GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3170515
Semester – VII
Subject Name: Piping Design

Type of course: Open Elective

Prerequisite: The student should have basic understanding of fluid mechanics, engineering and mechanical properties associated with the material.

Rationale:
Piping design and engineering is a key area in various streams of engineering. Piping and accessories constitute over 25% of the total capital investment in the chemical process industry, petroleum and petrochemical industry, pharmaceutical industry, power plants, and so on. The present course is intended to familiarize undergraduate students about the fundamental design aspects of piping components and their applications in process industries.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Contents	Total Hrs
1	**Fundamentals of piping:** Classification of pipe, Codes and standards, Pipe Fabrication, vibration, its prevention and control in piping systems, Mechanical Properties of material, schedule number, Piping materials and selection	04
2	**Design calculations for piping:** Determination of pipe size, Calculation of pressure drop in pipe, Equivalent length of pipe line for fittings and valves, Energy losses in pipe line, Different types of pumps and their selection criteria, NPSHA & NPSHR, Power required by pump, Calculation of flow measurement in pipe line.	06
3	**Piping component and Flow through pipe line:** Types of Fitting, Different types of flange and gasket, their selection criteria and applications, Different types of valves, their selection criteria and applications, Determination of valve size, Steam separators and steam traps, Calculation of pressure drop for two phase flow through pipe line by using Lockhart and Martinelli correlations, Piping drainage and water hammer in process plant, Calculations for water hammer in pipe line.	07
4	**Mechanical design of piping:** Operating pressure and temperature, Design Pressure & Design Temperature for Piping Systems, Design equation for longitudinal, hoop and allowable stresses, Determinations of thickness required by steel pipe for withstanding	06

		internal and external pressure, Determinations of thickness required by jacketed steel pipe for withstanding external pressure.	
5		**Pipe supports and P & I diagram:** Functions of Supports and selection, Types of loads, Different types of piping support, Determination of support location, Maximum span between the supports suggested by ASME B 31.1, Thermal expansion in pipe line, Different types of expansion joints and their applications, Difference between a PFD and P&ID, Typical P&I diagrams for pumps, distillation column, Reactors and Shell and tube heat exchanger.	**07**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
07	21	21	07	14	--

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Perry R.H., "Chemical Engineers' Handbook", McGraw-Hill, 2009.
2. Thakore S.B., Bhatt B.I., "Introduction to Process Engineering and Design", 2nd Edition, Tata McGraw Hill Publication, 2017.
3. Nayyar M.L., "Piping Handbook", 7th Edition, Tata McGraw Hill Publication, 2000.
4. Coulson J.M, Richardson J.F and Sinnott, R.K., "Coulson and Richardson's Chemical Engineering", Vol. 6, 4th Edition, Elesevier, New Delhi, 2006.
5. McCabe W.L, Smith J.C, Harriott P., "Unit Operations of Chemical Engineering", Mc Graw Hill Publication
6. Ludwig E., Chemical Process Equipment Design, 3rd Edition, Gulf Publications, 2002.
7. Kellogg, M. W Company., "Design of Piping Systems", Pullman Power Products, New York, 1976.

Course Outcomes: After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	To understand the safety and practical engineering aspects of piping systems.	20
CO-2	To understand the design and principles used in piping system.	35
CO-3	To know the terminology, concepts, equipment, and process used piping network	20

CO-4	To get an idea of pipe support with other accessories and P& I diagram	25

List of Open Source Software/learning website:

- Students can refer to the video lectures available on the websites including NPTEL lecture series.
- Students can refer to the CDs available with some reference books for the solution of problems using software/spreadsheets. Students can develop their own programs/spreadsheets for the solution of problems.
- MIT Open course lecture on Equipment design.
- Literature available for Process design of equipment in plant / industry.

Suggested List of Design Problems for practical/tutorials: (8 to 10 practicals are to be given)

- Prediction/Estimation of various physical properties such as density, viscosity, surface tension, specific heat, thermal conductivity etc.
- Finding suitable material of construction for handling various chemicals.
- Determination of pipe size and pressure drop for various fittings in the pipe line.
- Determination of Power required by centrifugal pump.
- Design of pipe flow measurement devices.
- Determination of valve size for pipe line.
- Determination of pressure drop for two phase flow through pipe line.
- Determination of water hammer in pipe line.
- Design of pipe subjected to internal and external pressure.
- Design of jacketed steel pipe under external pressure.
- Design of piping support.
- P&I diagrams for pumps, distillation column, Reactors, Shell and tube heat exchanger.