GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022) Semester-II

Course Title: Computer Aided Drafting-I
(Course Code: C4326503)

Diploma programmer in which this course is offered	Semester in which offered
Mechanical Engineering(CAD/CAM)	2nd Semester

1. RATIONALE

The students of mechanical engineering programme are mainly involved in drafting, manufacturing, inspection and planning activities (such as preparing process plans, preparing bill of materials, etc.) in industries. For all such activities, reference document is the drawing of component/assembly to be manufactured. In this context, it is of utmost importance to prepare, read and interpret these drawings correctly for production of components and assemblies accurately and precisely. The industrial practices of drafting are also important for the students to make them aware of drafting practices, symbols, codes, norms and standards generally used in industries. Development of sketching ability also strengthens effective engineering communication & presentation. Now a days the market driven economy demands frequent changes in product design to suit the customer needs. With the introduction of computers, the task of incorporating frequent changes as per requirement is becoming simpler. This course has been introduced at Diploma level in order to develop the skills in student so that they can generate various digital production drawings as required in industry using CAD software.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Prepare production drawings using codes, norms and standards.**
- **Prepare 3D surfaces and 3D models in AutoCAD.**

3. COURSE OUTCOMES

The practical should be carried out in such a manner that students are able to acquire different learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Draw production drawings of mechanical Components/assemblies using codes, norms and standards in AutoCAD. ii. Create and edit 3D models in AutoCAD.
iii. Extract two-dimensional views from a three-dimensional model for detail drafting.
iv. Create 3D surface models using a variety of techniques.
v. Prepare a report with Sketch of mechanical components showing each step with dimensions and sequence of commands with name, options and values.

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	
0	0	4	2	00	00	25*	25	50

(*): For this practical only course, 25 marks under the practical CA have 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

Following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). All PrOs are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Approx. Hrs. Required
1	a. Preparatory activity i. List different software used for CAD ii. Compare all software packages with application point of view.	2
2	a. **Recall AutoCAD 2D drawing commands.** Prepare orthographic production drawings (with all dimensions, tolerances, notes, title block, etc.) of 5 mechanical components ((i.e Gears, Bearings, tail stock etc. or should be based on real industrial components selected by student as student activity and approved by teacher) each made up of minimum 5-6 manufacturing operations using AutoCAD (Mechanical). Submit the completed drawings in PDF format. b. Prepare report on following. i. Select at least two physical mechanical components (approved by teacher). Sketch them with dimensions. ii. Write steps to prepare each drawing using AutoCAD (Mechanical). Steps must include followings. • Sketch of components at each step with dimensions. • Sequence of commands with name, options and values.	8

3	a. Select minimum 5 assemblies related to Mechanical engineering having 5-6 components. Create 3D models of all mechanical components and assemble them in AutoCAD.	24
Sr. No.	**Practical Outcomes (PrOs)**	**Approx. Hrs. Required**
	b. Calculate mass properties assuming appropriate material. c. Submit the completed drawings in PDF format. b. Prepare report on following: i. Select physical mechanical assembly i - students (approved by teacher). Mea them wi • Sketch of each component and a same. • Sequence of commands with nar values.	
4	a. Prepare production drawings by Extracting 2D views from 3D models for detail drafting, cut section from 3D using layout, SOLVIEW and SOLDRAW command in a pre-defined template including title block and instructions. Use Geometric dimensioning and tolerance (GD & T) in each drawing in AutoCAD. b. Take printout of the same in A3 sheet using predefined template and layouts. c. Prepare report on following: • Sketch of each component and assembly for the same. • Sequence of commands with name, options and values.	10
5	d. Create minimum 5 surface models related to mechanical engineering. e. Submit the completed drawings in PDF format. f. Prepare report on following: • Sketch of each component • Sequence of commands with name, options and values.	12
		56

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.*

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 %
1.	Lab Records and regularity	20
Sr. No.	**Sample Performance Indicators for the PrOs**	**Weightage in %**
2.	Question answer / Writing steps of exercise	20
3.	Execution of exercise	20
4.	Printout/Result	10
5.	Viva voice	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipments 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.	Computer system with latest configuration.	All
2.	Laser printer-scanner, plotter A3 size.	All
3.	Related software. (Auto CAD, Anti-Virus software).	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 while using electrical and electronics equipment.
c) Maintain tools and equipment.
d) Realize importance of E-waste management. (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 1st year ii.
'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd 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
Unit-I **Basics of CAD Software**	1a List Computer Aided Software packages. 2a Compare all available software packages.	1.1 Discuss about available software in CAD field and their capabilities. 1.2 List and compare all software packages.
Unit-II **Creating production drawings using a Computer Aided Drafting (CAD) Software (AutoCAD).**	2a. Invoke commands in AutoCAD. 2b. Create basic & advance 2D entities Close & save work 2c. Modify existing 2D entities. 2d. Enquire about various attributes of existing 2D entities. 2e. Use layers for proper management of drawings. 2f. Use Blocks effectively to create perfect drawings.	Recall to Basic Draw Commands, modify commands in Auto CAD. 2.1. Explain Drawing standards. (IS696 /SP 46) (Drawing/ printing/ storage). 2.2. Recall Quick Access Toolbar, Ribbon, Command Bar, Orientation tools, Status bar, Different Menu / Tools / commands, etc. 2.3. Methods of Specifying points- Absolute coordinates and Relative Cartesian & Polar coordinates. 2.4. Recall Use of object Snap, polar tracking, use of dynamic input and Commands of Draw and modify menu. Concept of Layers. Concept of Blocks. Concept of Hatch. Dimensioning.

Unit-III Creating and editing 3D models in AutoCAD.	3.a. Use of UCS (user coordinate system) in 3D modelling. 3.b. Create basic and advance 3D models. 3.c. Edit 3D models. 3.d. Create file exchanges and calculate mass properties.	Introduction to UCS and 3D coordinates, 3D commands, creating 3D models and editing 3D models. 3.1. Introduction to user coordinate systems, working with user coordinate systems, additional ways to change the UCS, managing user coordinate systems and displays, creating text with thickness, text and the UCS, and dimensioning in 3D. (**Commands and variables:**

Unit	**Unit Outcomes (UOs)** (4 to 6 UOs at different levels)	**Topics and Sub-topics**

		UCS, **UCSICON**, **DDUCSP**, **UC**, **UCSMAN**, **UCSFOLLOW**, and **PROPERTIES**) 3.2. Using rectangular 3D coordinates, the right-hand rule of drawing, displaying 3D views, 3D construction techniques, constructing wireframe objects, and constructing solid primitives. (**Commands: PLAN**, **UCS**, **3DORBIT**, **HIDE**, **BOX**, **SPHERE**, **CYLINDER**, **CONE**, **WEDGE**, and **TORUS**.) 3.3. Overview of solid modeling, constructing solid primitives, creating composite solids, and working with regions. (**Commands: BOX**, **SPHERE**, **CYLINDER**, **CONE**, **WEDGE**, **TORUS**, **SUBTRACT**, **UNION**, **INTERSECT**, **INTERFERE**, **REGION**, **BOUNDARY**, and **AREA**.) 3.4. Creating solid model with **EXTRUDE**, **REVOLVE** and Boolean operations with CSG. 3.5. Changing properties, aligning objects in 3D, 3D rotating, 3D mirroring, creating 3D arrays, filleting solid objects, chamfering solid objects, constructing details and features on solid models, and removing details and features. (Commands**:** **PROPERTIES**, **ALIGN**, **ROTATE3D**, **MIRROR3D**, **3DARRAY**, **FILLET**, and **CHAMFER etc)** 3.6. Overview of solid model editing, face editing, edge editing, body editing, and using **SOLIDEDIT** as a construction tool. 3.7. solid model analysis, and solid model file exchange. (**Commands:MASSPROP**, **ACISOUT**, **EXPORT**, **ACISIN**, **IMPORT**, and **STLOUT etc)**
Unit– IV Extracting 2D	4.a. Create orthographic views from 3D model.	Creating 2D views by extracting it from 3D models.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
views from 3D models for detail drafting.	4.b. creating Layout, pre-defined template 4.c. Use Geometric dimensioning and tolerance (GD & T)	4.1. Understanding viewports, creating viewports, drawing in multiple viewports, regenerating viewports, and creating a standard engineering layout. 4.2. Use **SOLVIEW**, **SOLDRAW** command to generate orthographic views/sectional orthographic views, layers, and layout viewports automatically for 3D solids 4.3. Standard sizes of sheet. Selecting various plotting parameters such as Paper size, paper units, Drawing orientation, plot scale, plot offset, plot area, print preview. 4.4. Create templates and layouts 4.5. Apply Geometric dimensioning and tolerance (GD & T) in a given drawing with following commands. (**Commands: TOLERANCE, QLEADER, MLEADER)** 4.6. Take print outs from a CAD Software in A3 size sheet.

Unit – V Create surface models in AutoCAD.	5a. Create surface models. 5b. Edit surface models. 5c. Rendering to given model 5d. Enquire about various attributes of existing 2D entities.	Introduction to surface modelling editing surfaces and assigning material & rendering the models and finding is properties. 5.1. Overview of surface modeling, creating 3D faces, creating invisible 3D face edges, and drawing surface primitives. (**Commands: 3DFACE**, **AI_BOX**, **AI_WEDGE**, **AI_PYRAMID**, **AI_CONE**, **AI_DOME**, **AI_DISH**, **AI_SPHERE**, and **AI_TORUS etc**.) 5.2. 3D mesh techniques, constructing a 3D mesh, constructing a single-plane mesh, constructing a 3D polyface mesh, polygon mesh variations, constructing enclosed surfaces with **EDGESURF**, creating a surface
Unit	**Unit Outcomes (UOs)** (4 to 6 UOs at different levels)	**Topics and Sub-topics**

		mesh with **RULESURF**, constructing tabulated surfaces with **TABSURF**, constructing revolved surfaces with **REVSURF**, drawing wireframe holes, and surfacing around wireframe holes. 5.3. Using grips to edit surface models, trimming and extending objects in 3D, creating surfaced fillets and rounds, editing polygon meshes, and editing polygon meshes with grips.(**Commands: TRIM**, **EXTEND**, **EDGE**, and **PEDIT etc**.) 5.4. Lights, creating scenes, rendering models, and rendering preferences and statistics.(**Commands: LIGHT**, **SCENE**, **RENDER**, **RPREF**, and **STATS etc)** 5.5. Creating surface finishes with materials; granite, marble, and wood; assigning materials to objects; using maps; mapping textures to objects; and material libraries.(**Commands: RMAT**, **SETUV**, and **MATLIB etc** .) 5.6. List, Dblist, Area, Massprop.

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
Not applicable						

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

10. SUGGESTED STUDENT ACTIVITIES

Other than the 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) Undertake micro-projects in team/individually.

b) Students are encouraged to register themselves in various MOOCs such as: Swayam, edx, Coursera, Udemy etc. to further enhance their learning.

c) Select at least four simple mechanical components each made up of minimum 5-6 manufacturing operations. Get them approved by teacher. Measure and sketch them in report pages with dimensions. (For Ex. No2).

d) Select at least one simple mechanical assembly in group of 5-6 students, each made up of minimum 5-6 components. Get them approved by teacher. Measure and sketch them in report pages with dimensions. (For Ex.No.3).

e) Bring Actual assembly from workshop/industry, measure dimensions, sketch it and make 2D production drawing for the same. (For Ex.No.4)

f) Prepare the Charts that classify recycling process for electronic waste and plastics.

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.
About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature may be given to the students for ***self-learning***, but to be assessed using different assessment methods.
Guide students on addressing the issues on environment and sustainability using the knowledge of this course.

c) Introduce IS Codes of drawing for self-study.

d) Guide students for keeping the drawings in digital form and reduce use of paper.

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 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 micro project should be about **1416** ***(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) Bring an industrial production drawing/component from workshop/industry. Learn to interpret and List the commands to be used to draw it.

b) Add-ons of AutoCAD software are to be downloaded and used for a given specialized exercise.

c) Sorting of e-waste: Compile a report for sorting different types of electronic and plastic waste.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1.	Machine Drawing including AutoCAD	Ajeet Singh	McGraw hill
2.	Production Drawing	K L Narayan	New Age Publication
3.	Fundamental of Geometric Tolerance and dimensioning	Alex Krulikowski	Cengage Learning
4.	Engineering Graphics with AutoCAD	Sarkar .A.K	PHI india
5.	Essentials of Engineering Drawing and Graphics using AutoCAD	Jeyapoovan	Vikas publication
6.	AutoCAD User Guide	Autodesk	Autodesk Press.

14. SOFTWARE/LEARNING WEBSITES

a. https://www.tutorialspoint.com
b. https://edu.google.com/intl/ALL_in/teacher-enter/products/forms/?modal_active=none
c. www.w3schools com
d. https://support.microsoft.com/en-us/training
e. https://edu.gcfglobal.org/en/topics/googleapps/
f. https://www.udemy.com
g. https://www.coursera.org/
h. https://www.digitalindiaportal.co.in/
i. https://getintopc.com/
j. https://nptel.ac.in/
k. https://magazine.opensourceforu.com/
l. https://www.netacad.com/

m. https://www.cert-in.org.in/
n. https://www.youtube.com/c/MechanicalEnggSubjectsGTU/playlists
o. https://youtu.be/MT1T31GtGpg
p. https://youtu.be/WEwkepkv6mg
q. https://youtu.be/trJQIvatIpI
r. https://nptel.ac.in/courses/112/103/112103019
s. https://nptel.ac.in/courses/112/105/112105294
t. https://en.wikipedia.org/wiki/Engineering_drawing
u. https://www.slideshare.net/search/slideshow?searchfrom=header&q=engineering+drawing
v. https://www.scribd.com/search?content_type=tops&page=1&query=engineering%20drawing&content_types=tops,books,audiobooks,summaries,articles,documents,sheet_music,podcasts
w. http://www.cognifront.com/tools.php
x. https://www.youtube.com/watch?v=C4c_kJtwtxc
y. https://www.youtube.com/watch?v=bmAlJAMndwM
z. https://www.youtube.com/watch?v=904_RPjGJg4
aa. https://www.youtube.com/watch?v=jzlDouas0Wc
bb. https://www.youtube.com/watch?v=VuHdV38fyjc
cc. https://www.youtube.com/watch?v=iOzlIJge_G0
dd. https://www.youtube.com/watch?v=-l0iRdH3MbA
ee. https://www.youtube.com/watch?v=vI5xhCD5mXQ
ff. https://www.youtube.com/watch?v=GDrD9nEZ9LY

15. PO-COMPETENCY-CO MAPPING

Semester II	Computer Applications and Graphics (Course Code: 4300019)						
	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 1. Prepare production drawings using computer and relevant software following standards codes and norms.	3		3	2		2	2
2. Prepare 3D surfaces and 3D models in AutoCAD.	2		3		2		
CO 1) Draw production drawings of mechanical Components/assemblie s using codes, norms and standards in AutoCAD.	3		3				
CO 2) Create and edit 3D models in AutoCAD.	3		3	2	2		2
CO 3) Extract twodimensional views from a threedimensional model for detail drafting.	2		3		2		2
CO 4) Create 3D surface models using a variety of techniques.	3		3	2	2		2
CO 5) Prepare a report of mechanical components with Sketch of components at each step with dimensions and sequence of commands with name, options and values.						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

Sr. No.	Name and Designation	Institute	Contact No.	Email

1.	Prof. A.A.Lohia, HOD in Mechanical Engineering	SIR Bhavsinhji Polytechnic Institute, Bhavnagar	9898189552	altaf.lohia@gmail.com
2.	Dr.J.B.Patel, Lecturer in Mechanical Engineering	SIR Bhavsinhji Polytechnic Institute, Bhavnagar	9998816294	jaybpti241120@gmail.com

BOS Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Dr.S.H.Sundarani BOS Chairman HOD Mechanical Engg.	Government Polytechnic Ahmedabad	9227200147	gpasiraj@gmail.com
2.	Dr.Rakesh.D.Patel BOS Member HOD Mechanical Engg.	B&B Institute of Technology V V Nagar	9825523982	rakeshgtu@gmail.com
3	Dr.Atul.S. Shah BOS Member Principal	B.V.Patel Institute of Technology Bardoli	7567421337	Asshah97@yahoo.in