Introduction

Chemical engineering plays a crucial role in various industries, including chemical, oil, gas, and petrochemical sectors. Engineers in this field are responsible for transporting and converting materials in all states of matter, but they must also understand mechanical, electrical, and instrumentation engineering. Key areas of chemical engineering include separation processes (e.g., distillation), heat transfer, fluid dynamics, reaction engineering, process control, and economic analysis. This course is designed to provide both foundational knowledge for newcomers and a refresher for experienced professionals, using real-world examples from industries such as oil and gas processing, petrochemicals, and chemical manufacturing.

Target Audience

- Petrochemical Engineers
- Chemical Engineers
- Plant Engineers
- Consulting Engineers
- Engineering Managers
- Maintenance Engineers/Technicians
- Project Engineers
- Process Control Engineers

Course Objectives

Upon completion of this course, participants will be able to:

- Interpret process flow diagrams and flowsheets.
- Apply mass and energy balances in process design.
- Understand fluid flow fundamentals, including pumping and mixing.
- Analyze real-world examples, particularly from the oil and gas industry.
- Design heat exchangers and compare various types.
- Grasp distillation and separation methods used in the oil and gas industry.
- Recognize the industry's role in controlling environmental pollution.
- Implement process control techniques.
- Conduct basic economic analysis for projects.

Targeted Competencies

By the end of the course, participants will be proficient in:

- Designing transfer equipment, especially heat exchangers.
- Applying mass and energy balances to design processes.
- Strategies for minimizing and treating effluent.
- Process control techniques.
- Basic economic analysis for project planning.

Course Content Breakdown

Unit 1: Process Engineering Fundamentals
This unit focuses on the core principles of chemical engineering:

- Fundamental chemical engineering principles.
- Interpretation of process flow diagrams and Piping and Instrumentation Diagrams (P&IDs).
- Introduction to process equipment and systems.
- Fundamentals of mass and energy balances.
- Understanding batch vs. continuous processes.
- Risk assessments and hazard studies in chemical engineering.
- Classification of electrical areas and flammability in the process industries.

Unit 2: Practical Fundamentals of Chemical Engineering: Fluid Flow
Fluid dynamics is a vital concept in chemical engineering:

- Pressure and head relationships.
- Bernoulli's Theorem and its implications.
- Principles of liquid flow and the significance of Reynolds number.
- Calculating pressure drop in pipelines.
- Understanding compressible flow and two-phase/multi-phase flow.
- Design principles for process relief devices and systems.
- Operation of pumps and compressors.
- Mixing techniques using various types of mixers.

Unit 3: Heat Transfer and Reaction Engineering Solutions
Heat transfer and reaction engineering are key to many chemical processes:

- Thermal conductivity and its role in materials.
- The mechanisms of heat transfer (conduction and convection).
- Insulation techniques and materials.
- Understanding heat transfer coefficients.

- Sizing and categorizing heat exchangers.
- Basics of chemical reactions and reaction kinetics.
- Overview of catalysis and green chemistry principles.

Unit 4: Introduction to Separation Processes
Separation processes are crucial in chemical engineering:

- Principles of distillation and vapor/liquid equilibria.
- Common distillation equipment and troubleshooting.
- Gas/liquid separation techniques.
- Insights into absorption and adsorption processes.
- Solid-liquid separation techniques.
- Approaches to controlling air and water pollution.
- Effluent treatment strategies in industrial processes.

Unit 5: Process Control and Economics Basics
Control and economics are essential for process efficiency:

- Examining measured variables in processes.
- Fundamentals of feedback control systems.
- Understanding Safety Integrity Levels (SIL) and Safety Instrumented Systems (SIS).
- Basics of air, water, cooling, and steam systems in process plants.
- Introduction to process economics, including fixed vs. variable costs and break-even points.
- Estimating raw materials usage and optimizing costs.
- The six-tenths rule for scaling up processes and estimating equipment costs.

This course offers a comprehensive overview of the practical foundations of chemical engineering, providing participants with the tools to enhance their technical skills and apply industry standards to improve their work in various process industries.