

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

Semester-III

Course Title: Computer Aided Machine Drawing Practice

(Course Code: 4331905)

Diploma programmer in which this course is offered	Semester in which offered
Mechanical Engineering & Mechatronics Engineering	Third

1. RATIONALE

The students of the mechanical engineering programme are mainly involved in drafting, manufacturing, inspection, and planning activities (such as preparing process sheets preparing the bill of materials (BOM), etc.) in industries. For all such activities, a reference document is the drawing of the component/assembly to be manufactured. In this context, it is of utmost importance to prepare, read and interpret these drawings correctly for the 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.

The development of sketching ability also strengthens effective engineering communication & presentation. Nowadays the market-driven economy demands frequent changes in product design to suit 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 the Diploma level in order to develop the skills in the student so that they can generate various digital production drawings as required in the industry using various 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 computer and relevant software and following standards codes and norms.**

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:

CO-1	Interpret and Draw, edit and modify 2D Production drawing/Machine Drawing of mechanical Components
CO-2	Create detailed drawings of various machine parts with sectional or plain elevations, plans, side views and dimensioning with bill of materials using (BOM) using CAD software like AutoCAD.
CO-3	Prepare a report of mechanical components with Sketch of components at each step with dimensions and sequence of commands with name, options and values.
CO-4	Create various parametric drawings of mechanical components with company logo, tolerances and level of surface finish by using latest parametric CAD software.
CO-5	Create given project drawings with orthographic projection, bill of material and report using CAD software.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				Total Marks
				Theory Marks		Practical 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 the 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). Some of the PrOs marked ‘*’ 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)	Unit No.	Approx. Hrs. Required
1	<p>A. Prepare orthographic production drawings of 3-4 mechanical components (Minimum two 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.</p> <p>B. Prepare report on following.</p> <p>i. Select at least two physical-mechanical components (approved by teacher). Sketch them with dimensions.</p> <p>ii. Write steps to prepare each drawing using AutoCAD Steps must include followings.</p> <p>i. Sketch of components at each step with dimensions.</p> <p>ii. Sequence of commands with name, options and values.</p>	1	06
2	<p>A. Machine drawing practice using Auto CAD: Detailed drawings of following machine parts are to be given to the students to assemble and draw the sectional or plain elevations, plans and side views with dimensioning and bill of materials using cad software (any 10 of the following).</p> <p>1) Sleeve & Cotter Joint, 2) Spigot & Cotter Joint, 3) Knuckle Joint, 4) Stuffing Box, 5) Screw Jack, 6) Foot Step Bearing, 7) Universal Coupling, 8) Plummer Block, 9) Simple Eccentric, 10) Machine Vice, 11) Connecting Rod, 12) Protected Type Flanged Coupling.</p> <p>B. Write steps to prepare each drawing using AutoCAD or AutoCAD Mechanical Steps must include followings.</p> <p>i. Sketch of components at each step with dimensions.</p> <p>ii. Sequence of commands with name, options and values.</p>	1	30
3	<p>Prepare 2D parametric drawings of 3-4 mechanical components (like fasteners & company’s logo) using AutoCAD, ProE (Creo)/Solid works/SolidEdge/Inventor professional.</p> <p>A. Prepare a report on the following. Write steps to prepare each</p>	1	06

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	Drawing using AutoCAD. Steps must include the followings. i. Sketch of components at each step with dimensions. ii. Sequence of commands with name, options and values.		
4	Prepare given project in the group of 4-5 students using AutoCAD or Inventor Professional/Creo/Solid Works/Solid Edge assembly drawing of minimum 6 different parts. Prepare orthographic drawings and bill of material.	1	14
Total			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.*
- ii. Care must be taken in assigning and assessing study report as it is a Second-year study report. Study report, data collection and analysis report must be assigned in a group. Teacher has to discuss about type of data (which and why) before group start their market survey.*

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	Quality of Drawing	30
2	AutoCAD/ Inventor professional/ Creo settings	10
3	Participation	20
4	Punctuality	20
5	Knowledge	20
Total		100

Sample rubrics Performance Indicators for the PrOs

Criteria	4	3	2	1
Quality of Drawing	<ol style="list-style-type: none"> Individual part is duplicated with 100% accuracy. Dimensions are provided as assigned. Correct Template used. Parametric relations used as assigned. 	<ol style="list-style-type: none"> Individual part is duplicated up to 70 to 80% accuracy. Minor Mistake found in dimension style. Minor mistake in Template Minor mistake in Parametric Relation. 	<ol style="list-style-type: none"> Individual part is duplicated up to 50 to 60% accuracy. One or two mistakes found in dimension style. One or two mistakes in template. One or two mistakes in Parametric Relation. 	<ol style="list-style-type: none"> Individual part is duplicated less than 50%. More than two mistakes found in dimension style. Major drawing errors are present in template. More than 02 mistake in Parametric Relation.
AutoCAD/ Inventor Professional/C reo Settings	AutoCAD settings* Are accurate as assigned.	One or Two mistakes in AutoCAD settings*.	Three or Four mistake in AutoCAD settings*.	More than four mistake in AutoCAD settings*..
Participation	Used time well in lab focused attention in exercise	Used time mostly in lab focused attention in exercise	Used time moderate in lab focused attention in exercise	Participation is minimum
Punctuality	Timely Submission	Submission late by 1 laboratory	Submission late by 2 laboratories	Submission late by more than 2 laboratories
Knowledge	Student give the correct answers 90% or more	Student give the correct answers between 70-89%	Student give the correct answers between 50-69%	Student give the correct answers less than 50%

- ***Units, Limits, UCS Icon, Layering, Planes, References etc.**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1.	CAD Workstation with 8 GB RAM and 1 TB hard disk drive with Windows -10 OS	1 to 4
2.	24" color or mono plotter	1 to 4
3.	Autodesk AutoCAD (Educational stand alone or network licensed the latest Version).	1 to 4

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
4.	Creo or Solid Edge or Inventor Professional (Educational stand alone or network licensed latest Version).	1 to 4

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.
- c) Follow ethical practices
- d) Maintain tools and equipment
- e) Practice environment 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 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 Introduction	1a. Interpret drafting, tolerance and geometrical symbols in given production drawings. 1b. Appreciate AutoCAD environment in context to production drawings.	1.1 Concept and need of machine drawings. 1.2 Drafting, tolerance and geometrical symbols used in machine drawing 1.3 AutoCAD screen, library, symbols, templates in context of machine drawing.
Unit – II 2D production drawings	2a. Prepare and plot 2D production machine drawings using AutoCAD.	2.1 Simple 2D production drawings of Mechanical components made up of various manufacturing operations using Auto CAD. 2.2 Draw assembly productions drawing of simple mechanical assembly having minimum 5-6 components each made up of Various manufacturing operations using AutoCAD.
Unit-III	3a. Prepare 2D parametric	3.1 Concept and examples of

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
2D parametric drawings	Drawings of simple machine components using AutoCAD, Pro/E (Creo)/Solid Works/Solid Edge or Inventor Professional.	Parametric and non-parametric models. 3.2 Concept, examples and applications of constraints and relations 3.3 Simple 2D parametric drawings of 6-7 machine components.
Unit – IV Project work	4a. Prepare assembly drawing of mechanical components with codes, standards and symbols using AutoCAD. (Inventor professional or Creo Software can be also used.)	4.1 Prepare one assembly drawing having 4-5 mechanical parts, draw orthographic projections of each component with Institute template and take print out of it. (Group of 5-7 students).

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 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:

- 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.
- Select at least one simple mechanical assembly in group of 5-6 students, each made up of minimum 5-6 manufacturing operations. Get them approved by teacher. Measure and sketch them in report pages with dimensions.
- Bring Actual assembly from workshop/industry, measure dimensions, sketch it and make 2D production drawing for the same.

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:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- Guide student(s) in undertaking micro-projects.
- '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**.
- f) Guide students for data sheets.

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 **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:

Assembly drawing of following mechanical part

- a) Bench vise
- b) Motor pulley block
- c) Motor blower
- d) Pipe wise
- e) Radial engine
- f) Shaper tool head

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	Pro Engineer Wildfire 5.0 For Engineers and Designers	Sham Tickoo	Dream Tech press
7	AutoCAD User Guide	Autodesk	Autodesk Press.
8	AutoCAD: A Problem-Solving Approach	Sham Tickoo	Thomson Learning EMEA, Limited

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
9	Machine Drawing	N.D.Bhatt	Charotar Publication
10	Autodesk Inventor Professional 2022 for Designers	Sham Tickoo	CADCIM Technologies, USA Prof. ShamTickoo, Purdue University Northwest, USA

14. SOFTWARE/LEARNING WEBSITES

- i. Autodesk AutoCAD (Educational network or stand-alone licensed latest Version)
- ii. Autodesk Inventor Professional or Creo (Pro-Engineer) or Solid edge (Educational network or stand-alone licensed latest Version).

Learning Websites

- (a) <https://www.cadcim.com>
- (b) <http://www.we-r-here.com/cad/tutorials/index.htm>
- (c) <http://www.cadtutor.net/tutorials/autocad/>
- (d) http://www.caddprimer.com/AutoCAD_training_tutorial/AutoCAD_training_lessons.htm
- (e) <http://www.autocadmark.com/>
- (f) <http://www.autocadtutorials.net/>
- (g) <https://www.autodesk.com/education/edu-software/autocad>
- (h) <https://www.autodesk.in/campaigns/autocad-tutorials>
- (i) <https://www.autodesk.com/education/support>

15. PO-COMPETENCY-CO MAPPING

Semester III	Computer Aided Machine Drawing Practice(Course Code: 4311702)						
	POs						
Competency & Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline specific knowledge	Problem Analysis	Design/ development of solutions	Engineering Tools, Experimentation& Testing	Engi tices for society, &	Project Management	Life-long Learning
Competency	Prepare production drawings using the computer and relevant software and following standards codes and norms						
Course Outcomes							
CO 1) Interpret and Draw, edit and modify 2D Production drawing/Machine Drawing of mechanical Components	3	-	2	-	-	-	2
CO 2) Create detailed drawings of various machine parts are with sectional or plain elevations, plans , side views and dimensioning with bill of materials using (BOM) using CAD software like AutoCAD.	3	3	3	-	2	-	2
CO 3) Prepare report of Technical components with Sketch of components at each step with dimensions and sequence of commands with name, options and values.	2	-	2	-	2	-	2
CO 4) Create various parametric drawing of mechanical components with company logo, tolerances and level of surface finish by using latest parametric CAD software.	3	2	3	-	2	-	2
CO 5) Create given projects drawings with orthographic projection, bill of material, and report using CAD software.	2	3	3	-	-	3	3

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.	Muhammad Azharuddin U Badi, Lecturer in Mechanical Engg.	Government Polytechnic, Porbandar	9558800951	muhammadabdi92@gmail.com
2.	Vinitkumar K. Modi, Lecturer in Mechanical Engg	B.&B. Institute of Technology V. V. Nagar	9428661810	modi_vinit@yahoo.com
3.	Amit M. Patel, Lecturer in Mechanical Engg.	Government Polytechnic, Ahmedabad	9426355443	hiamit24@gmail.com

BOS Resource Persons

S. No.	Name and Designation	Department	Contact No.	Email
1.	Dr.S.H.Sundarani BOS Chairman HOD Mechanical Engg.	Government Polytechnic Ahmadabad	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