

Program Name : Diploma in Production Engineering / Production Technology
Program Code : PG / PT
Semester : Fourth
Course Title : Computer Aided Drafting and Modeling
Course Code : 22043

1. RATIONALE

The market driven economy demands frequent changes in product design to suit the customer's needs. With the introduction of computers, the task of modeling any complex part and incorporating frequent changes as per customer requirement are 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 and making them competent in latest solid modeling and assembly practices.

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 production/assembly drawings using CAD 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 the CAD workspace and interface.
- Draw 2D entities using computer aided drawing software.
- Use dimension and text command.
- Develop 2D drawings.
- Create 3D models.
- Create assembly drawing.

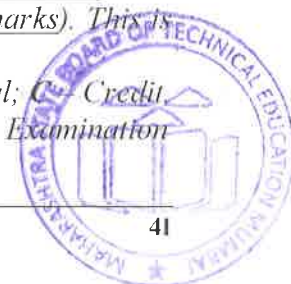
4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
L	T	P		Theory						Practical							
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
1	-	4	5	--	--	--	--	--	--	--	--	50@	20	50~	20	100	40

(**) marks should be awarded on the basis of internal/external end semester practical exam of 50 marks.

(~): 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.30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e.20 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, '#': No Theory Examination



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.

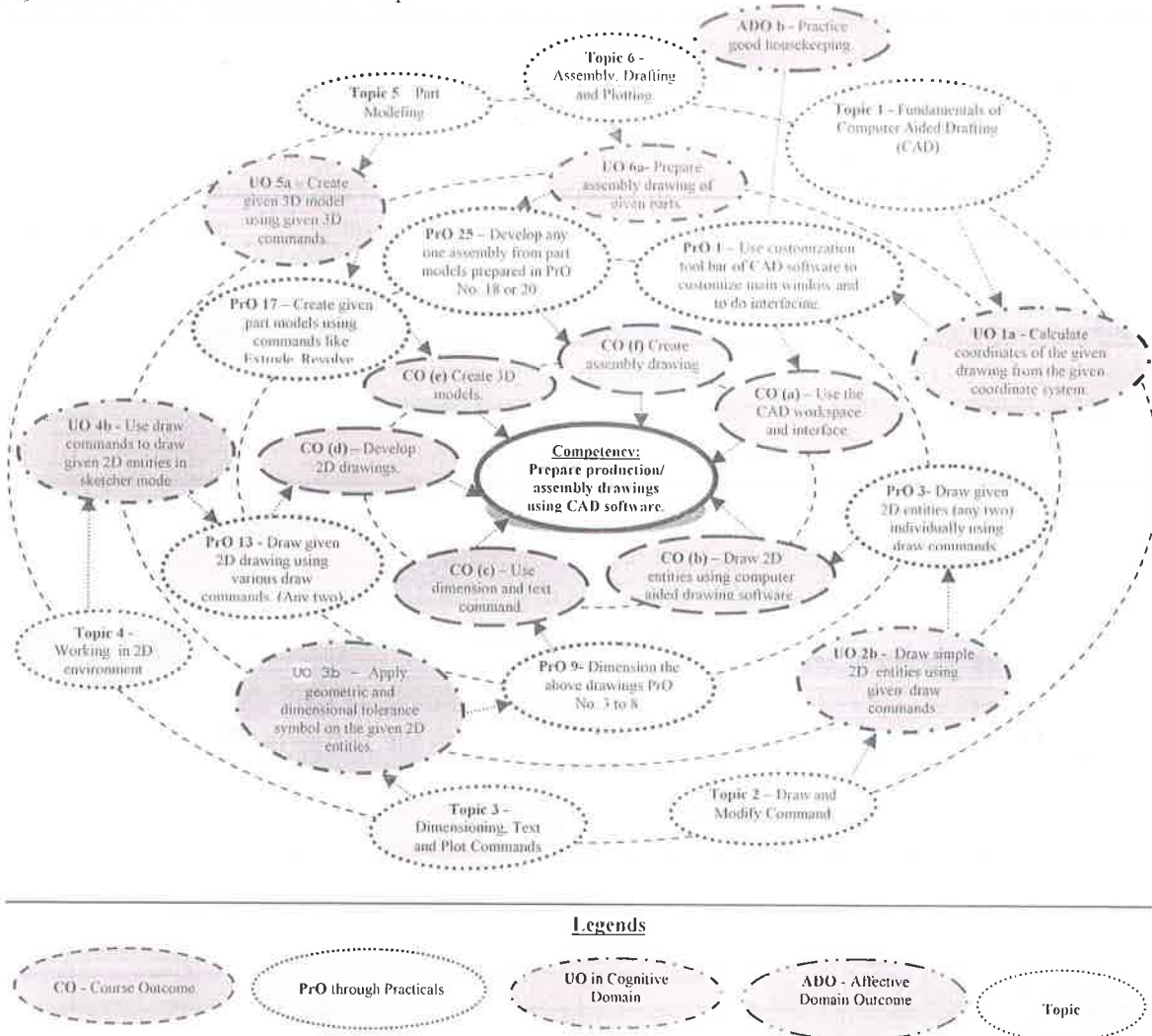


Figure 1 - Course Map

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.	Use customization tool bar of CAD software to customize main window and to do interfacing.	I	02
2.	Prepare a template of your institute.	I, II, III	02*
3.	Draw given 2D entities (any two) individually using draw commands.	I, II	02



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
4.	Draw given 2D entities (any two) and modify them individually using draw and edit commands.	I, II, III	02*
5.	Draw given views of Hexagonal nut and Bolt (similar objects can be taken up) using Computer Aided Drafting software.	I, II, III	02
6.	Draw given views of V-Groove Pulley, 2-Wheeler Piston (similar objects can be taken up) using Computer Aided Drafting software	I, II, III	02
7.	Draw given views of Open ended spanner, Deep groove ball bearing (similar objects can be taken up) using Computer Aided Drafting software.	I, II, III	02
8.	Draw given views of flange coupling, universal coupling (similar objects can be taken up) using Computer Aided Drafting software.	I, II, III	02
9.	Dimension the above drawings created in PrO. No. 3 to 8.	II, III	02*
10.	Make blocks of Hexagonal nut and bolt, Ball bearing and insert them in same or other files (similar objects can be taken up).	II, III	02*
11.	Print any three drawings from above list along with the template of institute prepared.	II, III	02
12.	Customize main window and interface of the 3D modeling software using customization tool bar.	IV	02
13.	Draw given 2D drawing using various draw commands. (Any two).	IV	02*
14.	Apply geometrical and dimensional constraints to the drawing drawn in PrO. No. 13	IV	02*
15.	Draw given 2D complex drawing using various draw, edit, modify and dimension commands. (Any two)	IV	02
16.	Apply geometrical and dimensional constraints to the drawing drawn in PrO. No. 15.	IV	02
17.	Create given part models using commands like Extrude, Revolve, Shell etc;	V	02*
18.	Create a given part using extrude and revolve feature like muff coupling, shaft etc;	V	02
19.	Create given part models using commands like Mirror, Chamfer, Fillet, Rib, Pattern etc;	V	02*
20.	Develop given simple part models of Cotter joint and flange coupling.	V	02
21.	Create a given simple part using commands like Sweep, Blend, Draft and loft or similar commands.	V	02
22.	Develop given part models of machine vice, tool post or Universal coupling.	V	02
23.	Develop complex part model of screw jack.	V	02
24.	Apply assembly constraints like mate, align, insert in the given drawing.	VI	02*
25.	Develop any one assembly from part models prepared in PrO. no. 18 or 20. Apply assembly constraints.	VI	
26.	Develop any one assembly from given part models prepared in PrO. No. 22 or 23. Apply assembly constraints.	VI	



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
27.	Create exploded view of the given assemblies.	VI	02*
28.	Create a part drawing using drafting mode.	VI	02
29.	Generate orthographic views of prepared solid model part. Apply important dimensions.	VI	02
30.	Generate sectional views of solid model.	VI	02
31.	Generate orthographic views of prepared solid model assembly and prepare bill of material.	VI	02
32.	(a) Plot part drawing on A4 (Any one) (b) Plot assembly drawing on A3. (Any one)	VI	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 judicious mix of minimum 24 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	Selecting relevant set up parameters.	20
2	Creating given 2D and 3D drawing using relevant minimum commands.	30
3	Dimensioning the given 2D entity/part/Assembly drawing and writing text.	20
4	Answer to sample questions.	20
5	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 safety practices.
- b. Practice good housekeeping.
- c. Practice energy conservation.
- d. Demonstrate working as a leader/a team member.
- e. Maintain tools and equipment.
- f. Follow ethical Practices.

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

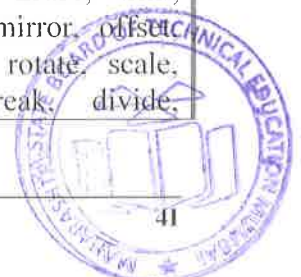
The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment/Instruments/Other resources name with Broad Specifications	Exp. No.
1	Networked Licensed latest version of any Parametric Computer Aided Design and Drafting software.	All
2	CAD workstation with latest configurations (i3-i5 preferable), RAM minimum 4 GB onwards, for each student.	All
3	Operating system: Windows XP/Windows 7/Windows 8/Windows 10 onwards.	All
4	Plotter/Printer with latest versions. (A3 and A4)	All
5	LCD projector and Screen/Interactive board.	All

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should 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 Computer Aided Drafting	1a. Calculate coordinates of the given drawing from the given coordinate system. 1b. Describe the procedure to apply the given setting commands in the given drawing. 1c. Apply different object selection methods in a given situation. 1d. Open, save and close new and given drawings/templates.	1.1 Fundamentals of Computer Aided Drafting (CAD) and its applications, Various Software 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, Itscale, Object tracking etc; 1.4 Object Selection methods - picking, window, crossing, fence, last and previous. 1.5 Open, save and close a new and existing drawing/template.
Unit– II Draw and Modify Commands	2a. Apply formatting commands in the given drawing. 2b. Draw simple 2D entities using given draw commands. 2c. Create given complex 2D entity using draw and modify commands. 2d. Use grip command to manipulate given 2D entity.	2.1 Zoom Commands – all, previous, in, out, extent, Realtime, dynamic, window, pan etc; 2.2 Formatting commands - linetype, linewidth, color. 2.3 Draw Command - Line, arc, circle, rectangle, polygon, ellipse, spline, block, hatch etc; 2.4 Modify Command - Erase, trim, extend, copy, move, mirror, offset, fillet, chamfer, array, rotate, scale, lengthen, stretch, break, divide.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		explode and align. 2.5 Grips editing - Move, Copy, Stretch.
Unit- III Dimensioning , Text and Plot Commands	3a. Create & modify Dimension styles as per requirement for a given 2D entities. 3b. Apply Geometric and dimensional tolerance symbols on the given entity. 3c. Write text on given 2D entity. 3d. Plot given 2D entities using proper plotting parameters.	3.1 Dimensioning commands – Create & modify Dimension styles, Dimensional Tolerances and geometrical Tolerances. 3.2 Text commands - dtext, mtext command. 3.3 Plotting a drawing - paper space, model space, creating table, plot commands.
Unit- IV Working in 2D environment	4a. Use given draw commands in sketcher mode. 4b. Use draw commands to draw given 2D entities in sketcher mode. 4c. Apply dimensioning constraints to given sketch. 4d. Apply geometrical constraints to given sketch.	4.1 Introduction, features and applications of different software packages used for solid modeling. System requirement & compatibility with other software. 4.2 Working in Sketcher mode – Line, Profile, Circle, Arc, curves, Rectangle and their sub options. 4.3 Constraints - Dimensioning constraint, Geometrical constraint.
Unit- V Part Modeling	5a. Create given 3D model using given 3D commands. 5b. Create given composite 3D solid model using Boolean operations. 5c. Use 3D modify commands to edit given drawing.	5.1 Working in 3D environment – Creating reference plane, creating 3D solid models of simple machine parts. 5.2 3D Commands – Extrude, Revolve, Sweep, Pattern, Draft, loft and Blend or similar commands. 5.3 Intersection of solids – Intersect two solid components by inserting new body option.
Unit- VI Assembly, Drafting & Plotting	6a. Prepare assembly drawing of given parts. 6b. Create exploded view of the given assembly. 6c. Generate 2D drawings of given part models and assembly. 6d. Plot the given drawing as per the given dimensions.	6.1 Assembly Drawing – Introduction to top down and bottom up approach of assembly. Preparation of assembly drawing by using assembly features. 6.2 Exploded view – Explode the assembly. 6.3 Working in Drafting mode - Generate orthographic projections i.e. front view, top view, side view, sectional views, isometric views, auxiliary views. 6.4 Dimensioning commands – Apply



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		dimensions. dimensional and geometrical tolerances. 6.5 Bill of material – Prepare part list table and name plate. 6.6 Page set up. Plot command.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above 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 Computer Aided Drafting	02	-	-	-	-
II	Draw and Modify Commands	03	-	-	-	-
III	Dimensioning, Text and Plot Commands	02	-	-	-	-
IV	Working in 2D environment	02	-	-	-	-
V	Part Modeling	03	-	-	-	-
VI	Assembly, Drafting & Plotting	04	-	-	-	-
Total		16	-	-	-	-

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.

This specification table also provides a general guidelines for teachers to frame internal end semester practical theory exam paper which student have to undertake on CAD workstations.

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:

- Maintain a separate folder on Computer workstation allotted, in which all above mentioned practical should be saved and will be submitted/ mailed as a part of term work.
- Collect at least one 2D/3D drawing like Production drawings, Layouts from nearby workshops/industries and develop them using computer aided drafting approach.
- Students will explain at least one problem for drafting to all batch colleagues. Teacher will assign the problem to the students.
- Assess at least one 2D/3D 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*.
- Guide student(s) in undertaking micro-projects.
- No. of practical's selection to be performed should cover all units.

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:

- 2D drawing:** Each batch will collect one or two drawings from the nearby industry/workshop and prepare a 2D drawing from it.
- 2D drawing:** Each batch will collect one or two components from the nearby industry/workshop and prepare a 2D drawing from it.
- 3D model:** Each batch will identify a small assembly from the institute workshop/laboratory. Measure the dimensions of each part and prepare sketches. Using sketches prepare 3D model of parts and assembly. Plot the assembly and detail drawings. (e.g. Bench vice, Machine vice, Tool post, Couplings, Joints, Bearings etc.)
- 3D model:** Each batch will identify a small assembly from the nearby industry. . Measure the dimensions of each part and prepare sketches. Using sketches prepare 3D model of parts and assembly. Plot the assembly and detail drawings. (e.g. Bench vice, Machine vice, Tool post. Couplings, Joints, Bearings etc ;)

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication



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
8.	CATIA V5R14 for Designers	Sham Tickoo	Softcover, Cadcim Technologies (ISBN No 1-932709-08-8)
9.	Pro/Engineer Wildfire for Designers	Sham Tickoo	Softcover, Cadcim Technologies (ISBN No 1-932709-03-7)
10.	Solid Works For Designers Release 2004	Sham Tickoo	Softcover, Cadcim Technologies (ISBN No 0-9663537-9-X)
11.	Autodesk Inventor for Designers: Release 10	Sham Tickoo	Softcover, Cadcim Technologies (ISBN No 1-932709-09-6)
12.	Engineering Analysis and Optimization using CAD software	Chougule N. K.	SCITECH publications (ISBN No 9789385983245)
13.	Solid Edge V16 for Designers	Sham Tickoo; Maini Deepak.	Softcover, Cadcim Technologies (ISBN No 1-932709-07-X)

14. SUGGESTED 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://www.solidworks.in/sw/products/3d-cad/3d-solid-modeling.htm>
- http://web.iitd.ac.in/~hegde/cad/lecture/L30_solidmod_basics.pdf
- https://en.wikipedia.org/wiki/Solid_modeling
- <http://npkauto.com/solid-modeling/>
- <https://www.youtube.com/watch?v=vjX4PDJcFOI>
- <https://www.youtube.com/watch?v=5BDHS4FN2->
- <https://www.youtube.com/watch?v=JjKs-lePIPY>



