GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-II

Course Title: Fabrication Drafting
(Course Code: C4325501)

Diploma programmer in which this course is offered	Semester in which offered
Fabrication Technology	Second

1. RATIONALE

This course provides the knowledge and practice regarding drafting/drawing of different types of fabricated products, process piping, structural products and mechanical assemblies. This course aims at development of fundamental understanding and application of fabrication drafting/drawing, so as to develop the ability to prepare, read and interpret drawings correctly and make aware of drafting practices, symbols, codes, norms and standards generally used in fabrication industries. It covers knowledge, application of drawing instruments and familiarizes the learner about codified symbols and principles of technical drawing as per BIS (Bureau of Indian Standards). The course also intended to develop the sense of drawing sequence and imagination in the students.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Prepare fabrication drawings using prevailing drawing standards and drafting instruments.**

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) Draw general format of fabrication drawing.
b) Draw orthographic sectional missing views and isometric projections.
c) Develop lateral surfaces of solid components having different geometrical shapes.
d) Prepare Inter penetration drawing of solids.
e) Prepare typical fabrication drawing showing different elements of process equipment, piping system and structural fabrication.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
2	0	6	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	Draw general format of fabrication drawing.	1	06
2	Draw orthographic projections for given object.	2	08
3	Draw sectional orthographic projections for given object.	2	06
4	Draw missing views in a given drawing.	2	06
5	Prepare detailed drawing for given mechanical assembly and visa-versa.	2	10
6	Draw isometric projections or views from given orthographic views.	2	10
7	Prepare development of lateral surfaces for given object.	3	12
8	Draw interpenetration of solids for given object.	4	08
9	Prepare a drawing of process equipment.	5	06
10	Draw process piping line diagram with symbols.	5	06
11	Draw different elements of structural fabrication drawing.	5	06
	Total		**84**

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. *Teachers should encourage students for optimum use of drawing sheet space. Further assignments should be prepared in sketchbook to reduce use of paper by instructing them to use both sides of page.*

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.

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Knowledge	20
2	Drawing Layout, Planning & Scale	20
3	Neatness & completeness	30
4	Dimensions (accuracy)	20
5	Punctuality	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipment / instruments 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.

No.	Equipment Name with Broad Specifications	PrO. No.
1	Drawing instruments for class room teaching (Large Size).	All
2	Models of various objects.	All
3	Drawing Board (B2) & Mini Drafter.	All
4	Other Instruments: T-Square, Set square (45˚ and 30˚-60˚), Roller Scale, Protector, Drawing Compass, Dividers, Drawing Pencils (Clutch Pencil with H & 2H Lead), Lead Box (H & 2H – 0.5 or 0.7 mm) Circle Master and other templates, French Curves, Stencils (8-6-4 mm, All in One), Eraser, Drawing sheets, Drawing Pins/Clips, Sheet Container and Drawing instrument box etc.	All
5	Interactive board with LCD projector.	All

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) Work as a leader/a team member.
b) Follow safety practices. Particularly don't use razor or blade to sharpen the pencils.
c) Follow ethical practices.
d) Maintain cleanliness.

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 and 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 **Introduction to Fabrication Drafting**	1a. Draw general format of fabrication drawing 1b. Write annotations on the given drawing. 1c. Choose appropriate line and dimensioning style. 1d. Draw limits, fits and tolerances as per BIS	1.1 General format of fabrication drawing. Information provided on fabrication drawing (Weld joint, detail design data, nozzle schedule, BOM, Title Block, Special note, General Notes etc.) 1.2 Lines, Lettering and Dimensioning methods as per BIS 1.3 Limits, fits and tolerances as per BIS 1.4 Surface roughness representation as per BIS
Unit– II **Orthographic and Isometric Projection**	2a. Describe different projection methods 2b. Interpret given orthographic views to imagine the shape of the component. 2c. Draw detail drawing from given mechanical assembly and vice versa 2d. Draw isometric projection by using isometric scale from given orthographic views	2.1 Orthographic Projection 2.1.1 Projection methods 2.1.2 Orthographic projection 2.1.3 Sectional views 2.1.4 Orthographic Reading 2.1.5 Detail and assembly drawing for any one of cotter joint, knuckle joint, flange coupling and machine vice. 2.2 Isometric Projection / Views / Drawing 2.2.1 Isometric lines, axes, planes 2.2.2 Isometric scale 2.2.3 Isometric views or drawing 2.2.4 Isometric projection
Unit-III **Development of Lateral Surfaces**	3a. Draw development of lateral surfaces of prism 3b. Draw development of lateral surfaces of cylinder 3c. Draw development of lateral surfaces of pyramid 3d. Draw development of lateral surfaces of cone	3.1 Development of Lateral Surfaces 3.1.1 Development of Prisms 3.1.2 Development of Cylinder 3.1.3 Development of Pyramids 3.1.4 Development of Cone
Unit-IV **Interpenetration of Solids**	4a. Draw interpenetration views of cylinder to cylinder	4.1 Interpenetration of Solids 4.1.1 Cylinder to Cylinder 4.1.2 Cylinder to Cone

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
	4b. Draw interpenetration views of cylinder to cone	
Unit-V **Process Equipment, Process Piping and Structural Drafting**	5a. Draw various process equipment drawings 5b. Draw different set-up & fit-up used in process equipment 5c. Draw various piping symbols and line diagram 5d. Draw structural set-up & fit-up and joints 5e. Identify different welding symbols represented in fabrication drawing 5f. Draw different riveted joint	5.1 Process Equipment Drafting 5.1.1 Drafting of Pressure Vessel (P/V), Heat Exchanger (H/E), Agitators, Filters, Distillation Columns etc. 5.1.2 Different types of process equipment set-up & fit-up 5.2 Process Piping Drafting 5.2.1 Piping Symbols 5.2.2 Piping line diagram 5.2.3 Piping flanges 5.3 Structural Drafting 5.3.1 Commercial forms of metal as per BIS (angle, flat, plate, channel, strip, I-section, pipe, etc.) 5.3.2 Welding symbols 5.3.3 Riveted joint drafting

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Fabrication Drafting	4	2	5	0	7
II	Orthographic and Isometric Projection	12	4	14	10	28
III	Development of Lateral Surfaces	4	2	3	7	12
IV	Interpenetration of Solids	4	2	2	6	10
V	Process Equipment, Process Piping and Structural Drafting	4	4	5	4	13
Total		**28**	**14**	**29**	**27**	**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:

a) Prepare solutions of different assignments given by subject faculty.
b) Prepare chart showing dimensioning methods.
c) Prepare chart for limits, fits and tolerances as per BIS.
d) Prepare chart for surface roughness representation as per BIS.
e) Prepare chart showing difference between first angle and third angle.
f) Take any object from your surroundings and prepare the orthographic projections (with appropriate dimension) and isometric views vice versa.
g) Prepare chart of different types of process equipment set-up & fit-up.
h) Prepare chart of welding symbols.

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 is 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 should 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-project 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) **Creating Digital Portfolio:** Students should observe and collect photographs and images of industrial/domestic components/items which contain shapes/features like cylinder, prism, pyramid, cone etc. and make a report of these activity.
b) **Chart making :** Prepare chart / drawing of various process equipment, piping system, structural fabrication etc.
c) **Model Making:** Students should build 3D model of various object as per shape and dimension from thermocol, hardboard scrap, wooden scrap, plastic or metal scrap or drawing sheet etc.
   - Prepare a model of cross-sectional orthographic projection.
   - Prepare model of development of lateral surfaces.
   - Prepare a model of interpenetration of solids.
d) **World of work connect:** Students should collect various fabrication drawings like steel structural drawing, piping drawing, process equipment drawing from industry and try to
   - redraw types of lines used
   - redraw lettering styles used
   - list BIS code referred
   - list the symbols/annotations/dimensioning used

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Elementary Engineering Drawing	N. D. Bhatt	Charotar Publishing house Pvt. Ltd., Anand, Gujarat, 2019. ISBN : 9789380358963
2	Machine Drawing	N. D. Bhatt	Charotar Publishing house Pvt. Ltd., Anand, Gujarat, latest edition ISBN: 9789385039232
3	A Textbook of Engineering Drawing	P.J. Shah	S. Chand, New Delhi. 2013 ISBN : 9788121941822
4	Engineering Drawing Practices for School and Colleges SP 46:2003	Bureau of Indian Standards	Bureau of Indian Standards, Government of India, Third Reprint, October 1998; ISBN:. 81-7061-091-2
5	Joshi's Process Equipment Design	V V Mahajani S B Umarji	MACMILLAN Publishers India Ltd., New Delhi 110002 ISBN 10 : 0230-63810-4 ISBN 13 : 978-0230-63810-5

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
6	Textbook of Machine Design	R S Khurmi J K Gupta	S. Chand & Company Pvt. Ltd. Ahmedabad, Gujarat 380014; 6th edition, ISBN-10 : 8121900883 ISBN-13 : 978-8121900881
7	The 'Piping Guide'	David R. Sherwood Dennis J. Whistance	Published by Syentek Books Company Inc. PO Box 26588, Sanfrancisco, CA 94126 ISBN 0 914082-04-3

14. SOFTWARE/LEARNING WEBSITES

- https://nptel.ac.in/courses/112/105/112105294/
- https://nptel.ac.in/courses/112/104/112104172/
- https://nptel.ac.in/courses/112/102/112102304/
- https://nptel.ac.in/courses/112/103/112103019/
- https://www.youtube.com/results?search_query=engineering+drawing
- https://www.youtube.com/c/MechanicalEnggSubjectsGTU/playlists
- https://www.youtube.com/watch?v=55mR97uzjys&list=PL5Rqb_WO7qVxzROfyk2EusQDokGkLXVax
- https://www.youtube.com/watch?v=WWH8NeW_95A
- https://www.youtube.com/watch?v=WXDbu7vm4_4
- https://workforce.libretexts.org/Bookshelves/Manufacturing/Interpretation_of_Metal_Fab_Drawings_(Moran)/01%3A_Chapters/00%3A_Front_Matter/03%3A_Table_of_Contents
- https://www.slideshare.net/search/slideshow?searchfrom=header&q=engineering+drawing
- https://www.scribd.com/search?content_type=tops&page=1&query=engineering%20drawing&content_types=tops,books,audiobooks,summaries,articles,documents,sheet_music,podcasts
- http://www.technologystudent.com/designpro/drawdex.htm

15. PO-COMPETENCY-CO MAPPING

Semester II	Fabrication Drafting (Course Code: C4325501)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ develop-ment of solutions	PO 4 Engineering Tools, Experimen-tation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency	Prepare fabrication drawings using prevailing drawing standards and drafting instruments.						
Course Outcomes **CO1)** Draw general format of fabrication drawing.	2	-	-	1	2	1	2
CO2) Draw orthographic sectional missing views and isometric projections	3	2	1	1	2	-	2
CO3) Develop lateral surfaces of solid components having different geometrical shapes.	3	2	2	1	2	-	2
CO4) Prepare Inter penetration drawing of solids.	3	2	2	1	2		2
CO5) Prepare typical fabrication drawing showing different elements of process equipment, piping system and structural fabrication.	3	2	2	1	2		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

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