

## GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

I – Semester

Course Title: **Engineering Drawing**

(Course Code: 4300007)

Diploma programme in which this course is offered	Semester in which offered
Mechanical, Automobile, Marine, Fabrication	First

#### 1. RATIONALE

Engineering drawing is a way of communication for engineers. It is a graphical language that essential for communicating design ideas and technical information to engineers in industry and other professionals throughout the design process. The purpose of an engineering drawing is to clearly and accurately capture all geometric features of a product or component so that a manufacturer or engineer can produce the required item. This course aims at development of fundamental understanding and application of engineering 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 industries. It covers knowledge & application of drawing instruments & also familiarizes the learner about codified symbols and principles of technical drawing as per BIS (Bureau of Indian Standards): “SP 46:2003” 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 engineering 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 this competency are to be developed in the student to display the following COs:

- a) Use scales, drawing standards and drafting instruments as per BIS codes.
- b) Construct polygons, circles and lines with different geometric conditions.
- c) Construct engineering curves as per given dimensions.
- d) Draw the projection of points, lines and planes under different conditions.
- e) Draw orthographic views from isometric views of simple objects and vice versa.

#### 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	CA	ESE	CA	ESE	
2	-	4	4	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.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	<b>Use of Drawing Instruments:</b> Draw following as per I.S. 1a. Draw different types of lines. 1b. Draw simple 2D entities and demonstrate the use of different types of dimensioning methods. 1c. Illustrate dimensioning of circle, arc, angle, square bar, hexagonal bar, cylinder & sphere through figures. 1d. Draw vertical and inclined alphabets and numerals. 1e. Draw 1st and 3rd angle orthographic projection symbols. 1f. Draw a typical Title block. 1g. Draw Angle using T-square and Set-squares. 1h. Draw simple objects using reduced and enlarge scales.	I,II,III	12
2	<b>Geometric Construction:</b> 2a. Draw set of lines with different conditions (Four problems). 2b. Draw circle and arcs with different geometric conditions and constraints (Four problems). 2c. Draw polygons by general methods (Triangle, square, pentagon, hexagon, heptagon) (Three problems). 2d. Draw polygons by special methods (Pentagon, hexagon and heptagon) (Three problems). 2e. Draw various problems related to tangency of circle and point (Three problems).	IV	08
3	<b>Engineering Curves (Conic Sections)-1:</b> 3a. Construct ellipse using concentric circle method, four center method, arc of circle method, rectangle method, oblong method and eccentricity method. 3b. Construct parabola using rectangular method, parallelogram method, tangent method and eccentricity method. 3c. Construct hyperbola using rectangular method, oblique method and eccentricity method.	V	06

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
4	<b>Engineering Curves-2:</b> 4a. Construct cycloid. 4b. Construct hypocycloid & epicycloid. 4c. Construct involute of circle. 4d. Construct involute of polygons. 4e. Construct Archimedean spiral.	V	06
5	<b>Projections of Points and Lines:</b> 5a. Draw projection of points (For 10 various conditions). 5b. Draw projection of lines with different conditions (Seven problems).	VI	04
6	<b>Projections of Planes:</b> Draw projections of different planar entities with different conditions. (Triangle, square/rectangular, pentagonal, hexagonal and circular – One for each) (Eight problems).	VII	04
7	<b>Orthographic Projections:</b> Draw Orthographic projections of different objects (three views of each object) (Six problems).	VII	08
8	<b>Isometric Projections:</b> 8a. Draw isometric drawing from given orthographic views (Six problems). 8b. Draw free hand sketch of all above isometric drawings without using any instruments.	VIII	08
<b>Total</b>			<b>56</b>

**Note**

- i. Note: The teacher should demonstrate -
  - Use of drawing instruments.
  - Planning and layout of drawing sheet as per IS code.
  - Scaling technique.
- ii. 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.
- iii. 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.
- iv. Teachers should encourage students for optimum use of drawing sheet space. Further, instruct them to use both sides of a drawing sheet. For example, draw sheet number 2 on back side of sheet number 1, 4 on back of 3, and likewise.
- v. First angle orthographic projection and IS codes (Engineering Drawing Practices for School and Colleges SP 46:2003) should be followed wherever applicable.
- vi. The dimensions of line, axes, distances, angle, side of polygon, diameter, etc. must be varied for each student in batch so that each student will have same problems, but with different dimensions.
- vii. The sketchbook should contain data related to all problems, solutions of all problems and student activities performed. Students' activities are compulsory to be performed.

- viii. A hand out containing applicable standards from IS codes including title block as per IS standard should be given to each student by concerned teacher.
- ix. For 25 marks Practical Marks ESE, students are to be assessed for competencies achieved. Students are to be given data for practical ESE to prepare drawings.

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Drawing planning and layout (for optimum use of drawing sheet)	10
2	Use of appropriate instruments, lines, dimensioning & annotations	20
3	Completing given practice problems	30
4	Accuracy of drawing	10
4	Neatness of drawing	10
5	Timely submission of completed drawing sheet	10
6	Answering viva voce questions	10
<b>Total</b>		<b>100</b>

## 6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Drawing instruments for class room teaching (Large Size).	1 to 8
2	Models of various objects (Mechanical, Electrical, Civil etc.).	3 to 8
3	Set of various drawings being used by industries/developed by experienced teachers.	7, 8
4	Drawing Board (B2) & Mini Drafter.	1 to 8
5	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, French Curves, Stencils (8-6-4 mm, All in One), Eraser, Drawing sheets, Drawing Pins/Clips, Sheet Container and Drawing instrument box.	1 to 8
6	Interactive board with LCD overhead 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.
- e) Practice environmental friendly methods and processes. (Environment related)

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 1<sup>st</sup> year
- ii. 'Organization Level' in 2<sup>nd</sup> year.
- iii. 'Characterization Level' in 3<sup>rd</sup> 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) (4 to 6 UOs at different levels)	Topics and Sub-topics
<b>Unit – I</b> <b>Engineering Drawing Aids</b>	1a. Use drawing instruments and materials effectively.	1.1 Drawing instruments and materials. 1.2 Instruments-types, specifications, method to use them and applications. 1.3 Pencils-grades, papers-grades, applications, types of points and applications. 1.4 Other materials-types and applications.
<b>Unit – II</b> <b>Planning Layout and Scaling of Drawing</b>	2a. Follow and apply standard practice as per B.I.S. for planning and layout. 2b. Choose appropriate scale factor for the drawing as per the given situation with justification.	2.1. I.S. cods for planning and layout. 2.2. Scaling technique used in drawing: a) Plain Scale b) Diagonal Scale
<b>Unit– III</b> <b>Lines, Lettering and Dimensioning</b>	3a. Write annotations on the given drawing where ever necessary. 3b. Choose appropriate line and dimensioning style for the given Geometrical entity.	3.1 Different types of lines. 3.2 Lettering. 3.3 Dimensioning methods. a) Aligned method. b) Unilateral with chain, parallel, progressive and combined dimensioning.
<b>Unit– IV</b> <b>Geometric Construction</b>	4a. Draw polygons, circles and lines with the given geometric conditions.	4.1 Geometric construction related with line. 4.2 Geometric construction related with angle. 4.3 Geometric construction related with circle & arc. 4.4 Construct polygons:

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		a) Hexagon: Using drawing tools. b) Polygon (Triangle, square, pentagon, hexagon and heptagon) by general method. c) Polygon (Pentagon, hexagon and heptagon) by special method.
<b>Unit– V Engineering Curves</b>	5a. Draw engineering curves with proficiency as per given dimensions.	5.1 Conic sections. a) Concept and understanding of focus, directrix, vertex and eccentricity and drawing of conic sections. b) Using various methods, understand construction and application of : <ul style="list-style-type: none"> <li>• Ellipse.</li> <li>• Parabola.</li> <li>• Hyperbola.</li> </ul> 5.2 Cycloidal Curves (Cycloid, Epicycloid, Hypocycloid). 5.3 Involutés of a circle and polygons. 5.4 Spiral (Archimedean spiral only).
<b>Unit– VI Projection of Points, Lines and Planes</b>	6a. Draw the projection of points, lines and planes with different conditions in first angle projection. 6b. Find out true shape and size of an inclined line or plane.	6.1 Concept of quadrant. 6.2 Reference planes, orthographic projections. 6.3 1st angle and 3rd angle projection and their symbols. 6.4 Projection of points. 6.5 Projection of lines – determination of true length and inclinations for following cases. <ol style="list-style-type: none"> <li>a) Line parallel to one or both the plane.</li> <li>b) Line perpendicular to one of the planes.</li> <li>c) Line inclined to one plane and parallel to another.</li> <li>d) Line inclined to both the planes.</li> </ol> 6.6 Projection of Planes. <ol style="list-style-type: none"> <li>a) Type of planes.</li> <li>b) Projections of planar object parallel to one of the reference planes.</li> <li>c) Projections of planar object inclined to one reference plane</li> </ol>

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
		<p>and perpendicular to another.</p> <p>d) Projections of planar object inclined to both reference planes.</p> <p><b>Note:</b> Planar objects like Triangle, Square / rectangle, pentagon, hexagon and circle shape should be considered.</p>
<p><b>Unit– VII</b></p> <p><b>Orthographic Projection</b></p>	<p>7a. Draw the orthographic views of objects containing lines, circles and arc geometry.</p> <p>7b. Interpret given orthographic views to imagine the shape of the component.</p>	<p>7.1 Types of projections-orthographic, perspective, isometric and oblique: concept and applications.</p> <p>7.2 Various term associated with orthographic projections.</p> <p>a) Theory of projection.</p> <p>b) Methods of projection.</p> <p>c) Orthographic projection.</p> <p>d) Planes of projection.</p> <p>7.3 Conversion of simple pictorial views into Orthographic views. Illustrative problems on orthographic projection.</p> <p>7.4 B.I.S. code of practice.</p> <p><b>Note:</b> Problem should be restricted up to three views Front view/Elevation, Top view/Plan and Side views only. Use First Angle Method only.</p>
<p><b>Unit– VIII</b></p> <p><b>Isometric Projection</b></p>	<p>8a. Draw the isometric view from orthographic views of object/s containing lines, circles, arcs and slant surfaces.</p>	<p>8.1 Isometric axis, lines and planes.</p> <p>8.2 Isometric scales.</p> <p>8.3 Isometric view and isometric drawing.</p> <p>8.4 Difference between isometric projection and isometric drawing.</p> <p>8.5 Illustrative problems limited to objects Containing lines, circles and arcs shape only.</p> <p>8.6 Draw all above problems with free hand sketch using pencil. (Without using any drawing instrument)</p> <p>8.7 Draw orthographic and isometric views with free hand sketch of various sections used in engineering. e.g. square, circular, hollow, L, T, U, I-sections, etc.</p>

## 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	Engineering drawing aids	0	0	0	2	2
II	Planning, layout and scaling of drawing	0	2	0	3	5
III	Lines, lettering and dimensioning	0	0	2	0	2
IV	Geometric construction	3	0	3	7	10
V	Engineering curves	6	2	0	10	12
VI	Projection of points, lines and planes	8	3	0	14	17
VII	Orthographic projections	6	0	0	12	12
VIII	Isometric projections	5	0	2	8	10
<b>Total</b>		<b>28</b>	<b>12</b>	<b>28</b>	<b>30</b>	<b>70</b>

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

**Note:** This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary 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:

- Solve all problems for all sheets number 1 to 8 in sketch book (with complete data and dimensions).
- Take one circular shape (i.e. tyre). Assume one point on circumference and mark it. Roll that shape on flat and circular surface. Observe the path of point and correlate the same with respective engineering curve.
- Take one circular shape and string which length is equal to circumference of circle. Try to wound and unwound string on it. Observe the path of point and correlate the same with respective engineering curve.
- List few engineering/domestic components in which involute curve is used.
- Take two simple objects in your vicinity and sketch 3D isometric of them. Also draw 2D orthographic projections of them (all views). Try to clearly and accurately capture all the geometric features present in the selected objects.
- Download soft copy of technical drawing of any engineering products. Read and interpret this drawing (e.g. Car, Cutting tools, gears, bearings etc.).
- Collect the orthographic views from your facilitator, at least three objects with few missing lines. The student will try to imagine the corresponding objects, complete the views and draw these views in sketch book.



- h) Explain at least one problem for construction and method of drawing in sheet to all batch colleagues. Teacher will assign the problem of particular sheet to be explained to each batch student.
- i) Each student will assess at least one sheet of other students (May be a group of 5-6 students identified by teacher can be taken) and will note down the mistakes committed by them. Student will also guide the students for correcting the mistakes, if any.

### 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**.
- f) Guide students for using BIS "SP 46:2003" standard

### 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 sixth 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 microproject 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 or their functioning create shapes/features like polygon, ellipse, parabola, hyperbola, cycloids, involute and spiral).
- b) **Technology in education:** Refer websites related to use of virtual drawing instruments and environment like <https://www.triumphcloud.com/>, <https://www.mathspad.co.uk/>. Practice few problems using the virtual drawing instruments.
- 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.

- d) **World of work connect:** Students should collect Production drawings, Building Drawings, Layouts from nearby workshops/industries/builders/contractors and try to
- redraw types of lines used
  - redraw lettering styles used
  - list BIS code referred
  - list the symbols/annotations/dimensioning used
  - list the type of scales used. Compare the size of component on drawing sheet with actual component.

### 13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Engineering Drawing	N.D. Bhatt	Charotar Publishing House;Anand, 2014. ISBN : 9789380358963
2	Textbook of Engineering Drawing	P.J. Shah	S.Chand, New Delhi. 2013 ISBN : 9788121941822
3	Textbook of Engineering Drawing	R K Dhawan	S.Chand, New Delhi. 2013 ISBN : 9789352837373
4	Engineering Drawing	M.B. Shah, B.C. Rana	Pearsons. 2009 ISBN: 9788131759714
5	Engineering Drawing	Basant Agrawal, C. M. Agrawal	McGraw-Hill, 2019 ISBN : 9789353167448
6	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

### 14. SOFTWARE/LEARNING WEBSITES

- a) [https://www.youtube.com/results?search\\_query=engineering+drawing](https://www.youtube.com/results?search_query=engineering+drawing)
- b) <https://www.youtube.com/c/MechanicalEnggSubjectsGTU/playlists>
- c) <https://youtu.be/MT1T31GtGpg>
- d) <https://youtu.be/WEwkepkv6mg>
- e) <https://youtu.be/trJQlvatIpl>
- f) <https://nptel.ac.in/courses/112/103/112103019>
- g) <https://nptel.ac.in/courses/112/105/112105294>
- h) [https://en.wikipedia.org/wiki/Engineering\\_drawing](https://en.wikipedia.org/wiki/Engineering_drawing)
- i) <https://www.slideshare.net/search/slideshow?searchfrom=header&q=engineering+drawing>
- j) [https://www.scribd.com/search?content\\_type=tops&page=1&query=engineering%20drawing&content\\_types=tops,books,audiobooks,summaries,articles,documents,shet\\_music,podcasts](https://www.scribd.com/search?content_type=tops&page=1&query=engineering%20drawing&content_types=tops,books,audiobooks,summaries,articles,documents,shet_music,podcasts)
- k) <http://www.cognifront.com/tools.php>

### 15. PO-COMPETENCY-CO MAPPING

Semester I	Engineering Drawing (Course Code: 4300007)						
	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
<b>Competency</b>	<i>Prepare engineering drawings using prevailing drawing standards and drafting instruments.</i>						
<b>Course Outcomes</b>							
CO a) Use scales, drawing standards and drafting instruments as per BIS codes.	3	1	2	3	-	-	2
CO b) Construct polygons, circles and lines with different geometric conditions	3	-	3	2	2	-	2
CO c) Construct engineering curves as per given dimensions	3	-	3	2	2	-	2
CO d) Draw the projection of points, lines and planes under different conditions.	3	-	3	2	2	-	2
CO e) Draw orthographic views from isometric views of simple objects and vice versa.	3	2	3	2	2	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

S.No.	Name and Designation	Institute	Contact No.	Email
1	Mr. M.D.Naraniya, Lecturer in Mech. Engg.	Government Polytechnic, Jamnagar	9726716135	naraniya98@gmail.com
2	Mr. P.C. Chavda, Lecturer in Mech. Engg.	AV Parekh Technical Institute, Rajkot	9978816965	pragneshchavda91@gmail.com
3	Dr. S.S. Sonigra, Lecturer in Mech. Engg.	Government Polytechnic, Rajkot	9427322129	sssonigra@gmail.com
4	Dr. H.R. Sapramer HOD, Mech. Engg.	Dr. J.N.Mehta Polytechnic, Amreli	9426587197	merhamir@gmail.com

#### NITTTR Resource Persons

S.No.	Name and Designation	Department	Contact No.	Email
1	Dr. Sharad K. Pradhan, Associate Professor	Mech. Engg. Education	9300802353	spradhan@nitttrbpl.ac.in
2	Dr. K.K. Jain, Professor	Mech. Engg. Education	9425017472	kkjain@nitttrbpl.ac.in