GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (CAD/CAM) (08)/ MECHANICAL (MACHINE DESIGN) (09)/
PRESSURE VESSEL AND PIPING SYSTEM DESIGN
SUBJECT CODE: 2740803
SEMESTER: IV

Type of course: Post Graduate

Prerequisite: Zeal to learn the subject

Rationale:
The course aims to impart basic knowledge of design of pressure vessels and piping system. It is also aimed to introduce use of various standards used for the pressure vessel design.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	0	2#	4	70	30	20	10	10	10	150

Content:

Sr. No	Topic	Lectures	Weightage
1	**Stresses in Vessels:** General theory of membrane stresses in vessel under internal pressure and its application to shells (cylindrical, conical and spherical) and end closures. Bending of circular plates and determination of stresses in simply supported and clamped circular plate; Thermal stresses; Stress concentration in plate having circular hole due to bi-axial loading, excessive elastic deformation, plastic instability, brittle, rupture and creep. Theory of reinforced opening and reinforcement limits.	**14**	**30%**
2	**Design of Vessels using Codes:** Introduction to ASME cods for pressure vessel design, Pressure vessel and related components' design using ASME codes; Supports for short vertical vessels, stress concentration at a variable thickness transition section in a cylindrical vessel; Design of nozzles;	**8**	**20%**
3	**Supports for vertical & horizontal vessels:** Design of base plate and support lugs. Types of anchor bolt, its material and allowable stresses. Design of saddle supports.	**4**	**10%**
4	**Other Design Considerations:** Buckling phenomenon, Elastic Buckling of circular ring and cylinders under external pressure, collapse of thick walled cylinders or tubes under external pressure, Effect of supports on Elastic Buckling of Cylinders, Design of circumferential stiffeners, Buckling under combined External pressure and axial loading.	**9**	**20%**

	Fatigue, shock, high pressure, high temperature, irradiation, corrosion, and other hostile environments, high strength, lightweight pressure vessels, vessels resistant to external high pressures found in undersea exploration, offshore drilling, and mineral mining.		
5	**Piping Analysis:** Flow diagram, Piping layout and piping stress analysis; Flexibility factor and stress intensification factor; Design of piping system as per B31.1 piping code. Piping components: bends, tees, bellows and valves. Types of piping supports and their behaviour; Introduction to piping Codes and Standards.	**10**	**20%**

References Books:

1. Harvey J F, Pressure vessel design CBS publication
2. Brownell L. E & Young. E. D , 'Process equipment design', Wiley Eastern Ltd., India
3. ASME Pressure Vessel and Boiler code, Section VIII Div 1, 2, and 3.
4. American standard code for pressure piping, B 31.1
5. Henry H Bednar, Pressure vessel Design Hand book, CBS publishers and distributors
6. Stanley M Wales, Chemical Process equipment, selection and design, Butterworths, series in Chemical Engineering,1988
7. J. Phillip Ellenberger Pressure Vessels : ASME Code Simplified
8. Smith P, Fundamentals of Piping Design, Elsevier.

Course Outcome:

On completion of this course students will be able to:

1. Analyse thin plates and shells for various types of stresses.
2. Design shells, end closures and nozzles of pressure vessels using ASME codes.
3. Analyse piping systems.

List of Tutorials:

1. Case studies based on membrane theory and its applications.
2. Case studies for the analysis of circular plates with hole.
3. Understand basic design procedure for low pressure vessel, using ASME code.
4. Understand basic design procedure for high pressure vessel, using ASME code.
5. Design of nozzles.
6. Design of supports for vessels.
7. Buckling analysis of vessels.
8. Design of pipes for various applications.
9. Design a pressure vessel from the industrial data and compare your design with existing design. Comment over the differences found (if any).

Major Equipment:

1. Software for Pressure vessel and piping design and analysis (like PV Elite, CAESAR II).
2. ASME Codes for pressure vessels and piping designs.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.