

NIRMA UNIVERSITY
School of Engineering, Institute of Technology
B.Tech. in Chemical Engineering
Disciplinary Minor in Chemical Engineering
Third Year /Semester VI

Institute:	Institute of Technology
Name of Programme:	B. Tech. (Chemical Engineering)
Course Code:	3CH604DC24
Course Title:	Mechanical Design of Process Equipment
Course Type:	Core
Year of introduction:	2024-2025

L	T	Practical component			
		LPW	PW	W	S
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Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. explain the basic concepts of mechanical aspects of equipment design (BL4)
2. design vessels with and without pressure (BL6)
3. design tall columns (BL6)
4. design storage and reaction vessels and their supports (BL6)

Total Teaching hours: 45

**Teaching
hours
10**

Syllabus:

Unit I

Overview of Vessel Design

Introduction to design and drawing. Basic considerations in mechanical design of process equipment. Concept of pressure vessel, definition and type, selection of type of vessel. Methods of fabrication of vessel, economic consideration. Selection Criteria for vessel design. Design Preliminaries like excessive allowable stress, design stress, factor of safety, Poisson's ratio, elastic deformation, plastic instability, brittle rupture, creep, thickness of vessel wall. Introduction to vessel codes and standards.

Unit II

Design of Pressure Vessels

Vessels under Internal Pressure: Design of pressure vessels under internal pressure, Design of wall thickness based on Lamé theorem and membrane stress theory, Types of closers for pressure vessel, design thickness of closer, Selection and Design of nozzles and reinforcement pads, Introduction to flanges and gasket, types and selection, design of flanges for pressure vessels.

Vessels under External Pressure: Industrial pressure vessels under external pressure, Design of vessel wall in the presence and absence of stiffeners using analytical & graphical methods, Design of circumferential stiffeners, Design of closers subjected to external pressure. High Pressure Vessel: Types of high-pressure vessel, Design of high-pressure vessel, Construction features, materials for high pressure shell design, vessel, closures

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Unit III	Design of Non-pressure Vessels Reaction vessels: Introduction to various components of reaction vessel Selection and design of various jackets and Coil, Selection and design of Agitators based on torque, moment and critical speed. Storage Vessels: Identification for storage for non-volatile & volatile liquids, storage of gases, Types & constructional features of storage vessels, rectangular storage tank design, Design of cylindrical storage tank, course to course calculation of wall, thickness, bottom design, roof design	10
Unit IV	Design of Tall Columns Industrial requirement of tall vessels, Construction & features in column stress & determination of shell thickness Supports for Vessels: Selection and design of different types - bracket or lug support, skirt support & saddle support, design calculations	10

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

Laboratory work will be based on the above content of course.

Suggested Readings/References:

1. Brownel, L. E.; Young, E. H. Process Equipment Design & Drawing; Wiley Eastern Ltd.
2. Umarji, S. B.; Mahajani, V.V. Process Equipment Design; Trinity Press.
3. Joshi, M. V., & Mahajani, V. V. Process equipment design. Macmillan India Limited.
4. Bhattacharya, B.C. Process Equipment Design: Mechanical Aspect; CBS Publisher and Distributors Pvt. Ltd.
5. Bhattacharya, B.C.; Narayanan, C.M. Computer Aided Process Equipment Design; New Central Book Agency (P) Ltd.

L= Lecture, T=Tutorial, P= Practical, C=Credit

List of Experiments:

Sr. No.	Practical	No. of Hours
1	Generalised design calculations for Vessel Design	02
2	Design calculations of Vessels under Internal Pressure	02
3	Design calculations of Vessels under Internal Pressure Vessels under External Pressure	02
4	Design calculations of Vessels under Internal Pressure High Pressure Vessel	02
5	Design calculations of Vessels under Internal Pressure Reaction vessels	02
6	Design calculations of Vessels under Internal Pressure Storage Vessels	02
7	Design calculations of Vessels under Internal Pressure Design of Tall Columns	02
8	Selection and design of different types - support	02
9	Design calculations skirt support & saddle support	02
10	Design calculations bracket or lug support	02