Course Overview

Chemical engineering is fundamental to a wide range of industries, including chemical, oil, gas, and petrochemical sectors. Engineers in this field play a crucial role in the transportation and conversion of materials in all states of matter. However, to be truly effective, chemical engineers must also have a broad understanding of other engineering disciplines, such as mechanical, electrical, and instrumentation. Central topics in chemical engineering include separation processes like distillation, heat transfer, fluid flow, reaction engineering, process control, and economics, which are the practical foundations of the discipline.

This **Fundamentals of Chemical Engineering Solution and Refresher Course** is designed to provide both newcomers to the field and seasoned professionals with an opportunity to deepen their knowledge or refresh their skills. Real-world examples from various industries, including oil and gas, petrochemicals, and chemical manufacturing, will be studied to highlight the application of core concepts in practice.

Targeted Groups

This course is aimed at:

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

Course Objectives

By the end of this course, participants will be able to:

- Interpret flowsheets and process flow diagrams.
- Apply mass and energy balances in process design.
- Understand fluid flow, including pumping and mixing principles.
- Analyze real-world examples from the oil and gas industry.
- Design heat exchangers and compare different types.
- Grasp distillation and separation methods used in oil and gas processing.
- Understand the industry’s role in controlling environmental pollution.
- Implement basic process control techniques.
- Conduct rudimentary economic project analyses.

Targeted Competencies

Upon completion of this course, participants will have the following competencies:

- Design of transfer equipment, particularly heat exchangers.
- Application of mass and energy balances in process design.
- Strategies for effluent minimization and treatment.
- Implementation of process control techniques.
- Conduct basic economic analysis for projects.

Course Content

Unit 1: Process Engineering Fundamentals

This unit provides an overview of essential principles in chemical engineering:

- Fundamental chemical engineering principles.
- Interpretation of flow diagrams.
- Understanding **Piping and Instrumentation Diagrams (P&IDs)**.
- Introduction to process equipment.
- Fundamentals of **mass and energy balances**.
- Differences between batch and continuous processes.
- Risk assessments and hazard studies.
- Flammability and electrical area classifications in the process industry.

Unit 2: Practical Fundamentals of Chemical Engineering: Fluid Flow

Fluid dynamics are critical in chemical engineering processes. This unit covers:

- Relationship between **pressure** and **head**.
- Bernoulli’s Theorem and its implications.
- Basic principles of liquid flow.
- Significance of **Reynolds number** and **pressure drop** in pipelines.
- Nature of compressible flow.
- Introduction to **thermodynamics**.
- Complexities of **two-phase** and **multi-phase flow**.
- Design principles for **process relief devices** and systems.
- Operation of **pumps** and **compressors**.
- Techniques in mixing using various mixers.

Unit 3: Heat Transfer and Reaction Engineering Solutions

This unit delves into two key areas:

- **Thermal conductivity** and its role in materials.
- Mechanisms of **conduction** and **convection**.
- **Insulation** techniques and materials.
- Understanding **heat transfer coefficients**.
- Categorizing and sizing **heat exchangers**.
- Basics of **chemical reactions** and **reaction kinetics**.
- An overview of **catalysis** and **green chemistry** principles.

Unit 4: Introduction to Separation Processes

Distillation and other separation processes are essential in chemical engineering. This unit includes:

- Principles of **distillation**.
- **Vapor/liquid equilibria** and its effect on phase behavior.
- Overview of distillation equipment and troubleshooting common issues.
- **Gas/Liquid separation** methods.
- Absorption and adsorption processes.
- Techniques for **solid-liquid separation**.
- Effluent treatment strategies in process industries.
- Approaches for controlling **air** and **water pollution**.

Unit 5: Process Control and Economics Basics

Process control and economic considerations are vital for efficiency. This unit covers:

- Examination of **measured variables** in processes.
- Fundamentals of **simple feedback control**.
- Understanding **Safety Integrity Level (SIL)** and **Safety Instrumented Systems (SIS)**.
- Basic principles of **process utilities** (air, water, steam).
- Review of **electricity** and **power generation** in process plants.
- Introduction to **process economics**.
- Conducting preliminary **economic analysis**.
- Understanding fixed vs. variable costs and **break-even points**.
- **Raw material usage** and optimization.
- The **six-tenths rule** and considerations for scaling up processes.
- Estimating costs associated with process equipment and operations.

This course will equip participants with the essential knowledge to address the key aspects of chemical engineering and improve their skills in process design, control, and economics.