

**GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)****Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)**

Semester - I &amp; II

Course Title: **Engineering Drawing and CAD**

(Course Code: 4300012)

<b>Diploma programme in which this course is offered</b>	<b>Semester in which offered</b>
Bio Medical, Instrumentation & Control , Power Electronics	First
Electronics & Communication Engineering	Second

**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 and to use computer aided software to create engineering branch specific 2D and 3D entities.

**2. COMPETENCY**

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of the following competency:

- **Prepare engineering drawings using prevailing drawing standards, drafting instruments and computer aided drafting software.**

**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) Use scales, dimensioning, drawing standards and drafting instruments as per BIS codes.
- b) Construct polygons, circles and lines with different geometric conditions.
- c) Draw orthographic views from isometric views of simple objects and vice versa.
- d) Use computer aided drafting software to draw 2D and 3D entities.**

#### 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	
-	-	4	2	0	0	25*	25	50

(\*): For this practical only course, 25 marks under the practical CA has two components i.e. the assessment of micro-project, which will be done out of 10 marks and the remaining 15 marks are for the assessment of practical. This is designed to facilitate attainment of COs holistically, as there is no theory ESE.

**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. They are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

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 1st and 3rd angle orthographic projection symbols. 1e. Draw a typical Title block. 1f. Draw two simple objects using reduced and enlarge scales.	I,II,III	08
2	<b>Geometric Construction:</b> 2a. Draw polygons by general methods (Triangle, square, pentagon, hexagon, heptagon) (Three problems). 2b. Draw polygons by special methods (Pentagon, hexagon and heptagon) (Three problems).	IV	04
3	<b>Orthographic Projections:</b> Draw Orthographic projections of different objects (three views of each object) (Four problems).	V	10
4	<b>Isometric Projections:</b> Draw isometric drawing from given orthographic views (Four problems).	VI	10
5	Draw basic 2D entities like: Rectangle, Rhombus, Polygon, Circles, Arcs, circular and rectangular array, blocks using AutoCAD (Print out should be a part of progressive assessment) (Six problems).	VII	08

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
6	Draw two complex branch specific components in 2D using AutoCAD (Print out should be a part of progressive assessment).	VII	08
7	Draw 6-8 basic and engineering branch specific components (3D) (Minimum two should be based on real industrial components selected by student as student activity and approved by teacher) using AutoCAD. Also take print outs of the same.	VII	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 of Practical exercises 1 to 4.	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

S. No.	Sample Performance Indicators for the PrOs of Practical exercises 1 to 4.	Weightage in %
6	Answering viva voce questions	10
<b>Total</b>		<b>100</b>

S. No.	Sample Performance Indicators for the PrOs of Practical exercises 5 to 7.	Weightage in %
1	Developing/ using Institute Template	20
2	Selecting relevant set up parameters	05
3	Creating given drawing using relevant Commands.	40
4	Dimensioning the given drawing and writing text using blocks and layers effectively.	15
5	Answer to sample questions	10
6	Submission of digital drawing file/plot in time	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 4
2	Models of various objects (Electronics, Bio Medical, Instrumentation, Mechanical, Electrical, Civil, etc.).	3 to 4
3	Set of various drawings being used by industries/developed by experienced teachers.	1 to 4
4	Drawing Board (B2) & Mini Drafter.	1 to 4
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 4
6	Interactive board with LCD overhead projector	All
7	CAD Workstation: i7, 2 GB RAM, 320 GB HDD, 17" Screen, 1 GHz. (Minimum requirement)	5 to 7
8	Plotter: Print resolution Up to 1200 x 600 dpi, 16 MB Memory	5 to 7
9	Licensed latest network version of AutoCAD software	5 to 7

## 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)
- f) Shutdown the CAD workstation if not in use.

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. a) Instruments-types, specifications, method to use them and applications. b) Pencils-grades, papers-grades, applications, types of points and applications. c) Drawing Symbols and conventions for electrical, electronics, instruments, bio Medical and Power electronics, components and materials.
<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 and Dimensioning</b>	3a. Choose appropriate line and dimensioning style for the given Geometrical entity.	3.1 Different types of lines. 3.2 Dimensioning methods. a) Aligned method. b) Unilateral with chain, parallel, progressive and combined dimensioning.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
<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: 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</b>  <b>Orthographic Projection</b>	5a. Draw the orthographic views of objects containing lines, circles and arc geometry. 5b. Interpret given orthographic views to imagine the shape of the component.	5.1 Types of projections-orthographic, perspective, isometric and oblique: concept and applications. 5.2 Various term associated with orthographic projections. a) Theory of projection. b) Methods of projection. c) Orthographic projection. d) Planes of projection. 5.3 Conversion of simple pictorial views into Orthographic views. Illustrative problems on orthographic projection. 5.4 B.I.S. code of practice. <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.
<b>Unit– VI</b>  <b>Isometric Projection</b>	6a. Draw the isometric view from orthographic views of object/s containing lines, circles, arcs and slant surfaces.	6.1 Isometric axis, lines and planes. 6.2 Isometric scales. 6.3 Isometric view and isometric drawing. 6.4 Difference between isometric projection and isometric drawing. 6.5 Illustrative problems limited to objects Containing lines, circles and arcs shape only.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
<b>Unit– VII</b> <b>Computer Aided Drafting using AutoCAD</b>	7a. Draw basic 2D entities using AutoCAD software. 7b. Prepare 2D drawing of simple engineering components using AutoCAD software. 7c. Draw basic 3D entities using AutoCAD software. 7d. Printing of digital drawings using Printer/plotter.	7.1 Basic knowledge of computer hardware, software and System requirement, understanding the interface. 7.2 AutoCAD main window elements: Title bar, standard tool bar, menu bar, object properties tool bar, draw tool bar, modify toolbar, cursor cross hair, command window, status bar, drawing area, UCS icon. 7.3 File features: New file, Saving the file, Opening an existing drawing file, Creating Templates, Quit. 7.4 Setting up new drawing, Units, Limits. Using Grid, Snap, Ortho, Object Snap. 7.5 Methods of Specifying points: Absolute coordinates, Relative Cartesian & Polar coordinates. 7.6 Draw basic entities like Line, Circle, Arc, Polygon, Ellipse, Rectangle, Multiline, Poly Line. 7.7 Modify and edit commands like trim, delete, copy, offset, array, block, layers. 7.8 Draw, modify and edit 3D entities using 3D commands like BOX, CONE, EXTRUDE, SLICE, 3D ARRAY, 3DORBIT, 3DROTATE, 3DMOVE, etc. 7.9 Dimensioning: Linear, Horizontal, Vertical, Aligned, Rotated, Baseline, Continuous, Diameter, Radius, Angular Dimensions. 7.10 Editing dimensions. 7.11 Text: Single line Text, Multiline text 7.12 Print/plot settings.

### 9. SUGGESTED SPECIFICATION TABLE

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
<b>Not Applicable</b>						

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

## 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) 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. Also draw the same using AutoCAD software.
- b) Download soft copy of technical drawing of any branch specific engineering product. Read and interpret this drawing.
- c) 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.
- d) Create an institute template with institute logo using AutoCAD software.
- e) 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.
- f) 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.
- 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 any branch specific engineering drawings 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.
  - Redraw the 2D entities using AutoCAD software.

### 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	Engineering Drawing	M.B. Shah, B.C. Rana	Pearsons. 2009 ISBN: 9788131759714
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	Electrical Engineering Drawing	S.K. Bhattachary	NewAge International Publishers
6	Machine Design Includes AutoCAD	Ajeet Singh	Second Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2018
7	AutoCAD 2020: A Problem-Solving Approach, Basic and Intermediate	Sham Tickoo	26th Edition, CADCIM Technologies, 2019

**14. SOFTWARE/LEARNING WEBSITES**

- [https://www.youtube.com/results?search\\_query=engineering+drawing](https://www.youtube.com/results?search_query=engineering+drawing)
- <https://www.youtube.com/c/MechanicalEnggSubjectsGTU/playlists>
- <https://youtu.be/MT1T31GtGpg>
- <https://youtu.be/WEwkepkv6mg>
- <https://youtu.be/trJQlvatIpl>
- <https://nptel.ac.in/courses/112/103/112103019>
- <https://nptel.ac.in/courses/112/105/112105294>
- [https://en.wikipedia.org/wiki/Engineering\\_drawing](https://en.wikipedia.org/wiki/Engineering_drawing)
- <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](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.cognifront.com/tools.php>
- <https://www.youtube.com/watch?v=bmAlJAMndwM>
- [https://www.youtube.com/watch?v=904\\_RPjGJg4](https://www.youtube.com/watch?v=904_RPjGJg4)
- <https://www.youtube.com/watch?v=jzlDouas0Wc>
- <https://www.youtube.com/watch?v=VuHdV38fyjc>
- [https://www.youtube.com/watch?v=iOzllJge\\_G0](https://www.youtube.com/watch?v=iOzllJge_G0)
- <https://www.youtube.com/watch?v=-l0iRdH3MbA>
- <https://www.youtube.com/watch?v=vI5xhCD5mXQ>
- <https://www.youtube.com/watch?v=GDrD9nEZ9LY>

**15. PO-COMPETENCY-CO MAPPING**

Semester I & II	Engineering Drawing and CAD (Course Code: 4300012)						
	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, drafting instruments and computer aided drafting software</i>						
<b>Course Outcomes</b>							
CO a) Use scales, dimensioning, 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) Draw orthographic views from isometric views of simple objects and vice versa.	3	2	3	2	2	2	2
CO d) Use computer aided drafting software to draw 2D and 3D entities.	3	-	3	3	-	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**

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

**NITTTR Resource Persons**

<b>S. No.</b>	<b>Name and Designation</b>	<b>Department</b>	<b>Contact No.</b>	<b>Email</b>
1	Dr. Sharad K. Pradhan, Professor	Mechanical Engineering Education	9300802353	spradhan@nitttrbpl.ac.in
2	Dr. Susan S. Mathew Associate Professor	Electrical and Electronics Engineering	9425649673	ssmathew@nitttrbpl.ac.in