

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2021)

Semester -V

Course Title: Fabrication Design

(Course Code: 4355501)

Diploma programmer in which this course is offered	Semester in which offered
Fabrication Technology	5 th Semester

1. RATIONALE

Fabrication is one of the major manufacturing processes which is extensively used in producing process equipments, steel structures and piping projects. This course develops capability to interpret and draft fabrication design & drawings using basic knowledge and skill attained through this course. The students will be able to apply this knowledge and skill in their real life application throughout their career in the world of work. Student will develop his lifelong learning skill in stress calculation, design of riveted joint, welded joint, main parts of pressure vessel and structural elements.

2. 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:

- Design simple machine parts, riveted joints, welded joints, pressure vessels basic elements and steel structures elements.

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

- a) Design simple machine parts
- b) Design riveted joints
- c) Design welded joints
- d) Describe basic considerations in process equipment design and drafting.
- e) Describe design considerations of steel structures.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
C	CA	ESE	CA	ESE	CA	ESE		
4	0	2	5	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be

taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: **L**-Lecture; **T**- Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *These PrOs need to be attained to achieve COs.*

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Interpret process equipment drawing.	4	2
2	Draw orthographic drawing by using AutoCAD – 2D.	4	8
3	Calculate stress & strain for given load and job conditions.	1	2
4	Design the shaft.	1	2
5	Design simple riveted joints.	2	2
6	Design riveted joint for structural use (lozenge joint).	2	2
7	Design simple welded joint.	3	2
8	Design eccentrically loaded welded joints.	3	2
9	Study design consideration of Industrial Shade and Transmission Line Tower.	5	2
10	Study design consideration of Roof struts and Steel bridge.	5	2
11	Draw S.F & B.M diagram for cantilever & simple supported beam and calculate the SF and BM.	5	2
	Total Hours		28

Note

- i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.
- ii. Boiler suit, safety shoes and necessary tools & instruments are compulsory while attending laboratory and has to be brought by students (Annexure-1).

The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOs no: 1, 3,4,5,6,7,8,9,10,11		
1	Knowledge of experiment	30

2	Quality of report	30
3	Participation	20
4	Originality	10
5	Punctuality	10
Total		100

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOs no: 2		
1	Knowledge	20
2	Quality of drawing	30
3	AutoCAD commands and tools	20
4	Dimensions (accuracy)	20
5	Punctuality	10
Total		100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical's in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1.	Desktop Computer	2

7. AFFECTIVE DOMAIN OUTCOMES

The following *sample* Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

- a) Follow safety practices in laboratory.
- b) Practice good housekeeping.
- c) Work as a leader/a team member.
- d) Maintain tools/equipment
- e) Follow ethical practices

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- i. 'Valuing Level' in 1st year
- ii. 'Organization Level' in 2nd year.
- iii. 'Characterization Level' in 3rd year & 4th year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If

required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit-I Machine design and stresses in machine parts	1a. Classify the machine design 1b. Design simple machine parts 1c. Design the shaft under torsional load 1d. Describe factor of safety 1e. Describe stress concentration	1.1 Definition 1.2 Classification of machine design 1.3 General considerations in machine design 1.4 General procedure in machine design 1.5 Fundamental units & its conversion 1.6 Load, Stress, Strain 1.7 Tensile, compressive, shear stress & strain 1.8 Young's modulus 1.9 Shear modulus 1.10 Bearing stress 1.11 Stress strain diagram 1.12 Working stress 1.13 Factor of safety and its selection criteria 1.14 Thermal stress 1.15 Linear and lateral strain 1.16 Poisson's ratio 1.17 Volumetric strain 1.18 Bulk modulus 1.19 Relation between bulk modulus and young's modulus 1.20 Relation between young's modulus and modulus of rigidity 1.21 Impact stress 1.22 Resilience 1.23 Torsional shear stress 1.24 Bending stress 1.25 Principal stress and principal plane 1.26 Application of principal stress in designing machine members 1.27 Cyclic stresses 1.28 Fatigue and endurance limit 1.29 Effect of different factors on endurance limit

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		1.30 Stress concentration & methods of reducing stress concentration 1.31 Notch sensitivity
Unit– II Design of Riveted Joints	2a. State Essential qualities of Rivet 2b. State types of rivets and riveted joint 2c. Describe failures of a riveted joint 2d. Design simple riveted joints.	2.1 Introduction & methods of Riveting 2.2 Material of rivet 2.3 Essential qualities of rivet 2.4 Types of rivets 2.5 Types of riveted joint 2.6 Important terms used in riveted joint 2.7 Failures of a riveted joint 2.8 Strength of riveted joint 2.9 Efficiency of riveted joint 2.10 Riveted joint for structural use – joint of uniform strength (Lozenge joint)
Unit-III Design of Welded Joints	3a. Describe advantages and limitations of welded joints over riveted joint 3b. Design transverse fillet & parallel welded joints 3c. Design welded joint for stress concentration 3d. Design axially loaded unsymmetrical welded sections	3.1 Introduction 3.2 Advantages and disadvantages of welded joint over riveted joint 3.3 Types of welded joint 3.4 Strength of transverse fillet welded joint 3.5 Strength of parallel fillet welded joint 3.6 Special cases of fillet welded joint 3.7 Strength of butt welded joint 3.8 Stresses for welded joint 3.9 Stress concentration factor for welded joint 3.10 Axially loaded unsymmetrical welded sections
Unit-IV Basic Consideration in Process Equipment Design and drafting	4a. Describe factor affecting process equipment Design. 4b. Describe failure in pressure vessel 4c. Calculate thickness of Pressure vessel as per ASME Sec VIII Div-1 4d. Calculate thickness of various types of dished end	4.1 Design codes 4.2 Factors affecting process equipment design 4.3 Maximum working pressure 4.4 Design pressure 4.5 Design temperature 4.6 Design stress & factor of safety 4.7 Corrosion allowance 4.8 Weld joint efficiency factor

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
	as per ASME Sec VIII Div-1	4.9 Design loadings 4.10 Stress concentration 4.11 Thermal stress 4.12 Criteria of failure 4.13 Failures in pressure vessel 4.14 Cylindrical shell design 4.15 Design of heads & closures 4.16 Compensation for opening in process equipment 4.17 Types & design criteria of flange 4.18 Gasket & its selection 4.19 Design consideration & types of support for pressure vessel 4.20 AutoCAD 2D drafting
Unit- V Design considerations of steel Structure	5a. Describe steps of steel structure design 5b. Describe different methods of structural design 5c. Describe different types of load affecting structural design 5d. Draw S.F and B.M diagram under point and uniformly distributed load	5.1 Factors governing structural layout 5.2 Structural design 5.3 Steps in design 5.4 Load analysis 5.5 Minimum thickness 5.6 Plans and drawings 5.7 Design considerations 5.8 Methods of structural design 5.9 Simple design 5.10 Semi-rigid design 5.11 Fully rigid design 5.12 Experimentally based design 5.13 Slenderness ratio 5.14 Corrosion protection 5.15 Increase of stresses 5.16 Fluctuation of stresses 5.17 Resistance to horizontal forces 5.18 Stability of the structure 5.19 Industrial building 5.20 Steel Bridges 5.21 Web stiffeners & its types 5.22 Roof trusses 5.23 Transmission line tower 5.24 Bending moment & shear force diagram 5.25 Cantilever beam with point load at end 5.26 Cantilever beam with uniformly distributed load

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		5.27 Simply supported beam with point load at mid point 5.28 Simply supported beam with uniformly distributed load

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Machine design and stresses in machine parts	22	6	8	14	28
II	Design of Riveted Joints	6	0	7	7	14
III	Design of Welded Joints	6	0	3	7	10
IV	Basic Consideration in Process Equipment Design and drafting	12	3	4	0	7
V	Design considerations Of steel Structure	10	0	4	7	11
	TOTAL	56	9	26	35	70

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

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks and marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

- Prepare solutions of different assignments given by subject faculty.
- Download videos showing correct practices for different design consideration.
- Visit at local manufacturer place and prepare the report on it.
- Arrange the local Industrial visit in industries.
- Fill up the lab manual.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- a) Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- b) Guide student(s) in undertaking micro-projects.
- c) '**L**' in **section No. 4** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
- d) About **20% of the topics/sub-topics** which are relatively simpler or descriptive in nature is to be given to the students for **self-learning**, but to be assessed using different assessment methods.
- e) With respect to **section No.10**, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and eighth semesters**, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-16 (fourteen to sixteen) student engagement hours** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

- a) **Chart making:** Student have to prepare a chart on machine design different elements, design consideration of riveted & welded joints, process equipment design elements etc. given by the subject teacher.
- b) **Video Preparation:** Student have to prepare his/her video on riveted joints, stress-strain diagram, types of load, types of stress and strain, design consideration of steel structural components, shear force and bending moment diagram etc. given by the subject teacher.
- c) **E-learning projects:** Students have to use internet and other online resources for preparation of report and/or download video on the topic given by the subject teacher within the syllabus or beyond the syllabus.
- d) **Report preparation:** Student has to use different books, technical magazine, journals etc. for preparation of a report on the topic given by the subject teacher within the syllabus or beyond the syllabus.

- e) **Power point presentation:** Students has to prepare a power point presentation of 10 to 15 slides on the topic given by the subject teacher within the syllabus or beyond the syllabus. In the end of presentation student has to ask at least 3 to 5 MCQ based question to identify the gain of listeners at the end presentation.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	A text book of machine design	R. S. Khurmi J. K Gupta	Euresia Publishing House (Pvt.) Ltd.
2	Pressure Vessel Design manual	Deniss Moss	Gulf professional publishing
3	Design and Analysis of Steel structures	V.N.Vazirani M.M.Ratwani Honey Mehra	Khanna Publishers
4	Chemical equipment design	B.C.Bhattacharya	CBS Publishers & Distributers
5	Process Equipment Design	V.V.Mahajani S. B. Umreji	Macmillan Publication
6	Pressure vessel design – Guide & procedure	Mr. Ghader Ghanbari Mr. Mohammad Ali Liaghat	
7	Strength of material	R.S.Khurmi	S.Chand & Company (Pvt.) ltd

14. SOFTWARE/LEARNING WEBSITES

- <https://youtu.be/U7CPRj1T5n8>
- <https://youtu.be/t6NTK7DNbQo>
- <https://youtu.be/C5ZPaCvoigw>
- <https://youtu.be/4TOpgLFXvWE>
- <https://youtu.be/7b1bd-lgra0>
- https://youtu.be/LQpxTqHB_p8
- https://youtu.be/Y1m7_RAsmdl
- <https://youtu.be/m2B8t8vzeUE>
- <https://youtu.be/8U9kf6D1-ig>
- <https://youtu.be/d2-D8dTrEWM>
- https://youtu.be/rpfqPAM_kRE
- <https://youtu.be/FBtARm2TT1o>
- <https://youtu.be/tM5hsUiNpGA>
- <https://youtu.be/ITuWnrI3aKI>
- https://youtu.be/l_xTyy4wqtw
- <https://youtu.be/nNcfzNjIifU>
- <https://youtu.be/q3c-ig5G3bA>

- <https://youtu.be/IWYKfzx-M1E>

15. PO-COMPETENCY-CO MAPPING

Semester V	Fabrication Design (Course Code: 4355501)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/development of solutions	PO 4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	Design simple machine parts, riveted joints, welded joints, pressure Vessels basic elements and steel structures elements.						
CO1) Design simple machine parts	2	2	3	1	1		2
CO2) Design riveted joints	2	2	3	1	1		2
CO3) Design welded joints	2	2	3	1	1		2
CO4) Describe basic considerations in process equipment design and drafting.	3	2	2	1	1		2
CO5) Describe design considerations of steel structures.	2	2	3	1	1		2

Legend: '3' for high, '2' for medium, '1' for low and '-' for no correlation of each CO with PO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1.	Mr.Samirbhai Y.Merchant I/C H.O.D Fabrication Technology Department	Sir Bhavsinhji Polytechnic Institute Bhavnagar	9428408314	symerchant72@gmail.com
2.	Mr. Rohankumar B. Zapadiya Lecturer in Fabrication Technology	Sir Bhavsinhji Polytechnic Institute Bhavnagar	9033219351	rohan.zapadiya@gmail.com
3.	Mr. Parthiv T. Trivedi Lecturer in Fabrication Technology	Sir Bhavsinhji Polytechnic Institute Bhavnagar	9924185501	trivediparthivbpti@gmail.com

ANNEXURE-1

❖ SAMPLE SAFETY CONTRACT:

(To be filled by the students and submitted to concerned faculty/staff)

-- Use for reference purposes only --

1. You have to read and sign the safety contract.
2. The safety contract says that you understand that safety is your responsibility.
3. The safety contract to be signed before you carry out any work in the laboratory and if you don't observe and obey the safety rules, you will not be allowed in the laboratory.

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Safety Contract

Date: _____

Name of Institute: _____

Name of Course with Code: Fabrication Design (4355501)

Name of Faculty/Staff with Designation: 1. _____
 2. _____
 3. _____

I RECOGNIZE THAT:

1. Safety is my responsibility when using a tool.
2. Safety regulations have been provided to me.
3. The possibility of accident and injury increases if I do not follow all the safety guidelines.
4. I must act responsibly to ensure my own safety & the safety of others in the work area.

I AGREE TO:

1. Never work in the shop without my faculty's/ Instructor's supervision.
2. Read and practice all the safety regulations that have been distributed to me in this course or have been posted in the work areas.
3. Act in a responsible manner at all times in the laboratory.
4. Follow all instructions given by the faculty/Instructor.
5. Immediately report any unsafe condition or activity to my faculty/Instructor.
6. Wear eye protection at all times when working with tools or working anywhere near someone who is using tools.
8. Cut or Tie back long hair, remove jewellery, secure loosed clothing, and wear boiler suit & safety shoes in the laboratory.
9. Clean all work areas and put equipment away before leaving the laboratory.

I, _____, have read and agree with all the safety instructions.

Particulars:

Programme: _____

Batch No.: _____

Enrolment No.: _____

Student Signature
