

**Program Name** : Electrical Engineering Program Group  
**Program Code** : EE/EP/EU  
**Semester** : Fourth  
**Course Title** : Electrical Drawing and CAD  
**Course Code** : 22033

### 1. RATIONALE

The electrical technician / supervisor are called upon to draw or interpret drawings of electrical systems that include machines, control panels, power system components such as transmission and distribution systems etc. This course aims to provide hands on practice in freehand sketches; drawings using relevant tools and computer based software. The course also provides practice to read and interpret electrical engineering drawings.

### 2. COMPETENCY

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

- Use CAD software for drawing electrical circuits and components.

### 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:

- Draw symbolic representation of electrical components manually.
- Draw free hand sketches, isometric and orthographic views of electrical machines and components.
- Use CAD tools to draw simple electrical components and machines.
- Use CAD to create electrical circuits with components.
- Edit electrical line drawings and control panel layouts in CAD.

### 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	Max	Min	
-	-	4	4	--	--	--	--	--	--	50@	20	50~	20	100	40

(~): 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 paper.

### 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.

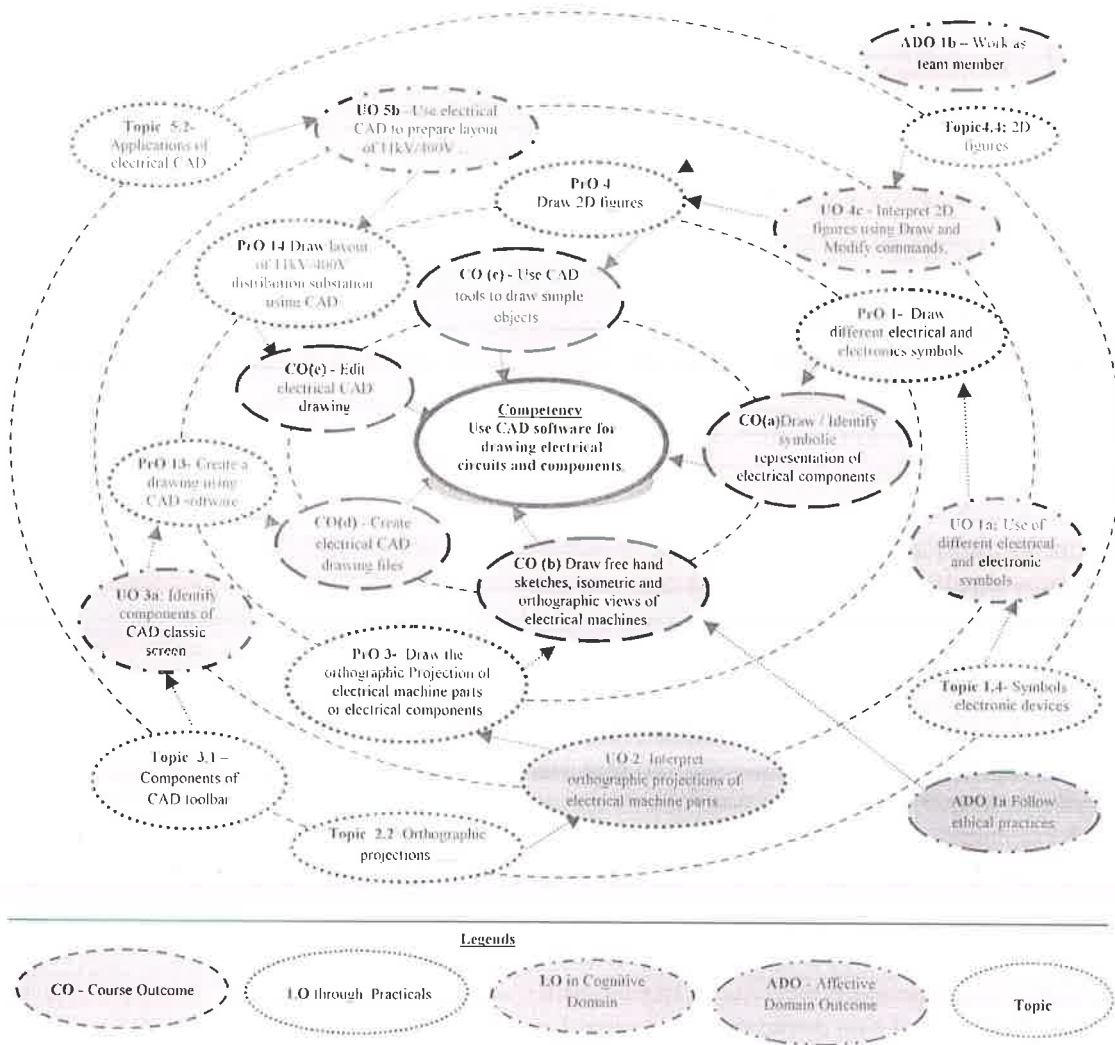


Figure 1 - Course Map

**1. 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
<b>Using Manual Drawing Tools</b>			
1	Draw different electrical (including electronics) symbols using drawing instruments as per IS: 1032 or new equivalent IS.	I*	02
2	Draw the freehand drawing of Electrical Machine parts and	II*	02
3	Draw the freehand drawing of electrical components.	II	02
4	Draw the orthographic Projection of Electrical Machine parts	II*	02
5	Draw the orthographic Projection of electrical components	II	02
6	Draw the isometric Projection of Electrical Machine parts	II*	02
7	Draw the isometric Projection of electrical components.	II	02
8	Draw labeled layout of Plate earthing.	II*	02



S. No.	Practical Outcomes (PrOs)	Unit No	Approx. Hrs. required
9	Draw labeled layout of Earth mat	II*	02
10	Draw labeled layout of Pipe earthing	II	02
<b>Using CAD software</b>			
11	Locate components of CAD classic screen by creating new drawing: CAD screen layout, drawing area, menu and toolbars, status bar	III*	02
12	Work with toolbar and commands	III*	02
13	Change the drawing limits, creating rectangle etc. saving drawing for first time.	III*	02
14	Draw a line diagram using absolute coordinate method. Use LIMITS, UNITS, LINE, ARC Commands: Absolute coordinate method	III*	02
15	Drafting set-up: units, angle, area, coordinate system, limits, grid, object snap	III*	02
16	Creating two dimensional drawings using draw commands- line and arc	III*	02
17	Draw a line diagram using relative coordinate and relative polar coordinate method. Use LIMITS, UNITS, LINE, ARC, Commands: Relative coordinate and relative polar coordinate method	III*	02
18	Draft set-up: units, angle, area, coordinate system, limits, grid, object snap	III*	02
19	Create two dimensional drawings using draw commands-line and arc.	III*	02
20	Draw a 2D figure using Draw and Modify commands. Use LINE, CIRCLE, OFFSET, TRIM, FILLET commands	III	02
21	Create two dimensional drawings using draw commands- line and circle	III	02
22	Modify two dimensional drawings using modify commands- offset, trim, fillet	III	02
23	Draw a 2D figure using Draw and Modify commands. Use LINE, ARC, POLYGON, ELLIPSE, COPY, MIRROR, TRIM, ROTATE, CHAMFER commands:	III	02
24	Create two dimensional drawings using draw commands- line, arc, polygon, ellipse.	III	02
25	Modify two dimensional drawings using modify commands- copy, mirror, trim, rotate, chamfer.	III	02
26	Draw isometric drawing of electrical machine. Use LIMITS, UNITS, ZOOM, GRID, SNAP, LINE, COPY, ISOPLANE, ELLIPSE, TRIM, ERASE, PROPERTIES, SAVE commands.	IV*	02
27	Draft set-up: units, limits, zoom, grid, object snap, ortho mode	IV*	02
28	Snap and grid- snap spacing, grid spacing, isometric snap type	IV	02
29	Create a simple drawing using electrical CAD software for the given electrical circuit diagram.	IV*	02
30	Create a simple drawing using electrical CAD software for the given electrical circuit diagram.	IV	02
31	Modify the given electrical CAD drawings as per requirement.	IV	02



S. No.	Practical Outcomes (PrOs)	Unit No	Approx. Hrs. required
	I		
32	Modify the given electrical CAD drawings as per requirement. Part II	IV	02
33	Draw the layout of the 11 kV/400 V distribution substation using electrical CAD software.	IV*	02
	<b>Total</b>	-	<b>66</b>

**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.
- i. 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	Plan the drawing.	20
2	Select relevant drawing / software tools.	20
3	Drawing skills judged by neatness and correctness.	20
4	Timely submission.	20
5	Answer to sample questions.	20
	<b>Total</b>	<b>100</b>

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. Practice good housekeeping.
- b. Demonstrate working as a leader/a team member.
- c. Maintain tools and equipment.
- d. 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 1<sup>st</sup> year
- 'Organising Level' in 2<sup>nd</sup> year
- 'Characterising Level' in 3<sup>rd</sup> year.

**2. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED**

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





S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Half imperial drawing boards.	1 to 5
2	Manual drawing tools: mini drafter, set squares protractor, compasses, and black lead pencil of hardness 'H'.	1 to 5
3	Any electrical CAD software.	6 to 14

### 8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Major Learning Outcomes (in cognitive domain)	Topics/sub-topics
<b>Unit – I Symbolic representation of electrical components.</b>	1a. Sketch the symbols of the given type of electric lamps. 1b. Sketch the symbols of the given type of electric wiring accessories. 1c. Sketch the symbols of the given type of electric machines, 1d. Sketch the symbols of the given type of electronic lamps.	<b>1.1.</b> Symbols: electrical lamps. <b>1.2.</b> Symbols: wiring accessories. <b>1.3.</b> Symbols: electrical machines. <b>1.4.</b> Symbols: electronic devices.
<b>Unit – II Free hand sketches, isometric and orthographic views.</b>	2a. Interpret freehand sketches of the given Electrical Machine parts 2b. Interpret freehand sketches of the given electrical components. 2c. Interpret orthographic Projection of the given Electrical Machine parts or electrical components. 2d. Interpret the isometric Projections of the given Electrical Machine parts or electrical components.	2.1. Need for free hand sketching with its importance. 2.2. Orthographic projections simple parts. 2.3. Isometric projections of simple parts.
<b>Unit- III CAD tools.</b>	3a. Identify the function of the given components of CAD classic screen. 3b. Identify the given components of CAD screen. 3c. Identify the given toolbar and commands.	<b>3.1.</b> Components of CAD classic screen <b>3.2.</b> Menu bar and status bar. <b>3.3.</b> CAD tool bar.
<b>Unit- IV Simple drawings in CAD.</b>	4a. Interpret the given line diagram using absolute coordinate method. 4b. Interpret the given line diagram using relative coordinate and relative polar coordinate method. 4c. Interpret the given 2D figures 4d. Interpret the given isometric drawing of electrical machine in	4.1 Absolute Coordinate Method: Commands: LIMITS, UNITS, LINE and ARC. 4.2 Relative coordinate Method: 4.3 Commands: LIMITS, UNITS, LINE and ARC. 4.4 Relative polar coordinate method: Commands: LIMITS, UNITS, LINE



	CAD.	and ARC. 4.5 2D figures: Commands: LINE, CIRCLE, OFFSET, TRIM, FILLET, ARC, POLYGON, ELLIPSE, COPY, MIRROR, TRIM, ROTATE and CHAMFER 4.6 Isometric drawings: commands: LIMITS, UNITS, ZOOM, GID, SNAP, LINE, COPY, ISOPLANE, ELLIPSE, TRIM, ERASE, PROPERTIES and SAVE.
<b>Unit- V Electrical drawings in CAD.</b>	4a. Interpret the given CAD electrical circuit diagram. 4b. Interpret the given CAD electrical layout of the 11 kV/400 V distribution substation. 4c. Interpret the given CAD layouts of two types of earthing systems.	5.1 Applications of electrical CAD software to: Draw electrical circuit diagrams. 5.2 Applications of electrical CAD software to: Draw layouts of substations. 5.3 Applications of electrical CAD software to: Draw layouts of earthing systems.

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

- Not Applicable -

## 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:

- Collect information on different available electrical CAD software.
- Read at least three different electrical drawings other than those covered in the practicals above.

## 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.
- Correlate subtopics with power system utility and electrical equipments.
- Use proper equivalent analogy to explain different concepts.



## 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 electric motors and using CAD software prepare drawings. The figures should be labeled and dimensioned using software.
- b. **2D Electric Machine Components:** Each batch will identify electric machine components and using CAD software and prepare drawings. The figures should be labeled and dimensioned using software.
- c. **3D Transmission:** Each batch will identify fasteners, couplings; joints used in electric machines and using CAD software and prepare isometric drawings. The figures should be labeled and dimensioned using software.
- d. **3D Electric Machine components:** Each batch will identify electric machine components and using CAD software and prepare isometric drawings. The figures should be labeled and dimensioned using software.
- e. **Digital Drawings:** Each batch will identify manual drawings of electric machine components using CAD software and create digital drawings using relevant software

## 13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Electrical Engineering Drawing	Bhattacharya, S. K.	New Age International, New Delhi, 2005, ISBN:81-224-0855-9
2.	Electrical Drawing	Narang, K. L.	Satyaprakashan, New Delhi, 2015 ISBN: 81-7684-150-1
3.	Electrical Drawing	Singh, Surjeet	SK Kataria and Sons, New Delhi, ISBN: 8177000454
4.	AutoCAD 2016 exercise workbook for windows	Shrock, Cheryl R. and Heather, Steve,	Industrial Press Inc. South Norwalk, USA, First, 2016 ISBN:978-0-8311-3518-8
5.	Computer Aided Electrical Drawing	Yogesh, M., Nagaraja, B. S., Nandan, N.	PHI Learning Pvt. Ltd., Delhi:110092 ISBN:978-81-203-4953-7
6.	Engineering Drawing with introduction to AutoCAD	Jolhe, Dhananjay A,	McGraw-Hill Co. Ltd., New Delhi, 2nd, 2008; ISBN:978-0-07-064837-1



S. No.	Title of Book	Author	Publication
7.	AutoCAD 2016 and AutoCAD LT 2016	Gladfelter. Donnie,	John Wiley and Sons. Inc. Indiana. 2016. ISBN:978-1-119-05955-4

#### 14. SUGGESTED SOFTWARE/LEARNING WEBSITES

- a. [www.mycadsite.com/tutorials/level\\_3/isometric-drawing-in-autocad-3-2.htm](http://www.mycadsite.com/tutorials/level_3/isometric-drawing-in-autocad-3-2.htm) accessed on 27<sup>th</sup> June, 2016
- b. [www.cadlearning.com/courses/autocad-mechanical-training-tutorials/](http://www.cadlearning.com/courses/autocad-mechanical-training-tutorials/), accessed on 27<sup>th</sup> June. 2016
- c. [www.staff.city.ac.uk/~ra600/ME1105/Tutorials/CAD-1/Tutorial%20CAD-1a.pdf](http://www.staff.city.ac.uk/~ra600/ME1105/Tutorials/CAD-1/Tutorial%20CAD-1a.pdf), accessed on 28<sup>th</sup> June, 2016
- d. [www.youtube.com/watch?v=yruPUj\\_61bw](http://www.youtube.com/watch?v=yruPUj_61bw), , accessed on 29<sup>th</sup> June, 2016
- e. [www.youtube.com/watch?v=Nv8skZZcUlw](http://www.youtube.com/watch?v=Nv8skZZcUlw), accessed on 29<sup>th</sup> June, 2016
- f. [www.youtube.com/watch?v=Lz6piHlBn7g](http://www.youtube.com/watch?v=Lz6piHlBn7g), accessed on 30<sup>th</sup> June, 2016

