



# Fundamentals of Process Engineering

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# Fundamentals of Process Engineering

## Introduction:

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Process engineering is at the heart of much of the chemical, oil, gas, and petrochemical industries. It requires familiarity not only with chemical engineering principles, but also with many of the other engineering disciplines including electrical and instrumentation, but especially mechanical.

The process engineer is interested in the transportation and transformation of solids, liquids and gases. Of specific importance are separation processes including distillation, heat transfer, hydraulics and fluid flow, reaction engineering, but also process control and economics.

The mechanical engineer is interested in safe containment and movement of solids, liquids and gases, often at high temperature and pressure. Of specific importance are failure modes such as fracture, fatigue and creep, corrosion and corrosion minimization, material properties, design standards, static and rotating equipment design, inspection and repair as well as an understanding of maintenance strategies and condition monitoring. Sound mechanical engineering principles, together with other engineering techniques including inspection, monitoring and condition evaluation, enable the mechanical engineer to design and maintain the equipment required by the process engineers.

## Who Should Attend?

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All Technical and nontechnical personnel in the chemical, petrochemical, oil and process and mechanical industries, petroleum engineers, production engineers, maintenance and project engineers, trainee mechanical engineers, trainee process engineers, RandD chemists, plant chemists, plant operators and economists.

## Course Objectives:

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**By the end of this course participants will be able to**

- Develop both fundamental and practical understanding of central issues in processes used in oil, gas, petrochemical, chemical, and allied facilities together with a practical understanding of central issues in mechanical engineering as applied in those industries.
- Understand the various static and rotating equipment used in the petrochemical environment.
- Apply different maintenance strategies and philosophies.
- Easily identify and assess active degradation of mechanisms and the failures they may cause
- Enhance their competencies in Mechanical design of pressure equipment and piping systems in compliance with applicable codes, standards, and regulations.

## Course Outline:

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Introduction and Fundamentals of Process Engineering

Process engineering basics

- Mass and energy balances
- Batch and continuous processes
- Reactor types
- Process equipment and flow diagrams

Flammability

- Electrical area classification

Risk Management and Hazard Studies

Hydraulics and Fluid flow

- Pressure and head
- Bernoulli's theorem and its field applications
- Flow of liquids
- Reynolds number and pressure drop in pipes
- Two-phase and multiphase flow

Enthalpy and thermodynamics

Principle of process relief devices and process design of relief systems

- Principles of pressure vessel and piping design

Mechanical Equipment Types and application guidelines

- Pumps
- Compressors
- Mixers

Heat Transfer and Reaction Engineering

Heat Transfer

- Thermal conductivity
- Conduction and convection
- Insulation
- Heat transfer coefficients and calculation
- Heat exchangers, type and sizing
- Steam reboilers
- Condensers and subcooling
- Introduction to energy recovery

Catalysis and Reaction Engineering

- Chemical reactions

- Reaction kinetics
- Introduction catalysis
- Green Chemistry and Engineering

## Reactor Design and Operation

## Distillation Processes and Equipment

### Distillation basics

- Gas/Liquid separation

### Distillation equipment Columns and vessels

- Columns and vessels Sizing and selection guidelines
- Column and vessel internals Types and selection guidelines
- Troubleshooting of process equipment

## Separation Processes and Equipment

### Overview of Other Separation Processes

- Absorption and adsorption
- Amine sweetening
- Solid Liquid separation
- Effluent treatment [in refinery and petrochemical] industries

## Process Control and Economics

## Process Control Basics

- Classification of control systems
- Measured variables
- Simple feedback control

## Process Economics

- Preliminary economic analysis
- Fixed and variable costs, break even analysis
- Calculating raw materials usage
- Estimating the cost of process equipment and plants