Equipment Design: Mechanical Aspects

1.1 Course Number: CH313

1.2 Contact Hours: 2-0-0 Credits: 6

1.3 Semester -offered: 3rd Year- Odd

1.4 Prerequisite: Nil

1.5 Syllabus Committee Member: Prof. Amit Ranjan, Dr Rakesh Kumar

2. **Objective:** The objective of the course is to provide knowledge for understanding of design parameters, design procedure for process equipment's and their attachments (e.g. vessels, high pressure vessels, tall vessels, storage tank, supports, flanges, gaskets etc.) as per Indian standards and codes.

3. **Course Content:**

Unit wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	General Design Considerations	Factors influencing the design of equipment, Equipment classification, Materials of construction, Design pressure and temperature, Fabrication techniques, Joint efficiency, Factor of safety, Design codes, Bureau of Indian Standards	1
2	Pressure vessels	Design of cylindrical and spherical shells subjected to internal pressure, Thin and thick pressure vessels.	2
3	Curved heads	Conical heads, Torispherical heads, Ellipsoidal heads and hemispherical heads,	3
4	Flat heads	Bending of thin circular plates, Design of flat heads, flanged flat heads.	3
5	Secondary stresses	Discontinuity stresses at the joints and openings	2
6	Nozzles	Stress enhancement around the openings, Compensated and uncompensated openings, Design of nozzles connected to shell walls.	3
7	Flanges	Kinds of flanges, Stresses and deformation in flanges, Design of flanges	3
8	Vessels Subjected to External Pressure	Elastic stability of long thin cylinders under external pressure, Plastic deformation, Out of roundness of shells, Design of circumferential stiffeners	2
9	Tall Vertical	Stresses in the shells of tall vertical vessels, Axial and	2

	Vessels	circumferential stresses due to internal pressure, Dead loads, Bending moments caused by wind loads, Eccentricity, Seismic (earthquake) loads, Resultant stresses, Equivalent stress, Design conditions	
10	Design of Storage Tanks	Optimum tank proportions based on economic considerations, Small capacity and large capacity tanks, Design of shell courses, Stability considerations, Design of self-supported roofs and structurally supported roofs (Roofs supported on rafters, girders and columns)	3
11	Design of Vessel Supports	Design of skirt supports, Design of lug supports, Design of saddle supports	3
		Total	**28**

4. **Readings**

4.1 Text Books:

1. Bhattacharyya, B. C., “Introduction to chemical Equipment Design: Mechanical aspects”, CBS Publishers & Distributors, New Delhi.
2. Brownell, H., and Young, E. H., “Process Equipment Design: Vessel Design”, John Wiley & Sons Inc., New York.
3. Coulson, J. M., and Richardson, J. F., “Chemical Engineering”, Volume 6, Pargamon Press

4.2 Reference Books:

1. Couper, J. R., Penney, W. R., Fair, J. R., and Walas, S.M., “Chemical Process Equipment Selection and Design”, Revised 2nd Ed., Butterworth Heinemann, Elsevier (2010).
2. IS 2825 (1969): Code for unfired pressure vessels.

5. **Outcome of the Course:** The student will be able to know the basics of process equipment design and equipment design parameters and they will also be able to design process vessels subject to internal and external pressure, design of heads, tall vessels, storage tanks and supports etc.