

Program Name : Automobile & Plastic Engineering Program Group
Program Code : AE, PS
Semester : Second
Course Title : Computer Aided Drafting
Course Code : 22011

1. RATIONALE

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:

- Use file management techniques in a CAD software.
- Draw complex 2D geometric figures using a CAD software.
- Modify complex 2D geometric figures using a CAD software
- Use software to dimension and write text on existing 2D geometric entities.
- Use software to plot existing drawing with desired plot parameters.
- Create Isometric drawings using a CAD software
- Use layers and blocks to create digital drawings using relevant softwares.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
L	T	P		Theory						Practical					
				ESE		PA		Total		ESE		PA		Total	
Paper Hrs.		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		
--	--	2	2	--	--	--	--	--	--	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 (seen in section 6) has a weightage of 60% (i.e. 15 marks) and micro-project assessment (seen 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.

1. 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.

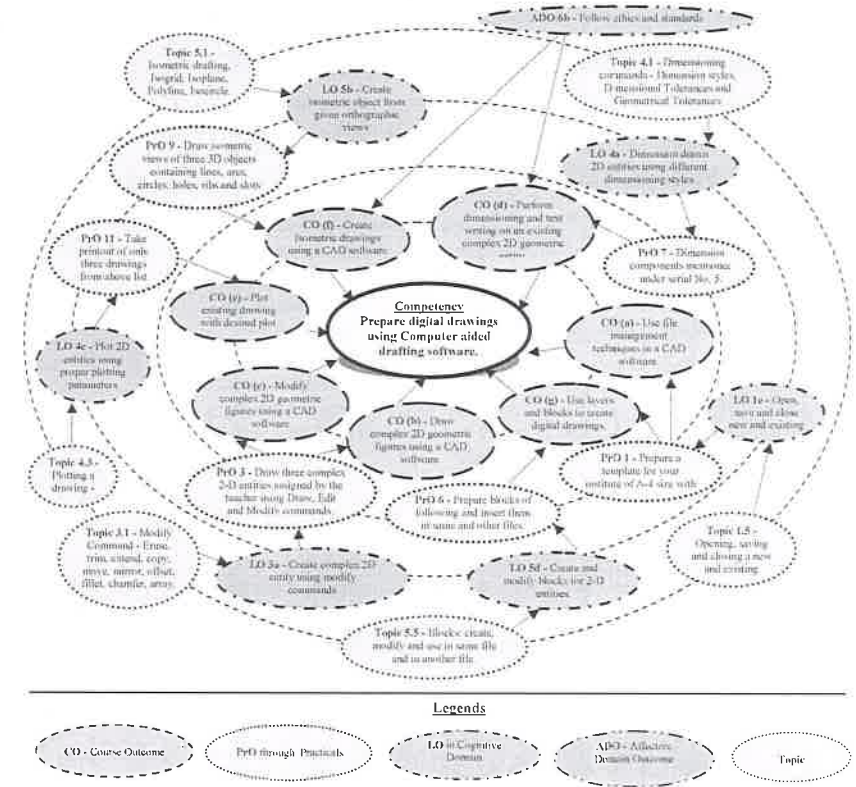


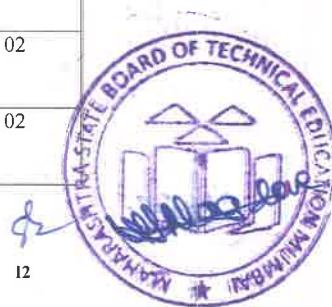
Figure 1 - Course Map

2. 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-4 size with title block and institute logo.	All	02
2.	Use the software to draw one simple 2-D entities using Draw commands individually. Part I	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
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
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.	II	02
10.	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
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 II	II	02
12.	Use the software to create Hexagonal nut and Bolt (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
13.	Use the software to create Front view and side view of V-Groove Pulley (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
14.	Use the software to create Spherical and Flat headed Rivet (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
15.	Use the software to create Front view of 2-Wheeler Piston (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
16.	Use the software to create Front view of typical Open Ended Spanner (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
17.	Use the software to create Front view of Connecting Rod (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
18.	Use the software to create Front view of Poppet valve (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
19.	Use the software to create Front view of Deep groove ball bearing (similar objects can be taken up) using Computer Aided Drafting approach.	II, III	02
20.	Use the software to prepare blocks of Hexagonal nut and bolt and insert them in same and other files (similar objects can be taken up). Part I	V	02
21.	Use the software to prepare blocks of Ball bearing and insert it in same and other files (similar objects can be taken up). Part II	V	02
22.	Use the software to prepare blocks of Chain sprocket and insert it in same and other files (similar objects can be taken up). Part III	V	02
23.	Use the software to dimension all above components mentioned under serial No.12-19. Also insert relevant text in the drawing. Part I	IV	02
24.	Use the software to draw sectional view of piston of a two-wheeler. Main drawing of Piston in one layer, hatching in another layer and dimensioning and text in third layer. Part I	IV, V	02
25.	Hatch above drawing using layer facility and write dimensions and text using on another layer. Part II	IV, V	02
26.	Use the software to draw isometric views of three 3D objects containing lines, arcs, circles, holes, ribs and slots. Part I	V	02
27.	Use the software to draw isometric views of three 3D objects containing lines, arcs, circles, holes, ribs and slots. Part II	V	02
28.	Use the software to draw isometric views of three 3D objects containing lines, arcs, circles, holes, ribs and slots. Part III	V	02
29.	Draw three Isometric drawings from given Isometric views and dimension it. Part I	V	02
30.	Draw three Isometric drawings from given Isometric views and dimension it. Part II	V	02
31.	Draw three Isometric drawings from given Isometric views and dimension it. Part III	V	02
32.	Take printout of only three drawings from above list using template developed in S. No. 01	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.
- 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:

- Follow safe practices to operate CAD workstations.
- Practice energy conservation.
- 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.

33. 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	Exp. No.
1	Networked Licensed latest version of Computer Aided Drafting software	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, Enquiry, Zoom and Formatting Commands	2a. Use viewing commands. 2b. Apply formatting commands 2c. Draw simple 2D entities using given draw commands 2d. Determine coordinates, distance, area, length, centroid of the given 2D entity	2.1 Zoom Commands – all, previous, out, in, extent, Realtime, dynamic, 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. 4f. 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	5a. Draw isometric entities.	5.1 Isometric drafting, Isogrid, Isoplane.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Isometric Drawings, Layers, and Blocks	5b. Create isometric object from given orthographic views.	Polyline, Isocircle.
	5c. Use Layers for 2D drawings.	5.2 Dimensioning Isometric drawings.
	5d. Create and modify blocks for given 2D entities.	5.3 Text writing on Isometric drawing.
	5e. Use blocks in same and in another given file.	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	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of CAD Drawing Setup	08	-	02	02	04
II	Draw, Enquiry, Zoom and Formatting Commands	14	02	02	08	12
III	Edit and Modify Commands	14	-	02	10	12
IV	Dimensioning, Text and Plot Commands	08	02	-	06	08
V	Isometric Drawings, Layers, and Blocks	16	02	02	10	14
Total		60	06	08	36	50

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 LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table. This specification table also provides a general guideline for teachers to frame internal end semester practical exam paper which students have to perform on computers with relevant Computer Aided Drafting software like AutoCAD etc.

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:

- 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.
- Collect at least one 2D drawing like Production drawings, Layouts from nearby workshops/industries/builders/contractors and develop them using computer aided drafting approach.
- Explain at least one problem for drafting to all batch colleagues. Teacher will assign the problem to be explained by student.

- 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:

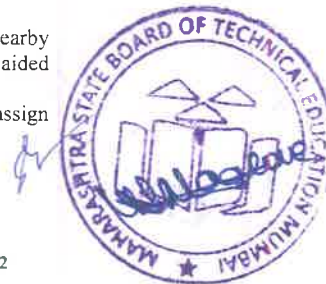
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- About 15-20% of the topics/sub-topics which 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).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Bring real objects in the classroom for demonstration purpose.
- Demonstrate use of various commands of CAD using LCD projector/ interactive board, during hands on sessions.
- Show videos and animations to explain use of layers, blocks and other relevant commands.
- Demonstrate use of hardware like plotter.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. 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.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should 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. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

- 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.
- 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.
- 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.
- 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
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

- <http://www.mycadsite.com/tutorials/>
- <http://tutorial45.com/learn-autocad-basics-in-21-days/>
- <https://www.lynda.com/AutoCAD-training-tutorials/160-0.html>
- <http://www.investintech.com/resources/blog/archives/5947-free-online-autocad-tutorials-courses.html>
- <http://www.cad-training-course.com/>
- <http://au.autodesk.com/au-online/overview>
- https://www.youtube.com/watch?v=yruPUj_61bw
- <https://www.youtube.com/watch?v=xquI8gcdwbs>
- <https://www.youtube.com/watch?v=JTOP6TV4Mvw>
- <https://www.youtube.com/watch?v=x7X25Xpa07o>
- <https://www.youtube.com/watch?v=Si93Y36tUmY>
- <https://www.youtube.com/watch?v=D8dPWKihkEo>

