PROCESS EQUIPMENT DESIGN
ENCH 411

Lecture:3 **Year: IV**
Tutorial:1 **Part: I**
Practical: 0

Course Objectives:
The objective of this course is to acquire basic understanding of design parameter, complete knowledge of design procedures for commonly used process equipment and their attachments and different types of equipment testing methods. After completion of this course student will be able to size different types of major and auxiliary process vessels used in chemical process industry.

1. Basis of Design (6 hours)
- 1.1. Basic considerations in process equipment design, Basis of Design (BOD)
- 1.2. Material of Construction (MOC), corrosion, welding types, engineered safety
- 1.3. Process hazards and safety measures in equipment design, pressure relief devices, battery limit, layer of plant safety, inherent safety in design, equipment life cycle
- 1.4. Preparation of equipment specification sheets, design codes and standards

2. Design and Layout Development (8 hours)
- 2.1. Introduction to various layouts used for process and equipment design
- 2.2. Preparing block flow diagram and process flow diagram for a process
- 2.3. Preparing basic Piping and Instrumentation Diagram (P&ID) for a process with control scheme
- 2.4. Performing Hazard and Operability (HAZOP) study and offering process safety on P&ID

3. Design of Piping System (6 hours)
- 3.1. Introduction to piping system, fittings, MOC, pipe end-connection types, support types
- 3.2. Pipe Routing, Pipe thickness calculation under internal and external pressure
- 3.3. Pipe sizing, Development of piping layout based on P&ID and pipe routing data
- 3.4. Pump selection and sizing and preparation of Bill of Quantity (BOQ) for piping works

4. Design of Storage Vessel (6 hours)
- 4.1. Introduction to atmospheric storage tank, Classification, Codes and Standards in use
- 4.2. Design considerations for storage vessels at atmospheric conditions
- 4.3. Process design and sizing of cylindrical flat bottom tank
- 4.4. Mechanical design of cylindrical flat bottom tank, Preparation of General Arrangement (GA) drawing

5. Design of Pressure Vessel (9 hours)

5.1. Selection of type of vessels, Pressure vessel classification
5.2. Design of cylindrical, spherical shells under internal and external pressure
5.3. Selection and design of closures and heads, design of jacketed portion of vessels, compensation of openings, supports for pressure vessel
5.4. Design of skirt, bearing-plate and anchor bolts for tall tower used at high wind and seismic conditions, Inspection and testing of pressure vessels

6. Design of Separators (4 hours)

6.1. Design considerations and criteria for gas-liquid separators
6.2. Classification of various Vapor-Liquid Separator (VLS), process design and P&ID
6.3. Mechanical design of VLS equipment,
6.4. Preparation of GA drawing

7. Plant Location, Site Selection and Layout (6 hours)

7.1. Site selection criteria, Greenfield vs Brownfield projects
7.2. Equipment spacing, plot plan preparation, failure scenario and design solutions
7.3. Environmental and climatic considerations: wind direction, seismic zones, flood risk
7.4. Hazardous area classification and creation of layout a process plant

Tutorial (15 hours)

1 Brainstorming and performing calculations to determine the project's BOD.
2 Preparing the block flow diagram, process flow diagram, P&ID, GA drawing and piping layout using the basis of design.
3 Performing sizing calculations for the pressure vessel.
4 Selecting the site and preparing the plot plan for the overall layout.

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks
1	6	8
2	8	11
3	6	8
4	6	8
5	9	12
6	4	5
7	6	8
Total	**45**	**60**

*There may be minor deviation in mark distribution.

References:

1. Bhattacharya, B. C. (2003). Introduction of chemical equipment design. CBS Publishers.
2. Joshi, M. V. (2017). Process equipment design (Latest ed.). Trinity Press.
3. Moran, S. (2017). Process plant layout (Latest ed.). IChemE.
4. Sinnott, R. K. (2005). Chemical engineering design: Chemical engineering (Latest ed.). Elsevier / Butterworth-Heinemann.
5. Thakore, S. B., & Bhatt, B. I. (2015). Introduction to process engineering & design (Latest ed.). McGraw-Hill Education.
6. Toghraei, M. (2019). Piping and instrumentation diagram development. John Wiley & Sons.