

Subject Code: 01CH0703
Subject Name: PROCESS EQUIPMENT DESIGN-II
B.Tech. Year – IV (Semester-VII)

Objective: To know design layouts of plant /equipment's and the relevant application for equipment design.

Credits Earned: 5 Credits

Course Outcomes: After completion of this course, student will be able to:

1. Analyze, compare process equipment's and modify the design of the existing equipment to the new process conditions or new required capacity.
2. Build a bridge between theoretical and practical concepts used for designing the equipment in any process industry.
3. Create understanding of equipment design with mechanical concepts.
4. Identify the use of design concepts and relevant application of equipment design in process industry.

Pre-requisite of course: Knowledge of Unit Operations of Chemical Engineering and mechanical properties associated with the material.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA (I)	CSE (C)	Viva (V)	Term work (TW)	
4	2	0	5	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	Mechanical design of Pressure vessel: Introduction, Different types of equipment: static and rotary equipment, Design temperature, Corrosion allowance, Concept of internal & external design pressure, Classification of pressure vessel as per IS-2825, Mechanical design of Shell: shell subjected to internal pressure and external pressure with & without stiffening ring, Different types of head, their selection criteria, Mechanical design of heads: Heads subjected to internal pressure and subjected to external pressure, Different types of Nozzles, their selection criteria, Design of nozzle pipe, Design of reinforcement pad by area for area method, Different types of flanges, Different types of	16

	standard flanges, their important features, & selection criteria, Different types of flange facings & their selection criteria, Different types of gaskets, their selection criteria.	
2	Mechanical design of Reaction Vessel: Mechanical design of jacket, agitator etc. Different types of agitators & their selection criteria, Different types of agitator shaft sealing system & their selection, Determination of power required for agitation, shaft diameter, blade thickness, etc., Different types of jackets & their selection criteria, Selection between coil & jacket	8
3	Mechanical design of Storage Tank: Classification of storage tank as per IS-803, Capacity of storage tank, its diameter & height, Design of shell and bottom plate for storage tank, Design of Self supported conical roof, Design of structured supported conical roof as per API 620, Selection of column, girders and rafters, Roof curb angel, Floating roof	10
4	Mechanical design of Shell & Tube Heat Exchangers: Mechanical design of Shell, tube, tube sheet, head, channel shell, etc. of shell & tube heat exchanger.	6
5	Mechanical design of Vertical tall tower (Distillation Column): Mechanical design of shell, head, tray support, nozzle, body flange, for Vertical tall tower, Determination of shell thicknesses at various heights for tray tower & packed tower in case of internal & external pressure, Different types of tray supports & their selection criteria, design of horizontal structural member with periphery ring type packing support	8
6	Supports : Different types of supports, Mechanical design of bracket support, skirt, support & saddle support	
	Total Hours	48

References:

- 1 Process Equipment Design - Vessel Design - L.E. Brownell & E.H. Young, First Edition.
- 2 Illustrated Process Equipment Design by S B Thakore, Second edition,
- 3 Process Equipment Design - M.V.Joshi & V V Mahajani, Third edition.
4. Process Equipment Design (Mechanical Aspects) By B.C.Bhattacharya.

List of Tutorials:

- Design of shell subjected to internal pressure and external pressure with & without stiffening ring

- Design of different heads
- Design of reinforcement pad by area for area method
- Determination of power required for agitation.
- Design of Self/ structured supported conical roof
- Design of Shell and Tube Heat-Exchanger
- Design of Distillation Column
- Design of bracket support

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory marks					
Remember	Understand	Apply	Analyze	Evaluate	Create
10%	25%	30%	15%	10%	10%

Instructional Method:

- a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

Design Based Problems (DP)/ Open Ended project (OEP):

In the beginning of the session, subject faculty will allot an OEP / DP to the students. Students will be free to choose a topic of their choice which will be relevant to the syllabus and they will either prepare a working model/ report / presentation / poster on their topic.