PRESSURE VESSEL DESIGN

Course Code	22MEMD1T2	**Year**	I	**Semester**	I
Course Category	Programme core	**Branch**	ME	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	Design of Machine Elements
Continuous Internal Evaluation:	40	**Semester End Evaluation:**	60	**Total Marks:**	100

Course outcomes: At the end of the course, the student will be able to:

CO	Statement	BTL	Units
CO1	Understanding of the fundamental engineering processes and principles of pressure equipment design.	L2	1,2
CO2	Understand the suitable Pressure vessel materials and their environment.	L2	3,4
CO3	Apply vessel design codes in influencing vessel design features, stresses, materials and inspection/testing requirements.	L3	3
CO4	Design pressure vessels and various parts of vessels	L4	4

Contribution of Course outcomes towards achievement of programme outcomes & Strength of correlations (High:3, Medium: 2, Low:1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	1	1			2			1		2	3	2
CO 2	3	3	1	1			2			1		2	3	2
CO 3	3	3	1	1			2			1		2	3	2
CO 4	3	3	1	1			2			1		2	3	2

Syllabus		
Unit	**Contents**	**Mapped CO**
1	**INTRODUCTION:** Materials-shapes of Vessels-stresses in cylindrical, spherical and arbitrary, shaped shells. Cylindrical Vessels subjected to internal pressure, wind load, bending and torque-dilation of pressure vessels-conical and tetrahedral vessels.	**CO1**

	THEORY OF THICK CYLINDERS: Shrink fit stresses in built up cylinders-auto frettage of thick cylinders. Thermal stresses in Pressure Vessels.	
2	**THEORY OF RECTANGULAR PLATES:** Pure bending- different edge conditions. **THEORY OF CIRCULAR PLATES:** Simple supported and clamped ends subjected to concentrated and uniformly distributed loads-stresses from local loads. Design of dome bends, shell connections, flat heads and cone openings.	**CO1**
3	**PRESSURE VESSEL MATERIALS AND THEIR ENVIRONMENT:** Introduction, ductile material tensile tests, structure and strength of steel, Leuder's lines, determination of stress patterns from plastic flow observations, behaviour of steel beyond the yield point, effect of cold work or strain hardening on the physical properties of pressure vessel steels, fracture types in tension, toughness of materials, effect of neutron irradiation of steels, fatigue of metals, fatigue crack growth, fatigue life prediction, cumulative fatigue damage, stress theory of failure of vessels subject to steady state and fatigue conditions.	**CO2, CO3**
4	**STRESS CONCENTRATIONS:** Influence of surface effects on fatigue, effect of the environment and other factors on fatigue life, thermal stress fatigue, creep and rupture of metals at elevated temperatures, hydrogen embrittlement of pressure vessel steels, brittle fracture, effect of environment on fracture toughness, fracture toughness relationships, criteria for design with defects, significance of fracture mechanics evaluations, effect of warm prestressing on the ambient temperature toughness of pressure vessel steels.	**CO2, CO4**

Learning Resources
Text Book(s): 1. Theory and design of modern Pressure Vessels by John F. Harvey, Van nostrand reihold company, New York, 1974 2. Pressure Vessel Design and Analysis by Bickell, M.B.Ruizcs, 1998.
References: 1. Process Equipment design- Beowll & Yound Ett, John Wiley & Sons Inc, 1959. 2. Indian standard code for unfired Pressure vessels IS:2825, 1969. 3. Pressure Vessel Design Hand Book, Henry H.Bednar, P.E., C.B.S.Publishers, New Delhi, 1989.