Course Learning Objectives (CLO) and Course Outcomes (CO)

M.Tech. Chemical Engineering

PCH101 CHEMICAL ENGINEERING THERMODYNAMICS

Course Objective:
To introduce the principles of chemical engineering thermodynamics and illustrate their applications in the design of chemical process plants.

Course Outcome:

- Understand the terminology associated with engineering thermodynamics and have knowledge of contemporary issues related to chemical engineering thermodynamics
- Knowledge of phase equilibria in two-component and multi-component systems
- Ability to estimate thermodynamic properties of substances in gas or liquid state of ideal and real mixture
- Ability to predict intermolecular potential and excess property behavior of multi-component systems

PCH102 SEPARATION PROCESSES

Course Objective:
To learn conceptual design of separation processes and design of equipment involved.

Course Outcome:

- Knowledge of various chemical engineering separation processes
- Ability to Select appropriate separation technique for intended problem
- Ability to analyze the separation system for multi-component mixtures
- Ability to design separation system for the effective solution of intended problem

PCH103 REACTION ENGINEERING & REACTOR ANALYSIS

Course Objective:
To learn about reaction kinetics for single, multiple, isothermal, non-isothermal reactions and reactor design procedures.

Course Outcome:

- Ability to analyze chemical reactors and reaction systems
- Designing experiments involving chemical reactors, and analyzing and interpreting data
- Ability to solve problems of mass transfer with reaction in solid catalyzed reactions
- Design and sizing of industrial scale reactor on the basis of kinetic data obtained at lab scale

PCH104 PROCESS INTEGRATION

Course Objective:

To learn process integration with regard to energy efficiency, waste minimization and an efficient use of raw materials.

Course Outcome:

- Understanding of process integration
- Ability to do pinch analysis
- Ability to analyze heat exchanger networks
- Understanding of heat and power integration
- Ability to modify processes for minimization of waste water and raw water utilization

PCH105 CHEMICAL ENGINEERING LAB I

Course Objective:
To learn chemical engineering principles and their practical applications in the areas of mass transfer, reaction engineering and particle mechanics.

Course Outcome:

- Ability to plan experiments and present the experimental data meaningfully
- Ability to apply theoretical concepts for data analysis and interpretation
- Capability to visualize and understand chemical engineering unit operations related to fluid and particle mechanics, and mass transfer
- Understand the experimental techniques related to chemical reaction engineering

PCH201 TRANSPORT PHENOMENA

Course Objective:
To be able to analyze various transport processes with understanding of solution approximation methods and their limitations.

Course Outcome:

- Ability to understand the chemical and physical transport processes and their mechanism
- Ability to do heat, mass and momentum transfer analysis
- Ability to analyze industrial problems along with appropriate approximations and boundary conditions
- Ability to develop steady and time dependent solutions along with their limitations

PCH202 PROCESS MODELING AND SIMULATION

Course Objective:
Learn to develop mathematical models of phenomena involved in various chemical engineering processes and solutions for these models.

Course Outcome:

- Understand the important physical phenomena from the problem statement
- Develop model equations for the given system
- Demonstrate the model solving ability for various processes/unit operations
- Demonstrate the ability to use a process simulation

PCH203 COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING

Course Objective:
To learn various computational techniques for analyzing and solving chemical engineering problems.

Course Outcome:

- Understanding of fundamental mathematics and to solve problems of algebraic and differential equations, simultaneous equation, partial differential equations
- Ability to convert problem solving strategies to procedural algorithms and to write program structures
- Ability to solve engineering problems using computational techniques
- Ability to assess reasonableness of solutions, and select appropriate levels of solution sophistication

PCH204 CHEMICAL ENGINEERING LAB II

Course Objective:
To learn analytical experimental methods using sophisticated instruments and interpretation of experimental data.

Course outcome:

- Ability to understand, explain and select instrumental techniques for analysis
- Ability to plan experiments and operate several specific instruments
- Ability to analyze and interpret the experimental data

PCH111 PROCESS OPTIMIZATION

Course Objective:
To learn the modeling skills necessary to describe and formulate optimization problems arising in process systems engineering.

Course Outcome:

- Identify different types of optimization problems
- Understanding of different optimization techniques
- Ability to solve various multivariable optimization problems
- Ability to solve optimization using MATLAB

PCH112 PROJECT ENGINEERING AND MANAGEMENT

Course Objective:
To understand the principles associated with effective project management and application of these principles in avoiding common difficulties associated with project management.

Course Outcome:

- To acquaint with the project management skills
- Ability to use CPM and PERT methods in effective project management

- Ability to do resource planning and project scheduling
- Ability to do project costing and adopt latest trends in project management

PCH113 PROCESS DEVELOPMENT AND SCALE-UP STUDIES

Course Objective:
To learn the basics of process development and scale-up from bench scale to the production scale.

Course Outcome:
- Understand the basis of scale-up criteria
- Ability to scale-up homogeneous and heterogeneous reactors
- Ability to scale-up mixing and fluidization systems
- Ability to scale-up mass transfer processes

PCH114 BIOPROCESS ENGINEERING

Course Objective:
To introduce the engineering principles of bioprocesses including characteristics of different microbial cells, enzymes, microbial kinetics, and design considerations.

Course Outcome:
- The fundamental concepts of bioprocessing
- Understand the difference between bioprocesses and chemical processes
- Bioprocess design and operation
- Ability to select the bioreactor

PCH115 ENVIRONMENTAL POLLUTION CONTROL

Course Objective:
To learn about air and water pollution control techniques and solid waste management.

Course Outcome:
- Understanding of air/water pollution regulations and their scientific basis
- Apply knowledge for the protection and improvement of the environment
- Ability to monitor and design the air and water pollution control systems
- Ability to select and use suitable waste treatment technique

PCH221 FLUIDIZATION ENGINEERING

Course Objective:
To learn the fluidization phenomena, industrial applications of fluidized beds and their operational and design aspects.

Course Outcome:
- Understanding of fluidization behaviour

- Ability to estimate pressure drop, bubble size, TDH, voidage, heat and mass transfer rates for the fluidized beds
- Ability to write model equations for fluidized beds
- Ability to design gas-solid fluidized bed reactors

PCH222 ENERGY RESOURCES AND MANAGEMENT

Course Objective:
To learn about energy resources, scenario, auditing and conservation in process industries.

Course Outcome:
- Understanding energy sources, supply and demand
- Ability to recognize opportunities for rational use of energy
- Knowledge of energy auditing and conservation practices
- Knowledge of latest technologies to conserve the energy
- Knowledge of fuel cells and hydrogen energy

PCH223 CATALYTIC REACTOR ENGINEERING

Course Objective:
To learn catalytic phenomena with extensions to reactor design and catalyst characterization.

Course Outcome:
- Knowledge of heterogeneous catalytic reactions and their applications in industry
- Understanding of the mechanism and kinetics of heterogeneous catalytic reactions
- Choice of catalytic materials, preparation and characterization of catalysts
- Consideration of mass and heat transfer effects in heterogeneous catalysis
- Ability to design reactors for heterogeneous catalytic reactions

PCH224 PROCESS DYNAMICS AND CONTROL

Course Objective:
To learn about dynamic behaviour of nonlinear, distributed and other complex systems, and design their control schemes.

Course Outcome:
- Knowledge of phase plane, Laplace domain, and frequency domain analysis of nonlinear distributed, and multivariable systems for dynamic behavior and stability
- Ability to design controllers
- Knowledge of advanced control strategies

PCH225 PROCESS EQUIPMENT DESIGN

Course Objective:
To learn about the design procedures of process equipment used in chemical process plants.

Course Outcome:

- Able to design heat transfer equipment and mass transfer equipment
- Able to design cooling and heating systems of chemical reactors
- Able to use software tools for the analysis of process equipment

PCH226 FUEL COMBUSTION SYSTEMS

Course Objective:
To learn about types of fuels and their characteristics, and combustion systems with emphasis on engineering applications.

Course Outcome:
- Ability to characterize the fuels
- Understanding of thermodynamics and kinetics of combustion
- Understand and analyze the combustion mechanisms of various fuels

PCH231 NANOCHEMICAL ENGINEERING

Course Objective:
To learn the fundamental concepts of energy, mass and electron transport in materials confined or geometrically patterned at the nanoscale, where departures from classical laws are dominant.

Course Outcome:
- Understand and apply basic concepts of nanotechnology and nanoscience
- Understand the different nano-materials along with their characterization
- Understand the applications of nanomaterials in Chemical Engineering

PCH232 SELECTED TOPICS IN FLUID MECHANICS

Course Objective:
To learn the basics and advanced concepts of fluids and fluid flow including flow of compressible fluids, laminar and turbulent boundary layer flows and multiphase flow.

Course Outcome:
- Understand and apply the differential equations of fluid mechanics including the ability to apply and understand the impact of assumptions made in the analysis
- Understand the concepts of boundary layer and its estimation in different flows
- Understand and apply the compressible flow equations and multiphase flow correlations
- Understand the dynamics of drops and bubbles quantitatively

PCH233 SELECTED TOPICS IN HEAT TRANSFER

Course Objective:
To learn the basics and advanced concepts of heat transfer and design methodologies involved in various types of heat transfer devices.

Course Outcome:
- Understanding of various types of heat transfer process and devices

- Ability to analyze and select the heat transfer device
- Ability to solve the problems of heat transfer related to nano-fluids, micro-channels and heat pipes
- Ability to use software tools for solving heat transfer problems

PCH234 POLYMER REACTION ENGINEERING

Course Objective:
To understand mathematical modeling of polymerizations and design batch and continuous reactors.

Course Outcome:
- Understand mechanism and mathematical modeling of different types of polymerizations
- Quantitative determination of degree of polymerization and molecular weight distribution
- Design of batch and continuous reactors for these polymerizations

PCH235 MOLECULAR MODELING AND SIMULATION

Course Objective:
To learn to mimic the real system and phenomena in virtual world using molecular level information and computational resources and to develop and design the novel performance chemicals and materials.

Course Outcome:
- Understanding of the principles of molecular mechanics applicable in molecular modeling
- Understanding of various simulation techniques and their use for model solutions
- Ability to use molecular modeling software
- Acquaintance with modern analysis techniques and visualization packages
- Capability of developing/improving simulation experiments

PCH236 ADVANCED SEPARATION PROCESSES

Course Objective:
To understand the governing mechanisms and driving forces of various advanced separation processes and to perform process and design calculations for advanced separation processes.

Course Outcome:
- Understanding of modern separation technique in various applications
- Ability to analyze and design novel membranes for intended application
- Ability to analyze and design pervaporation, chromatography and dialysis based separation processes