Program Name   : **Diploma in Mechanical Engineering**

Program Code   : **ME**

Semester   : **Fourth**

Course Title   : **Computer Aided Drafting**

Course Code   : **22042**

1.   RATIONAL

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. Moreover, the technology driven competitive environment in today's market is compelling design/consulting engineering firms and manufacturing companies to seek CAD conversion of their existing paper based engineering documents. The focus of this course is to provide the student with hands-on experience in drafting and editing of an industrial production drawing using one of the commercial Computer Aided Drafting software with particular emphasis on the application of CAD software.

2.   COMPETENCY

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

* **Prepare digital drawings using computer aided drafting software.**

3.   COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Use file management techniques in a CAD software.

b. Draw complex 2D geometric figures using a CAD software.

c. Modify complex 2D geometric figures using a CAD software

d. Use software to dimension and write text on existing 2D geometric entities.

e. Use software to plot existing drawing with desired plot parameters.

f. Create Isometric drawings using a CAD software

g. Use layers and blocks to create digital drawings using relevant softwares.

4.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
					Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
--	--	4	4	--	--	--	--	--	--	--	25#	10	25 ~	10	50	20

(**) *marks should be awarded on the basis of internal end semester theory exam of 50 marks based on the specification table given in S. No. 9. (~)For the* **practical only courses,** *the PA*

has two components under practical marks i.e. the assessment of practicals (see in section 6) has a weightage of 60% (i.e. 15 marks) and micro-project assessment (see in section 12) has a weightage of 40% (i.e. 10 marks). 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, ESE - End Semester Examination; PA - Progressive Assessment. @ Internal Assessment, # External Assessment, *# On Line Examination, ^ Computer Based Assessment*

5.   COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.
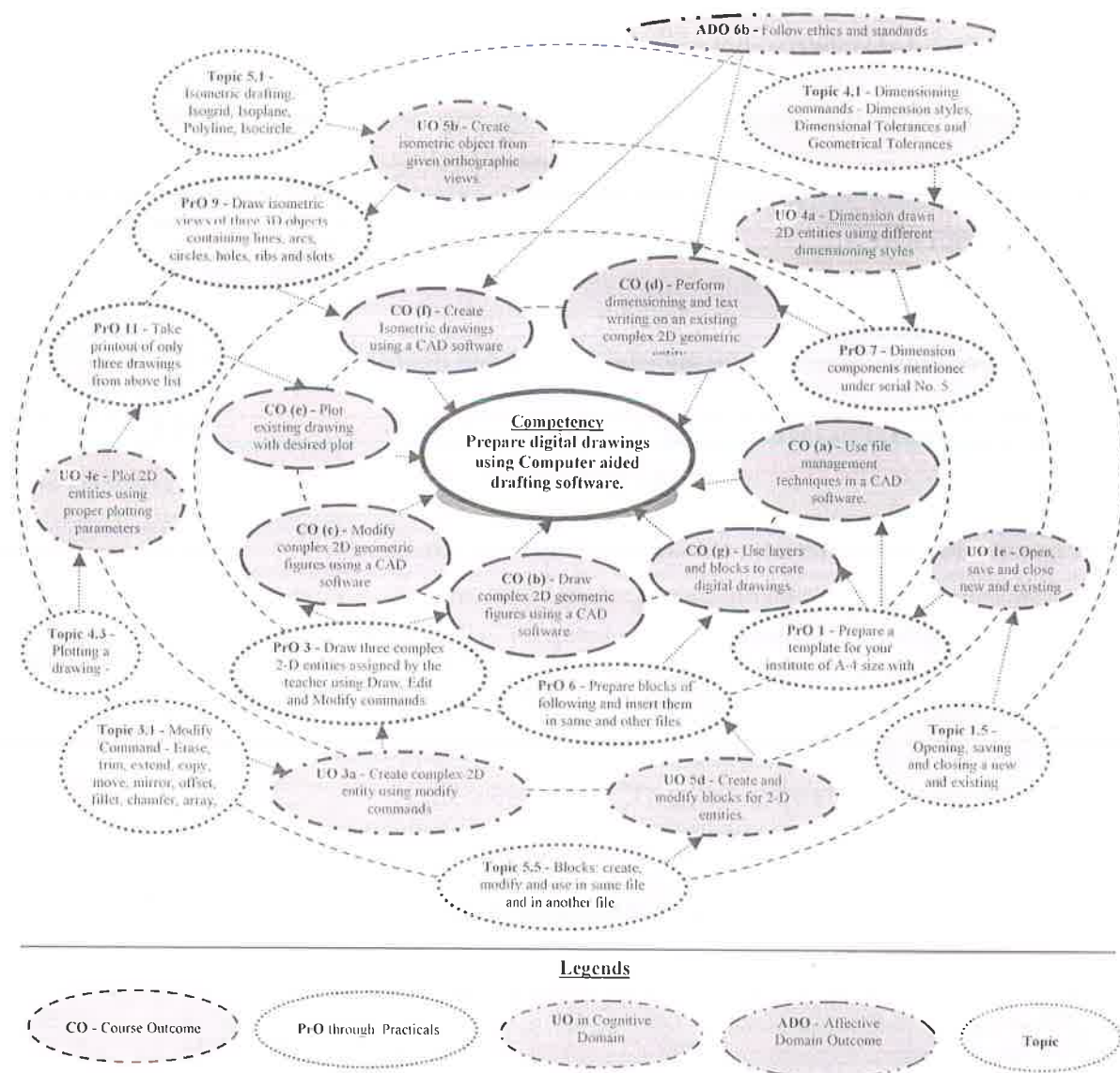

Figure 1 - Course Map

6.   SUGGESTED PRACTICALS / EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Prepare a template for your institute of A-2/A3 size with title block and institute logo.	All	02*
	1		
2.	Use the software to draw one simple 2-D entities using Draw commands individually. Part 1	II	02*
3.	Use the software to draw another simple 2-D entities using Draw commands individually. Part II	II	02
4.	Use the software to draw another simple 2-D entities using Draw commands individually. Part III	II	02
	2		
5.	Use the software to draw four complex 2-D entities assigned by the teacher using Draw, Edit and Modify commands. Part I	II, III	02*
6.	Use the software to draw four complex 2-D entities assigned by the teacher using Draw, Edit and Modify commands. Part II	II, III	02*
7.	Use the software to draw four complex 2-D entities assigned by the teacher using Draw, Edit and Modify commands. Part III	II, III	02
8.	Use the software to draw four complex 2-D entities assigned by the teacher using Draw, Edit and Modify commands. Part IV	II, III	02
	3		
9.	Use the software to draw to estimate Area, Perimeter, and Centroid for the given 2D entities like Circle, Pentagon, Trapezium, hexagon and 2D entity with arcs and spline curves using 'Enquiry' and 'List' commands. Part I	II	02
10.	Use the software to draw to estimate Area, Perimeter, and Centroid for the given 2D entities like Circle, Pentagon, Trapezium, hexagon and 2D entity with arcs and spline curves using 'Enquiry' and 'List' commands. Part II	II	02
	4		
11.	Use the software to draw Epicycloid and Hypocycloid curves using pitch circle as directing circle of a cycloidal gear and an appropriate size smaller circle as generating circle. Part I	II	02
12.	Use the software to draw Epicycloid and Hypocycloid curves using pitch circle as directing circle of a cycloidal gear and an appropriate size smaller circle as generating circle. Part II	II	02
	5		
13.	Use the CADD software to create any two problems of orthographic projections using first angle method of Projection Part I.	II, III	02*
14.	Use the CADD software to create any two problems of orthographic projections using first angle method of Projection Part II	II, III	02*
15.	Plot the above Orthographic Projection Drawing on A2/A3 size Paper with title block and institute logo.	II, III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	6		
16.	Use the CADD software to create any two problems of orthographic projections using Third angle method of Projection Part I.	II, III	02*
17.	Use the CADD software to create any two problems of orthographic projections using Third angle method of Projection Part II	II, III	02*
18.	Plot the above Sectional Orthographic Projection Drawing on A2/A3 size Paper with title block and institute logo	II, III	02*
	7		
19.	Use the CADD software to create any two problems of Sectional orthographic projections using Both (First and Third) angle method of Projection Part I	II, III	02*
20.	Use the CADD software to create any two problems of Sectional orthographic projections using Both (First and Third) angle method of Projection Part II	II, III	02*
21.	Plot the above Sectional Orthographic Projection Drawing on A2/A3 size Paper with title block and institute logo	II, III	02*
	8		
22.	Use the software to draw isometric views of given two objects containing lines, arcs, circles, holes, ribs and slots. Part I	II, III	02*
23.	Use the software to draw isometric views of two objects containing lines, arcs, circles, holes, ribs and slots. Part II	II, III	02*
24.	Plot the above Isometric Projection Drawing on A2/A3 size Paper with title block and institute logo	II, III	02*
	9		
25.	Use the CADD software to draw an assembly drawing from the given detailed drawing showing conventional representations, Bill of Material. (Part I)	IV	02*
26.	Use the CADD software to draw an assembly drawing from the given detailed drawing showing conventional representations, Bill of Material . (Part II)	IV	02*
27.	Plot the above assembly drawing on A2/A3 size Paper with title block and institute logo	IV	02*
	10		
28.	Use the CADD software to draw an assembly drawing from the given detailed drawing showing conventional representations, Dimensional and Geometrical tolerances and surface finish symbols. (Part I)	IV	02
29.	Use the CADD software to draw an assembly drawing from the given detailed drawing showing conventional representations, Dimensional and Geometrical tolerances and surface finish symbols. (Part II)	IV	02
30.	Plot the above assembly drawing on A2/A3 size Paper with title block and institute logo	IV	02
	11		

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
31.	Use the CADD software to draw working drawings from given assembly drawing (Sr.No 21,22) showing conventional representation, Dimensional and Geometrical tolerances and surface finish symbols. (Part I)	IV	02*
32.	Use the CADD software to draw working drawings from given assembly drawing showing conventional representation, Dimensional and Geometrical tolerances and surface finish symbols. (Part II)	IV	02*
33.	Plot the above working drawing on A2/A3 size Paper with title block and institute logo	IV	02*
12			
34.	Use the CADD software to draw working drawings from given assembly drawing (Sr.No 23,24) showing conventional representation, Dimensional and Geometrical tolerances and surface finish symbols. (Part I)	IV	02
35.	Use the CADD software to draw working drawings from given assembly drawing showing conventional representation, Dimensional and Geometrical tolerances and surface finish symbols. (Part II)	IV	02
36.	Plot the above working drawing on A2/A3 size Paper with title block and institute logo	IV	02
	Total		**64**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	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
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

    a. Follow safe practices to operate CAD workstations.
    b. Practice energy conservation.

c.   Follow ethics and standards.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7.   MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

S. No.	Equipment/Instruments/Other resources name with Broad Specifications	PrO. No.
1	Networked Licensed latest version of Computer Aided Drafting software freeware	All
2	CAD workstation with latest configurations for each student.	All
3	Plotter/Printer with latest versions.	All
4	LCD projector and Screen/ Interactive board	All

8.   UNDERPINNING THEORY COMPONENTS

The following topics/subtopics is to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Fundamentals of CAD Drawing Setup	1a. Explain use of computer in drafting and designing. 1b. Use the AutoCAD workspace and interface. 1c. Work with the User Coordinate System and World Coordinate System. 1d. Apply different object selection methods in a given situation 1e. Open, save and close new and given drawings/ templates	1.1 Fundamentals of Computer Aided Drafting (CAD) and its applications, Various Softwares for Computer Aided Drafting. 1.2 Co-ordinate System- Cartesian and Polar Absolute, Relative mode, UCS, WCS. 1.3 CAD initial setting commands- Snap, grid, Ortho, Osnap. Limits, Units, Ltscale, Object tracking. 1.4 Object Selection methods- picking, window, crossing, fence, last and previous. 1.5 Opening, saving and closing a new and existing drawing/template
Unit– II Draw,	2a. Use viewing commands. 2b. Apply formatting commands	2.1 Zoom Commands – all, previous, out, in, extent, Realtime, dynamic,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Enquiry, Zoom and Formatting Commands	2c. Draw simple 2D entities using given draw commands 2d. Determine coordinates, distance, area, length, centroid of the given 2D entity	window, pan. 2.2 Formatting commands - Layers, block, linetype, lineweight, color. 2.3 Draw Command - Line, arc, circle, rectangle, polygon, ellipse, spline, block, hatch 2.4 Enquiry commands – distance, area.
Unit– III Edit and Modify Commands	3a. Create given complex 2D entity using modify commands 3b. Use grip command to manipulate given 2D entity	3.1 Modify Command - Erase, trim, extend, copy, move, mirror, offset, fillet, chamfer, array, rotate, scale, lengthen, stretch, measure, break, divide, explode, align. 3.2 Grips editing- Move, Copy, Stretch.
Unit– IV Dimensioning, Text and Plot Commands	4a. Dimension given 2D entities using different dimensioning styles 4b. Apply Geometric and dimension tolerance symbols on the given entity. 4c. Write text on given 2D entity. 1f. Create user defined dimension and text styles for a given situation 4d. Plot given 2D entities using proper plotting parameters.	4.1 Dimensioning commands - Dimension styles, Dimensional Tolerances and Geometrical Tolerances, Modify dimension style. 4.2 Text commands - dtext, mtext command. 4.3 Plotting a drawing - paper space, model space, creating table, plot commands.
Unit– V Isometric Drawings, Layers, and Blocks	5a. Draw isometric entities. 5b. Create isometric object from given orthographic views. 5c. Use Layers for 2D drawings. 5d. Create and modify blocks for given 2D entities. 5e. Use blocks in same and in another given file.	5.1 Isometric drafting, Isogrid, Isoplane, Polyline, Isocircle. 5.2 Dimensioning Isometric drawings. 5.3 Text writing on Isometric drawing. 5.4 Layer, Layer properties and applications. 5.5 Blocks: create, modify and use in same file and in another file.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER (INTERNAL) DESIGN

Unit No.	Unit Title	Practice Hours	Distribution of Practical Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of CAD Drawing	06	-	02	02	04

Unit No.	Unit Title	Practice Hours	Distribution of Practical Marks			
			R Level	U Level	A Level	Total Marks
	Setup					
II	Draw, Enquiry, Zoom and Formatting Commands	12	01	-	02	03
III	Edit and Modify Commands	24	02	-	08	10
IV	Dimensioning, Text and Plot Commands	12	01	-	02	03
V	Isometric Drawings, Layers, and Blocks	10	01	00	04	05
	Total	**64**	**05**	**02**	**18**	**25**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note: *This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may 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 conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Maintain a separate folder on Computer workstation allotted, in which all above mentioned practicals should be saved and will be submitted/ mailed as a part of term work.

b. Collect at least one 2D drawing like Production drawings, Layouts from nearby workshops/industries/builders/contractors and develop them using computer aided drafting approach.

c. Explain at least one problem for drafting to all batch colleagues. Teacher will assign the problem to be explained by student.

d. Assess at least one 2D drawing of other students (A group of 5-6 students may be identified by teacher) and note down the mistakes committed by the group. Selected students will also guide other students for correcting 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. **'L' in item No. 4** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.

c. About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentations (see implementation guideline for details).

d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.

e. Guide student(s) in undertaking micro-projects.

f.   Bring real objects in the classroom for demonstration purpose.

g.   Demonstrate use of various commands of CAD using LCD projector/ interactive board, during hands on sessions.

h.   Show videos and animations to explain use of layers, blocks and other relevant commands.

i.   Demonstrate use of hardware like plotter.

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. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, 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 total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a.   **2D Transmission**: Each batch will identify fasteners, couplings, joints used in plastic machines and using CAD software prepare drawings. The figures should be labeled and dimensioned using software.

b.   **2D Machinery components**: Each batch will identify machinery components used in plastic machines and using CAD software prepare drawings. The figures should be labeled and dimensioned using software.

c.   **3D Transmission**: Each batch will identify fasteners, couplings, joints used in plastic machines and using CAD software prepare isometric drawings. The figures should be labeled and dimensioned using software.

d.   **3D Machinery components**: Each batch will identify machinery components used in plastic machines and using CAD software prepare isometric drawings. The figures should be labeled and dimensioned using software.

e.   **Digital Drawings:** Each batch will identify manual drawings of machinery components used in plastic machines and using CAD software create digital drawings using relevant software.

13.   SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Engineering Drawing Practice for Schools and Colleges IS: SP-46	Bureau of Indian Standards	BIS, GOI, Third Reprint, October 1998, ISBN: 81-7061-091-2
2.	Engineering Drawing	Bhatt, N.D.	Charotar Publishing House, Anand, Gujarat, 2010, ISBN:978-93-80358-17-8
3.	Machine Drawing	Bhatt, N.D.; Panchal, V. M.	Charotar Publishing House, Anand, Gujarat, 2010, ISBN:978-93-80358-11-6

S. No.	Title of Book	Author	Publication
4.	Engineering Graphics with AutoCAD	Kulkarni D. M.; Rastogi A. P.; Sarkar A. K.	PHI Learning. New Delhi (2010), ISBN: 978-8120337831
5.	Essentials of Engineering Drawing and Graphics using AutoCAD	Jeyapoovan T.	Vikas Publishing House Pvt. Ltd. Noida, 2011. ISBN: 978-8125953005
6.	AutoCAD User Guide	Autodesk	Autodesk Press. USA, 2015
7.	AutoCAD 2016 for Engineers and Designers	Sham Tickoo	Dreamtech Press; Galgotia Publication New Delhi, Twenty Second edition, 2015. ISBN-13: 978-9351199113

14.   SOFTWARE/LEARNING WEBSITES

a. http://www.mycadsite.com/tutorials/
b. http://tutorial45.com/learn-autocad-basics-in-21-days/
c. https://www.lynda.com/AutoCAD-training-tutorials/160-0.html
d. http://www.investintech.com/resources/blog/archives/5947-free-online-autocad-tutorials-courses.html
e. http://www.cad-training-course.com/
f. http://au.autodesk.com/au-online/overview
g. https://www.youtube.com/watch?v=yruPUj_61bw
h. https://www.youtube.com/watch?v=xquI8gcdwbs
i. https://www.youtube.com/watch?v=JTOP6TV4Mvw
j. https://www.youtube.com/watch?v=x7X25Xpa07o
k. https://www.youtube.com/watch?v=Si93Y36tUmY
l. https://www.youtube.com/watch?v=D8dPWKihkEo