • Study of Taxes and Insurance: cost of capital, corporate tax, insurance Depreciation investments • Find out the optimum solution methodologies – one variable and two variable, optimum production rates in plant operation.
Chemical engineering Design –II **(CHE-S401)**	**Course outcomes (CO):** • To find out the Design information and data – prediction of physical properties, phase equilibrium data • To study the characteristics of different types of pumps, criterion for selection of pumps; theory of compression, equipment for gas compression; Ejectors and Vacuum systems. • To determine the Equipment selection and specification for Separation processes, solid- solid separations; liquid solid separators - thickeners and classifiers, filtration, centrifuges, hydro-cyclones; separation of dissolved solids - Evaporation and crystallisation • Discuss the detailed design of separation column and heat transfer equipment like distillation column; shell and tube heat exchanger; condenser and evaporator. • To estimate the detailed design of pressure vessel and its support.
Chemical Reaction Engineering – II **(CHE-S402)**	**Course outcomes (CO):** • Understanding of the difference between homogeneous and heterogeneous reactions • Understanding of the role of catalysts in chemical reactions and the different types of catalysts used industrially • Primary knowledge of catalyst preparation and characterization methods • Develop rate laws for heterogeneous reactions and kinetic models and design of reactors for heterogeneous catalytic reactions • Knowledge of heat and mass transfer effects (internal and external transport

	processes) on catalytic reactions • Understanding the process of deactivation in catalysts, its types and its effect on reaction rate • Develop kinetic models and design strategy for heterogeneous non-catalytic reactions • Develop kinetic models and design strategy for heterogeneous fluid-fluid systems with and without chemical reaction
Transport Phenomena **(CHE-S404)**	**Course outcomes (CO):** • To study the transport process on macro and micro level for mass, heat and momentum transfer. • Able to drive the transport equation for various conservative law with boundary conditions. • Able to solve the transport problem by applying the Shell balance approach. • Able to model the problem by using differential equation. • Able to use of various mathematical package to solve the equations.
Reaction engineering & instrumentation control lab **(CHE-S407)**	**Course outcomes (CO):** • Verify the various theoretical principles of reaction engineering and process control. • Operate instrumentation and automation systems in modern chemical plant operation. • Develop experimental skills. • Work in team and develop interpersonal skills • Develop skills for technical writing.
Process modelling and simulation **(CHE-S510)**	**Course outcomes (CO):** • Model deterministic systems and differentiate between nonlinear and linear models. • Numerically simulate linear and non linear ordinary differential equations for determin systems • Estimate and validate a model based upon input and output data. • Create a model prediction based upon new input and validate the output data • Develop steady state models for flash vessels, equilibrium staged processes, distillation columns, absorbers, strippers, CSTR, heat exchangers and packed bed reactors, • Demonstrate the knowledge of various simulation packages and available numerical software libraries.
Safety in Chemical Process Industries **(CHE-S502)**	**Course outcomes (CO):** • Study the hazards associated with chemical substances, safety related properties of hazardous substances, Classification of dangerous substances. • Study the hazards associated with chemical plants, Safety in process plant maintenance, Safety considerations in plant site selection and layout planning. • Study the Hazard identification and assessment for ,various Hazard identification techniques, Hazard and operability studies (HAZOP), Fire and explosion index and toxicity index, Fault tree and event tree analysis, • To understand the Fault tree and event tree analysis, Emission of toxic and flammable gases and vapours, Dispersion of toxic and flammable gases and vapours, • Heat radiation from vapour cloud explosions, jet fires, fire balls and pool fires, Probability of accidents and risk calculation.

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Principles of polymer engineering **(CHE-S501)**	**Course outcomes (CO):** • Connect properties of polymeric materials to their structures and explain how differe material parameters and external factors affect the mechanical properties. • Decide which test methods are suitable for measurement of mechanical properties • Correlate structure-processing-properties relationships for polymers, blends and composites • Select a suitable processing and manufacturing technique for a given polymer. • Identify methods for rheological measurements and analysis of the rheological data u models for non-Newtonian fluids.
Optimization: theory and practices **(CHE-S508)**	**Course outcomes (CO):** • Identify different types of optimization problems • Explain different optimization techniques • Solve various multivariable optimization problems • Solve problems by using Linear Programming • Solve optimization problems of staged and discrete processes, understand the concept of specialized & Non-traditional Algorithms
Advanced separation processes **(CHE- S507)**	**Course outcomes (CO):** After completing the course students should be able to • Understand important features, advantages and limitations of advanced separation processes • Write the governing principle and law of the transport processes involved in membranes separation, electrochemical separations, ion-exchange, chromatographic separations and supercritical extractions • Classify different membrane separation processes and write their governing principles and areas of application • Understand the structure of different membrane modules and membrane plant configurations • Possess introductory knowledge working principle of membrane contactors and membrane reactor
Environmental Pollution and Control (CHE-S504)	**Course outcomes (CO):** • Assessing and understanding the sources, causes and effects of air, water and land pollution • Understanding the metrological aspects of air pollutant dispersion, and the dispersion and control of air pollutants • Ability to design air pollutant abatement systems for particulate matter and gaseous pollutants • Understanding the types of water pollutants and their effect on human and animal life • Understanding the physical, chemical and biological methods for wastewater

	treatment and the different unit operations involved in them • Ability to design wastewater and industrial treatment units • Understanding the processes for sludge treatment and solid-waste disposal • Understanding the process and modelling of treatment wastewater disposal in water bodies