

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**

**COURSE CURRICULUM  
COURSE TITLE: PROCESS PIPING FABRICATION  
(COURSE CODE: 3355502)**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
Fabrication Technology	5 <sup>th</sup> Semester

### 1. RATIONALE

This course focuses on different types of process piping fabrication work. This course helps to practice use of different tools, equipments and machineries applicable in piping fabrication. This includes hands on practice to student for deciding fundamental technical requirements in piping fabrications. This course also helps student to become conversant with related manufacturing codes and standards of process piping fabrication e.g. ASME, API, ASTM, ANSI etc. This also creates safety consciousness and basic abilities required for the piping fabrication work. Thus this course prepares the student for the employable in process piping fabrication industries.

### 2. LIST OF COMPETENCY

The course should be taught and implemented with the aim to develop required skills in students so that they are able to acquire following competency:

- **Plan and supervise process piping fabrication by using appropriate process, equipment, tools, along with safe working procedures as per drawing, standards and codes.**

### 3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to required learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes

- i. Describe the responsibilities of piping field engineer
- ii. Use pipe's standard tables for different calculations.
- iii. Describe the functions and features of various piping components/Element
- iv. Apply various codes and standard for piping in a given situation.
- v. Measure pressure in pipes.
- vi. Explain precautions to be taken in piping fabrication to minimise loss in head due to flow of fluid through piping
- vii. Interpret and use various simple piping drawings in a given situation
- viii. Plan and supervise process of surface preparation and painting/coating.
- ix. Perform the process of pipe shaping, bending and forming.

#### 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			C	ESE	PA	ESE	PA	150
4	0	2	6	70	30	20	30	

**Legends:** L-Lecture; T – Tutorial/Teacher Guided Student Activity; P - Practical; C – Credit;; ESE - End Semester Examination; PA - Progressive Assessment.

#### 5. COURSE CONTENT DETAIL

Unit	Major Learning Outcomes (outcomes in cognitive domain)	Topics and Sub-topics
<b>Unit – I Introduction to Piping</b>	1a. Classify pipes 1b. Calculate weight of pipe by using standard table. 1c. State the piping color codes 1d. Describe the responsibilities of piping field engineer.	<b>Introduction To Piping:</b> 1.1 Introduction to piping 1.2 Piping 1.3 Pipe classification 1.4 General definitions 1.5 Length area, surface & volume Acronyms and abbreviation Colour coding of piping as per types fluid passing through piping ( IS 2379:1990) 1.6 Concept of high point vent & low point drain 1.7 Duties & responsibilities of piping field engineer 1.8 Role of field engineer in safety field craft supports/communications
<b>Unit– II Life Cycle of Piping Process Plants</b>	2a. Describe the various phases of life cycle of piping process plants.	<b>Life Cycle Of Piping Process Plants:</b> 2.1 Introduction to major phases of piping process plants 2.2.1 Feasibility study (techno- economical survey) 2.2.2 Design ,Construction Commission/erection phase 2.2.3 Operational/production phase
<b>Unit– III Piping Components Hanger And Supports</b>	3a. Describe the functions and features of various piping components/Element.	<b>Piping Components:</b> 3.1 Pipe & tube product 3.2 Pipe sizes & materials 3.3 Pipes joints & bending 3.4 Valves

Unit	Major Learning Outcomes (outcomes in cognitive domain)	Topics and Sub-topics
<b>(Restrain)</b>		3.5 Strainers & traps 3.6 Expansion joints 3.7 Threaded joints 3.8 Flanges' 3.9 Gaskets 3.10 Fasteners 3.11 Welded & brazed joint 3.12 Joining ductile or cast iron pipes
	3b. Describe types of support, calculation and their field of application. 3c. Describe the Bolt/stud and nuts fastening and loosening sequence.	<b>Hanger And Supports (Restrain)</b> 3.2 Introduction 3.13 Concept and Function 3.14 Classification/Types of supports 3.15 Pipe support material 3.16 Oversized and Slotted Holes 3.17 Bolting Installation Procedure 3.18 Hanger installation guide lines 3.19 Calculation for pipe supports 3.20 e.g. spacing, span, and pipe welding space, etc.
<b>Unit- IV Piping Codes &amp; Standards</b>	4a. Apply various codes and standard for piping in a given situation.	<b>Piping Codes &amp; Standards</b> 4.1 Introduction of ASME codes 4.2 Code cases interpretation 4.3 Introduction of ASME B 31.1,31.2,31.3 4.4 Introduction of ANSI 4.5 Introduction of ASTM 4.6 Introduction of API 4.7 Introduction of AWS
<b>Unit-V Fluid Mechanics and Pipe Sizing</b>	5a. Describe various fluid properties. 5b. Describe various types of fluid flow. 5c. Apply fundamentals of fluid mechanics in process piping fabrication. 5d. Explain methods of measuring pressure in pipes. 5e. Explain precautions to be taken in piping fabrication to minimise loss in head due to flow of fluid through piping.	<b>Fluid Mechanics And Pipe Sizing</b> 5.1 Introduction to Fluid mechanics 5.2 Definition of hydraulics, fluid mechanics, Fluid 5.3 Definition of total pressure and centre of pressure 5.4 Properties of fluid 5.4.1 Liquid and their properties 5.4.2 Density, specific gravity viscosity, Surface tension & capillarity action, Compressibility and bulk modulus. 5.4.3 Vapour Pressure 5.4.4 Fluid characteristics

Unit	Major Learning Outcomes (outcomes in cognitive domain)	Topics and Sub-topics
		5.5 Pressure measurement 5.5.1 Pressure of fluid, 5.5.2 pressure head of a liquid 5.5.3 Pascal laws 5.5.4 Relation amongst Positive and negative gauge pressure (Vacuum), and absolute pressure. 5.6 Fluid kinematics 5.6.1 Type of fluid flow 5.7 Fluid dynamics 5.7.1 Introduction 5.7.2 Different types of head 5.7.3 Bernoulli's equation 5.8 Laminar flow & Turbulent flow in pipe 5.9 Flow through Pipes 5.9.1 Loss of energy / head in pipes Loss of head due to friction 5.9.2 Minor energy losses 5.9.3 Water hammer in pipes
<b>Unit – VI Piping Drawing</b>	6a. Classify the various types of piping drawing. 6b. Interpret and use various simple piping drawings in a given situation. 6c. Interpret piping and instrumentation diagram/engineering flow diagram.	<b>Piping Drawing:</b> 6.1 Piping drawing symbols and abbreviations 6.2 Classification/Types of drawing 6.3 Introduction to simple piping drawings 6.3.1 Plot Plan 6.3.2 G.A Drawing 6.3.3 Process flow diagram (P.F.D) 6.3.4 Piping and instrumentation diagram(P&ID) / Engineering flow diagram 6.3.5 Piping Isometric Drawing /Spool Drawing 6.3.6 Equipment Lay-Out

Unit	Major Learning Outcomes (outcomes in cognitive domain)	Topics and Sub-topics
<b>Unit-VII Pipe Coating And Insulation</b>	7a. Describe the properties of various types of coating. 7b. Describe the various types of painting terminology. 7c. Describe the process of surface preparation for painting and coating.	<b>Pipe Coating And Insulation</b> 7.1 Introduction and function, Definition 7.2 Types / Classification 7.3 Surface preparation for coating and painting 7.4 Painting as Coating 8.4.1 Terminology of painting 7.5 Problems related to painting and coating 7.6 Definition of insulation 7.7 Classification of insulation 7.8 Functions and objectives of insulation
<b>Unit-VIII Pipe Welding &amp; Fabrication</b>	8a. Describe various types of pipe fabrication, welding and joints 8b. Describe pipe welding Defects 8c. Describe the process of pipe shaping, bending and forming. 8d. Describe the features and functions of equipment / Tools / Accessories used in piping fabrication	<b>Pipe Welding &amp; Fabrication</b> 8.1 Orbital pipe welding 8.2 Up-hill / down-hill welding. 8.3 Spiral pipe welding 8.4 Various pipe welding position groove & fillet. 8.5 General fabrication procedure for piping spool. 8.6 Shop weld plan for piping. 8.7 Underground pipe laying (needs & method ) 8.8 Fit-up & set-up for welding of pipe. 8.9 Purging / Trailing gas concept in pipe fabrication FPW- full penetration welding of pipe. 8.10 Different types of purging. 8.11 Equipment / Tools / Accessories' used in piping fabrication (e.g pulling& lifting ). 8.12 Various electrodes & filler wire used piping fabrication 8.13 Hot Taping process 8.14 TKY joint 8.15 WPS / WPQ / PQR for pipe fabrication. 8.16 Pipe Shaping / bending / forming 8.17 Welding defect in piping fabrication.

## 6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (Theory )

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total
I	Introduction to piping	08	3	3	4	10
II	Life cycle of piping process plants	04	-	4	-	4
III	Piping component & Hanger and supports (restrain)	12	-	8	8	16
IV	Piping codes & standards	04	-	5	-	5
V	Fluid mechanics and pipe sizing	08	-	5	5	10
VI	Piping drawing	08	-	4	5	9
VII	Pipe coating and insulation	04	3	3	-	6
VIII	Pipe welding & fabrications	08	-	5	5	10
<b>TOTAL</b>		<b>56</b>	<b>06</b>	<b>37</b>	<b>27</b>	<b>70</b>

**Legends:** R = Remember; U = Understand; A = Apply and above levels (Bloom's Revised taxonomy)

**NOTE:** Suggested specification table shall be treated as only general guidance for students and teachers. The actual distribution of marks in the question paper may vary from above table.

## 7. SUGGESTED LIST OF EXERCISE / PRACTICAL / EXPERIMENTS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes mainly in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

*Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.*

Sr. No.	Unit No.	Exercise / Practical (Outcomes in psychomotor domain)	Approx Hours. Required
1.	I	Draw different pipe fittings in chart forms with application, specification symbols and types.	4
2.	VI	Draw simple Process Flow Diagram (PFD)	4
3.	VI	Draw simple P & ID diagram	4
4.	VI	Draw four simple Spool/Isometric piping drawings	4
5.	VIII	Prepare a job of T type piping joint.	2

6.	VIII	Prepare a job of L or Angle type piping joint.	2
7.	VIII	Prepare a job of K or Y type piping joint.	2
8.	VII	Prepare a job of piping support.	2
9.	III	Practice sequence of fastening 16 holes flange.	2
10.	III	Identify different type of gaskets from given set.	2
11.	III	Select set of different fittings required for given piping drawing.	2
12.	VIII	Perform purging operation for given piping joint.	2
<b>Total Hrs.</b>			<b>30</b>

## 8. SUGGESTED LIST OF PROPOSED STUDENT ACTIVITIES

Following is the list of proposed student activities:

- i. Prepare model answers to given questions.
- ii. Prepare sketch book /drawing sheet for given examples of piping fabrication.
- iii. Explore internet to study the advances in different aspects of process piping fabrication and prepare reports.
- iv. Solve various examples of process piping fabrication.

## 9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Arrange visit to a process industry and discuss different features of process piping in use.
- ii. Collect process piping drawings from some process industry and ask students to develop working drawings for fabrication of these process piping.
- iii. Show video films/animation films/photographs of different process industries to discuss the features of piping used.
- iv. Arrange expert lecture by some experienced process piping engineer.

## 10. SUGGESTED LEARNING RESOURCES

### A. List of Books

Sr.No	Title of Books	Author	Publication
1	Fluid mechanics	R.K Rajput	S. Chand & co. Ltd.
2	Fluid mechanics and hydraulics	BANSAL	Laxmi Publication Pvt. Ltd.
3	Fluid mechanics and hydraulics	R. S. Khurmi	S. Chand & co. Ltd.
4	Welding Engineering & Technology	Dr. R.S.Parmar	Khanna Publishers
5	Maintenance Engineering and management	Sushil Kumar Srivastava	PHI Learning Pvt. Ltd.
6	Modern arc welding	S.V.Nadkarni	Oxford Publication
7	Piping/mechanical hand book	Mohinder L. Nayyar.	Peter H. O. Fischer, Manager, Pipeline Operations, Bechtel

Sr.No	Title of Books	Author	Publication
			<i>Corporation</i>
8	Handbook of piping design	S.K. Sahu	Elsevier <i>Publishers</i>
9	ASME PIPING CODES	ASME	ASME
10	API CODES	API	API
11	ASTM CODES	ASTM	ASTM

### B. List of Major Equipment/ Instrument

- i. Welding rectifier and consumables
- ii. Inverter type GTAW welding machine and consumables
- iii. Marking & measuring tools & equipments
- iv. Tong tester
- v. Portable disc grinder for edge preparation.
- vi. Sheet metal working tools & equipments.
- vii. Sprit level and water tube level.
- viii. Pipe cutting, pipe holding and pipe bending tools & equipments.
- ix. Torque wrench and various types of spanners.
- x. Thread gauge.
- xi. Installation tools for fitting of gaskets & seals.

### C. List of Software/Learning Websites

- i. [www.rockhillindustrial.com](http://www.rockhillindustrial.com)
- ii. [www.processconstruction.com](http://www.processconstruction.com)
- iii. [en.wikipedia.org/wiki/Pipefitter](http://en.wikipedia.org/wiki/Pipefitter)
- iv. <http://en.wikipedia.org/wiki/Piping>

## 11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

### Faculty Members from Polytechnics

- **Prof. P.B.Pathak**, I/C HOD, Dept of Fabrication Technology, Sir B.P.I., Bhavnagar
- **Prof. B. K. Gandhi**, Sr. Lecturer, Dept of Fabrication Technology, Sir B.P.I., Bhavnagar
- **Prof. S.Y. Merchant**, Sr. Lecturer, Dept of Fabrication Technology, Sir B.P.I., Bhavnagar

### Co-coordinator and Faculty Members from NITTTR Bhopal

- **Dr. A. K. Sarathe**, Associate Professor Deptt. of Mechanical Engineering
- **Dr. C. K. Chugh**, Professor Deptt. of Mechanical Engineering