



THE CHEMICAL ENGINEERING MAJOR

**Applied Process Design – Equipment Sizing,
Selection, Applications, Troubleshooting, Process
Control and Process Safety**

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Applied Process Design – Equipment Sizing, Selection, Applications, Troubleshooting, Process Control and Process Safety

Course Description?

This extensive training course is designed to provide comprehensive understanding of process equipment design concepts and techniques. Process design methods and criteria are presented and discussed to familiarize engineers with practical techniques for selection, sizing and design of process equipment for refineries, petrochemical and related oil and gas processing plants. During the course period, participants will be trained on short-cut methods, rules-of-thumb and example problems on the course topics, which include:-

- Process Design, Categories & Constraints
- Hydrocarbon Properties, Parameters and Definitions
- Development of Process Design Data & Methods
- Engineering Flow Diagrams & Specifications
- Sizing, Selection & Design of Major Process Equipment
- Mechanical & Safety Aspects
- Process Design Specification Packages

In addition to basic calculation procedures for design and rating of process equipment, design approaches in revamp of existing plant facilities are also discussed and guidelines provided. Each session will be conducted in a

lecture/discussion format designed to provide intensive instruction and guidance.

Objectives:

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

- Calculate, evaluate and compile basic process data essential for design of process equipment and plant.
- Acquire enhanced skills and knowledge of process design methods and calculation procedures (including use of practical short-cut techniques), application of criteria for sizing and design of process equipment and perform evaluations of existing equipment designs and revamp methods.
- Prepare comprehensive Process Design Specification document package.
- Troubleshoot process equipment and solve their related problems

Contents:

PRE-TEST

Introduction

- Nature of Design
- Design Constraints
- Design Categories

Petroleum Properties & Definitions

- Composition of Petroleum streams
- Petroleum Processing – Continuous Process Industry: An Overview
- Hydrocarbon Properties: (Pure Hydrocarbons, Defined Mixtures, Undefined Mixtures)
- Characterization Parameters & Definitions

Development of Process Data

- Process Design Tasks & Sequence
- Process Calculations Methods: (Empirical Procedure, Rigorous Procedure)
- Process Design Simulation Techniques: (Commercial Packages, Equipment Software, Process Data Packages)
- Data Compilation and Presentation: (Process Flow Diagram, Equipment Data Sheets, Accuracy and Significance)

Equipment Sizing, Selection and Design Process Equipment Categories

- Required vs. Calculated Data

Piping

- Fluid Flow Equations
- Pressure Loss Categories
- Pipe Properties
- Sizing Criteria
- Two-Phase Flow
- Sizing Methods
- Maintenance & Troubleshooting

Pumps

- Categories & Types
- Performance Characteristics
- Key Design Parameters
- Calculation Method/Typical Format and Examples

- Pump Selection Guidelines
- Maintenance & Troubleshooting
- Pumps: Performance, Control and Operation
- Pumps: Selection, Standards, and Specifications
- Pumps: Design, Materials and Seals

Compressors

- Categories and Types
- Compression Process
- Characteristics & Terminologies
- Key Design Parameters
- Compressor Control Methods
- Calculation Method/Typical Format & Examples
- Selection Guidelines
- Maintenance & Troubleshooting
- Compressors: Design, Materials and Seals

Heat Exchangers / Air Coolers

- Types of heat exchangers
- Shell-and-Tube Construction – TEMA
- Heat Transfer Relation
- Key Design Considerations, Fouling Factors, Process Applications
- Types of Reboilers
- Calculation Methods – Short-cut with Example
- Rating Existing Exchangers with Example
- Selection Guidelines
- Air cooled exchangers: Types – Forced and Induced flow, Key Design Consideration, Calculation Procedures, Monitoring & Troubleshooting
- Plate type heat exchangers
- Maintenance & Monitoring & Troubleshooting exchanger performance

Direct-Fired Heaters

- Types – Size and Configuration
- Fuel options

- Combustion systems
- Design Considerations – Process & Combustion
- Control Systems
- Troubleshooting

Process Vessels

- Types and Functions, Design Considerations
- Calculation Method and Examples
- Vessel internals – distributors, demisters etc
- Troubleshooting

Fractionators Columns

- Fractionators Types: Simple and Complex Columns
- Design Methods – Process/Hardware
- Process Design Procedure/ Examples: Simple Column-Stabilizer; Complex Column-C2 splitter Column
- Reboiling options – side reboilers etc
- Heat Pumped columns
- Internals: Different type of Trays, random & structured Packings / Grids, Vessel internals – distributors, demisters
 - Hydraulic Criteria
 - Performance Comparison
 - Process Specification Data Sheets
 - Maintenance & Troubleshooting

Reactors

- Fixed-Bed Reactors Types
- Gas Phase Reactors (GPR)
- Design Considerations
- Sizing Methods – Pressure Drop Calc
- Internals
- Maintenance & Troubleshooting

Ancillary Equipment

- Steam Jet Ejectors
- Pressure Relief Devices
- Troubleshooting

Mechanical & Safety Aspects

- Codes, Standards and Specifications
- Materials of Construction – Overview
- Safety in Design – Equipment Spacing

Process Control

- PID Controllers
- Feedback, Feed Forward and Cascade Controls
- DCS
- Advanced Control

Materials of Construction

- Selection Criteria
- Construction Materials
- Code & Standards to avoid Catastrophes
- Material Selection (Ferrous Material, Non Ferrous material, others)
- Corrosion Considerations

Process Risk Analysis

- Risk priority matrix
- Evaluation methods
- HAZOP study
- QRA “Ishikawa” diagrams
- MSDS

Cost Estimating

- Cost Estimating Methods
- Estimate Types and Accuracy
- Equipment Installation Factors
- Contingency Allowances
- Cost Escalation

Process Design Specifications

- Purpose of Specification Package
- Types of Specification Packages
- Specification Package Contents
- Process Design in Project Cycle
- Cost of Process Design

Q & A Discussion

POST-TEST