Ref No:

< Sri Krishna Institute of Technology, Bengaluru>

COURSE PLAN

Academic Year 2019-2020

Program:	B E – Electrical & Electronics Engineering
Semester :	6
Course Code:	17EE651
Course Title:	Computer Aided Electrical Drawing
Credit / L-T-P:	3 / 3-0-0
Total Contact Hours:	40
Course Plan Author:	AVINASH S

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Note : Remove “Table of Content” before including in CP Book
Each Course Plan shall be printed and made into a book with cover page
Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	EE
Semester:	6	Academic Year:	2019-20
Course Title:	CAED	Course Code:	17EE651
Credit / L-T-P:	3 / 3-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	40 Hours	SEE Marks:	60 Marks
CIA Marks:	40 Marks	Assignment	1 / Module
Course Plan Author:	Avinash S	Sign ..	Dt:
Checked By:		Sign ..	Dt:
CO Targets	CIA Target : 100 %	SEE Target:	100 %

Note: Define CIA and SEE % targets based on previous performance.

2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute. Identify 2 concepts per module as in G.

Module	Content	Teaching Hours	Identified Module Concepts	Blooms Learning Levels
1	**Winding Diagrams:** (a) Developed Winding Diagrams of D.C. Machines: Simplex Double Layer Lap and Wave Windings. (b) Developed Winding Diagrams of A.C. Machines: (c)Integral and Fractional Slot Double Layer Three Phase Lap and Wave Windings. (d) Single Layer Windings – Un-Bifurcated 2 and 3 Tier Windings, Mush Windings, Bifurcated 3 Tier Windings.	10	- DC Armature winding, - AC Armature winding	Understand L2, Apply L3
2	**Single Line Diagrams:** Single Line Diagrams of Generating Stations and Substations Covering Incoming Circuits, Outgoing Circuits, Busbar Arrangements (Single, Sectionalised Single, Main and Transfer, Double Bus Double Breaker, Sectionalised Double Bus, One and a Half Circuit Breaker Arrangement, Ring Main),Power Transformers, Circuit Breakers, Isolators, Earthing Switches, Instrument Transformers, Surge or Lightning Arresters, Communication Devices (PowerLine Carrier) and Line Trap	10	- Generating stations & Substations.	Understand L2, Apply L3, Analyze L4
3	**Electrical Machine Assembly Drawings Using Design Data, Sketches or Both:** Transformers - Sectional Views Of Single And Three Phase Core And Shell Type Transformers	10	- Types of single and Three phase transformers, -Sectional Views, -voltage levels.	Understand L2, Apply L3, Analyze L4
4	**Electrical Machine Assembly Drawings Using Design Data, Sketches or Both:** D.C. Machine - Sectional Views of Yoke with Poles, Armature and Commutator dealt separately.	10	- Interior construction, - Sketches & Placements	Understand L2, Apply L3, Analyze L4
5	**Electrical Machine Assembly Drawings Using Design Data, Sketches or Both:** Alternator – Sectional Views of Stator and Rotor dealt separately	10	- Interior construction, - Sketches & Placements	Understand L2, Apply L3, Analyze L4
-	**Total**	**50**	-	-

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes
2. Design: Simulation and design tools used – software tools used ; Free / open source
3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modul	Details	Chapters	Availability

es		in book	
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	**-**	**-**
1,2,3,4,5	Computer Aided Electrical Drawing, M.Yogesh, B S Nagaraja, N Nandan, Ashoke K Ghosh, PHI learning Pvt Ltd, 2014		In Lib / in Dept
1,2,3,4,5	Computer Aided Electrical Drawing, uLektz, uLektz Learning Solutions Private Limited.		Not Available
1,2,3,4,5	CAD for Electrical Engineers, Dr.Indira, V D Sankarlal & D Beula, 2nd, Sanguine Technical Publishers, 2015		n Lib / in Dept
1,2,3,4,5	Computer Aided Electrical Drawing, Panel Of Experts		Not Available
B	**Reference books (Title, Authors, Edition, Publisher, Year.)**	**-**	**-**
1, 2	A course in Electrical Machine design, A. K. Sawhney, Dhanpat Rai 6th Edition, 2013		In Lib / in Dept
1, 2	Electrical Engineering Drawing K. L. Narang Satya Prakashan 2014		Not Available
	"Electrical Machine Design" , M.V. Deshpande, Third Edition, ,PHI Learning Pvt Ltd2009.		Not Available
C	**Concept Videos or Simulation for Understanding**	**-**	**-**
C1	Design of DC Winding https://www.youtube.com/watch?v=moF2y87Gdlk https://www.youtube.com/watch?v=EZjpNooSXIo https://www.youtube.com/watch?v=X1TTGjNgyrg		
C1	Design of AC Winding https://www.youtube.com/watch?v=PII4pz7ohpA https://www.youtube.com/watch?v=OONCU5QbDpU		
C2	Study of Substation equipments https://www.youtube.com/watch?v=diKm2vHzQ_A		
C2	Sketch of Station layouts https://www.youtube.com/watch?v=huKkzrJPFU4		
C3	Design of Single phase Transformer https://www.youtube.com/watch?v=XOgPqtLy1Sk https://www.youtube.com/watch?v=X85MbtWodFQ		
C3	Design of Three phase Transformer https://www.youtube.com/watch?v=nF9FF7220dM https://www.youtube.com/watch?v=X85MbtWodFQ&t=23s		
C3	Study of Sectional views https://www.youtube.com/watch?v=Wf7Ckmzb5A8		
C3	Design of DC machine https://www.youtube.com/watch?v=oI-O9FCDqmg https://www.youtube.com/watch?v=hTjfg4lt9zo https://www.youtube.com/watch?v=rgP0aMth7LM		
C3	Study of Sectional views https://www.youtube.com/watch?v=Wf7Ckmzb5A8		
C3	Design of Alternator https://www.youtube.com/watch?v=tiKH48EMgKE		
D	**Software Tools for Design**	**-**	**-**
	AutoCAD		
E	**Recent Developments for Research**	**-**	**-**
F	**Others (Web, Video, Simulation, Notes etc.)**	**-**	**-**
1	https://www.youtube.com/watch?v=CSnTL9ndyis		
2	https://www.youtube.com/watch?v=wex3ZenASl0 https://docs.google.com/viewer?a=v&pid=sites&srcid=Y21yaXQuYWMuaW58a2FzaGlmYWhtZWR8Z3g6N2YwMjA5YzdmNzEzMGE5MQ		

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.
Students must have learnt the following Courses / Topics with described Content . . .

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
3,4&5	15EE15/25	Basic Electrical Engineering	DC machine, Alternator and Transformer/ knowledge of construction	1st / 2nd	A Seminar on DC machine, Transformer and Alternator	Understand L2
3	15EE33	Transformers and Generators	Single and Three phase Transformer / Knowledge on Types of transformers	3rd	A Seminar on DC machine, Transformer and Alternator	Understand L2

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.
Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level
1	AC & DC Windings / Knowledge on Armature winding	Placements & Gate	A seminar on Winding terminologies	Apply L3
2	Substation / Knowledge on Different sub-stations and their operations	Placements	A seminar on substations	Analyze L4
3	Transformers / Knowledge on design of Transformers and their specifications and voltage levels and insulation	Placements & Gate	A seminar on Transformers	Analyze L4
4	DC machines / Knowledge on design of DC machine and their specifications	Placements & Gate	A seminar on DC machines	Analyze L4
5	Alternators / Knowledge on design of Alternators and their specifications	Placements & Gate	A seminar on Alternators	Analyze L4

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

Modules	Course Code.#	Course Outcome **At the end of the course, student should be able to . . .**	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
1	17EE651.1	Interpret the notations and formulas required and design the winding diagrams of AC and DC machines.	5	DC Winding	Lecture /PPT	Assignment & Unit Test	Apply L3
1	17EE651.1	Interpret the notations and formulas required and design the winding diagrams of AC and DC machines.	5	AC Winding	Lecture /PPT/ Hands On	Assignment & Unit Test	Apply L3
2	17EE651.2	Develop a layout for substation using the standard symbols for	4	Substation equipment	Lecture /PPT/	Assignment &	Analyze L4

		substation equipment		s	Hands On	Unit Test	
2	17EE651.2	Develop a layout for substation using the standard symbols for substation equipment	6	Station layouts	Lecture / PPT/Hands On	Assignment & Unit Test	Analyze L4
3	17EE651.3	Talk about and development of sectional views of Transformers, DC machines, Alternators and its parts using the design data, sketches.	5	Single phase Transformer	Lecture / PPT/Hands On	Assignment & Unit Test	Analyze L4
3	17EE651.3	Talk about and development of sectional views of Transformers, DC machines, Alternators and its parts using the design data, sketches.	5	Three phase Transformer	Lecture / PPT/Hands On	Assignment & Unit Test	Analyze L4
4	17EE651.3	Talk about and development of sectional views of Transformers, DC machines, Alternators and its parts using the design data, sketches.	4	Sectional views	Lecture / PPT	Assignment & Unit Test	Apply L3
4	17EE651.3	Talk about and development of sectional views of Transformers, DC machines, Alternators and its parts using the design data, sketches.	6	DC machine	Lecture / PPT/Hands On	Assignment & Unit Test	Analyze L4
5	17EE651.3	Talk about and development of sectional views of Transformers, DC machines, Alternators and its parts using the design data, sketches.	4	Sectional views	Lecture / PPT	Assignment & Unit Test	Apply L3
5	17EE651.13	Talk about and development of sectional views of Transformers, DC machines, Alternators and its parts using the design data, sketches.	6	Alternator	Lecture / PPT/Hands On	Assignment & Unit Test	Analyze L4
-	**-**	**Total**	**50**	**-**	**-**	**-**	**L3-L4**

2. Course Applications

Write 1 or 2 applications per CO.
Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	Winding diagrams are used to design DC armature and field windings, where good speed regulation is needed with varying loads, such as grinding machines and lathes.	CO1	L4
1	In automotive, hoists, lifts and cranes as it has a high starting torque. They are mainly used for heavy industrial applications and for machine tools. In automotive applications for electric and hybrid electric vehicles.	CO1	L4
2	Used for protection against abnormal conditions and helps for Transmission and Distribution purpose.	CO2	L3
2	Single line diagrams are useful in planning a substation layout. It serves as protection hub of the transmission system. It assists in determining energy transfer with help of transmission lines.	CO2	L3

3	The main application of Transformer is to Step up (Increase) or Step down (Decrease) the level of Voltage in substations and industries. They operate as a step-down voltage transformer and decrease the home voltage value to the value suitable for electronics supplying.	CO3	L4
3	Three Phase transformers are widely used as Power transformers, Distribution transformers and in Electrical Grids	CO3	L4
4	Used to show interior detail that is too complicated to be shown clearly and dimensioned by the traditional orthographic views and hidden lines.	CO3	L3
4	Used in Traction system, Cranes, air compressors, Vaccum Cleaner, Sewing machine, Lathe Machines, Centrifugal Pumps, Fans, Blowers, Conveyors, Lifts, Weaving Machine, Spinning machines. Used as a supply source of DC motors and to charge the battery and Providing excitation to the alternators	CO3	L4
5	Used to show interior detail that is too complicated to be shown clearly and dimensioned by the traditional orthographic views and hidden lines.	CO3	L3
5	One of the most important application of synchronous machines is to generate electric power at power station. Synchronous motors are also used in paper mills, refineries and numerous other applications	CO3	L4

3. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Course Outcomes	Program Outcomes														-
Modules	CO.#	**At the end of the course student should be able to . . .**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	17EE651.1	Interpret the notations and formulas required and design the winding diagrams of AC and DC machines.	3	2	3	-	3	-	-	-	-	-	-	-	2	3	-	L3
1	17EE651.2	Develop a layout for substation using the standard symbols for substation equipment	3	3	3	-	3	-	-	-	-	-	-	-	2	3	2	L4
2	17EE651.3	Talk about and development of sectional views of Transformers, DC machines, Alternators and its parts using the design data, sketches.	3	3	3	-	3	-	-	-	-	-	-	-	2	3	-	L4
-	**EE651PC**	**Average attainment (1, 2, or 3)**																**-**
-	*PO, PSO*	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design*															

4. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1	Substations	Seminar		Mr Avinash S, SKIT	PO1, PO2,PO3 and PO5
2	Winding terminologies	Seminar		Mr Avinash S, SKIT	PO1, PO2,PO3 and PO5
5	Alternators	Seminar		Mr Avinash S, SKIT	PO1, PO2,PO3 and PO5

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Modules	Title	Teach. Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Winding Diagrams	10	1	-	-	1	1	2	CO1, CO1	L3
2	Single Line Diagrams	10	1	-	-	1	1	1	CO2, CO2	L4
3	Electrical Machine Assembly Drawings Using Design Data, Sketches or Both (Transformer)	10	-	1	-	1	1	1	CO3, CO3	L4
4	Electrical Machine Assembly Drawings Using Design Data, Sketches or Both (DC Machine)	10	-	1	1	1	1	1	CO3, C03	L4
5	Electrical Machine Assembly Drawings Using Design Data, Sketches or Both (Alternator)	10	-	-	1	1	1	1	CO3, CO3	,L4
-	**Total**	**50**	**2**	**2**	**2**	**5**	**5**	**6**	**-**	**-**

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Modules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam – 1	30	CO1, CO1, CO2,CO2	L4,L4,L3,L3
3, 4	CIA Exam – 2	30	CO3, CO3, CO3, CO3	L4,L4,L3,L4
5	CIA Exam – 3	30	CO3, CO3	L3,L2
1, 2	Assignment - 1	10	CO1, CO1, CO2,CO2	L4,L4,L3,L3
3, 4	Assignment - 2	10	CO3, CO3, CO3, CO3	L4,L4,L3,L4
5	Assignment - 3	10	CO3, CO3	L3,L2
	Final CIA Marks	**40**	**-**	**-**

D1. TEACHING PLAN - 1

Module - 1

Title:	Winding Diagrams	Appr Time:	12 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Interpret the notations and formulas required and design the winding diagrams of AC and DC machines.	CO1	L3
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
1	Winding Diagrams introduction	CO1	L2
2	Developed Winding Diagrams of D.C. Machines	CO1	L3
3	Simplex Double Layer Lap Windings	CO1	L3
4	Simplex Double Layer Wave Windings	CO1	L3
5	Dummy coil problem on wave winding	CO1	L3
6	Developed Winding Diagrams of A.C. Machines	CO1	L2

7	Integral and Fractional Slot Double Layer Three Phase Lap	CO1	L3
8	Wave Windings	CO1	L3
9	Single Layer Windings – Un-Bifurcated 2 and 3 Tier Windings	CO1	L3
10	Mush Windings, Bifurcated 3 Tier Windings	CO1	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Design DC windings	CO1	L3
2	Design AC windings	CO1	L3
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Draw the armature winding of a DC machine with 4 poles, 14 slots, double layer progressive lap show the position of brush & direction of induced emf. Draw the sequence diagram	CO1	L3
2	Develop a double layer winding for a DC machine having 16 slots and 4 poles. Mark the poles. Draw the sequence diagram. Indicate the position of the brushes; show the direction of induced emf give equalizer connection	CO1	L3
3	Draw the developed diagram of a DC machine with the following details. no of poles =4, no of slots=26 the winding is double layer lap type, fix the poles draw the sequence diagram ,fix the position of polarity of the brush	CO1	L3
4	Design & draw the developed double layer lap winding of DC armature with 24 conductor and 4 poles. Also show the direction current in the coils and brush position. Draw the sequence diagram.	CO1	L3
5	Draw the developed winding diagram of a six pole eighteen armature slots double layer full pitch lap wound DC generator fix the poles. Draw the sequence diagram. fix the position and polarity of brushes. Mark the direction of rotation of armature.	CO1	L3
6	Draw the developed winding diagram of a 4 pole 15 slots double layer lap wound DC generator; show the position and polarity of brush by sequence diagram	CO1	L3
7	Design and draw a duplex winding diagram of a Dc machine with 32 conductors and 4 poles. Draw the sequence diagram. Fix the position and polarity of brushes.	CO1	L3
8	Design and draw a wave winding (progressive) for an armature with 34 conductors accommodated 17 slots, Draw the sequence diagram show position of brush, direction of current etc.	CO1	L3
9	Draw the simplex retrogressive wave winding with a 4 pole DC machine having 42 armature conductors, 21 slots. The winding is double layer. Draw the sequence diagram show position of brush, direction of current etc	CO1	L3
10	Draw the developed winding diagram of the armature of the DC machine with the following data. Number of poles=4, Number of Slots=12,Type of winding: Simplex wave	CO1	L3
11	Design and draw a wave winding (progressive) for an armature with 36 conductors accommodated in 18 slots, Draw the sequence diagram show position of brush, direction of current etc	CO1	L3
12	Design and draw Developed duplex Winding Diagram for a 16 slots, double layer, 4-pole, Progressive lap winding. Draw the sequence diagram	CO1	L3
13	Design and draw Developed Winding Diagram for a 18 slots, 36 conductors, double layer, 4-pole, duplex DC Progressive WAVE winding	CO1	L3
14	Design and draw Developed duplex Winding Diagram for a 16 slots, double layer, 4-pole, Retrogressive lap winding. Draw the sequence diagram	CO1	L3
15	Design and draw Developed Winding Diagram for a 23 slots, 46 conductors, double layer, 6-pole, duplex DC Progressive WAVE winding	CO1	L3
16	Design and draw Developed duplex Winding Diagram for a 18 slots, double layer, 4-pole, Progressive lap winding. Draw the sequence diagram	CO1	L3
17	Design and draw Developed Winding Diagram for a 23 slots, 46 conductors, double layer, 6-pole, duplex DC retrogressive WAVE winding.	CO1	L3
18	Draw the developed winding diagram for an AC machine with following	CO1	L3

	details: a) Poles = 4 b) phases= 3 c) Slots =24 d) winding = single coil short pitched by one slot lap winding star connected		
19	Draw the developed winding diagram of a 3 phase induction motor, which have 18 slots 2 poles, winding is chorded by 2 slots, double layer lap delta connection	CO1	L3
20	Design and draw the developed winding diagram for an alternator with following details No. of poles =2 No. of phase =3 No .of slots =15 Winding = double layer, lap short pitched by one slot	CO1	L3
21	Draw the developed winding diagram for an diagram for AC three phase rotating machine with the following details 4 poles, 36 slots each slots contains one coil side lap winding connected in star& bring out the details as A,B,C & N winding be full pitched	CO1	L3
22	Draw a developed winding diagram for an AC machine having 24 slots, one conductor per slots 4 poles & delta connected	CO1	L3
23	Design and draw developed winding diagram of an AC machine with following details: No of poles= 4 No of slots= 36 No. of phase=3 Single layer lap, star connected	CO1	L3
24	Design and draw developed 3 phase full pitched AC lap winding for 24 conductor, double layer, 4poles, also show winding in star connection	CO1	L3
25	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots= 36 full pitch lap winding double layer and delta connected.	CO1	L3
26	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots = 24 full pitch wave winding	CO1	L3
27	Design and draw the developed winding diagram of an AC motor having the following details. No. of phase= 3 No. of slots = 12 No. of poles = 4 double layer full pitch wave with star connections.	CO1	L3
28	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots = 24 wave winding chorded by one slot	CO1	L3
29	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots = 24 Un-bifurcated winding in 2 tiers.	CO1	L3
30	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 6 No. of slots = 36 Unbifurcated winding in 2 tiers	CO1	L3
31	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots = 24 mush winding.	CO1	L3
32	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots = 24 single layer bifurcated winding arranged in 3 tiers.	CO1	L3
33	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots = 36 mush winding.	CO1	L3
34	Draw the developed winding diagram of an 3 phase induction motor, which have 18 slots 6 poles,2 coil sides / slot , full pitch, star connected lap winding.	CO1	L3
35	Draw the developed winding diagram for an AC machine with following details: a) Poles = 4 b) Phases = 3 c) Slots =36 d) Double layer, short pitched by one slot, lap winding star connected.	CO1	L3
36	Draw the developed winding diagram for an AC machine with following details: a) Poles = 4 b) Phases = 3 c) Slots =21 d) Double layer, lap winding star connected.	CO1	L3
37	Draw the developed winding diagram for an AC machine with following details: a) Poles = 4 b) Phase= 3 c) Slots =30 d) double layer, lap winding star connected.	CO1	L3
38	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots = 24 full pitch wave winding.	CO1	L3

e	**Experiences**	-	-
1			

Module – 2

Title:	Single Line Diagrams	Appr Time:	7 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Develop a layout for substation using the standard symbols for substation equipment	CO2	L4
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
13	Itroduction , Power Transformers, Circuit Breakers, Isolators	CO2	L2
14	Earthing Switches, Instrument Transformers	CO2	L2
15	Surge or Lightning Arresters	CO2	L2
16	Communication Devices (Power Line Carrier) and Line Trap.	CO2	L2
17	Main and Transfer Double Bus Double Breaker	CO2	L2
18	Single Line Diagrams of Substations Covering Incoming Circuits	CO2	L3
19	Single Line Diagrams of Outgoing Circuits.	CO2	L3
18	Busbar Arrangements -Single, Sectionalized Single bus	CO2	L3
19	Sectionalized Double Bus, One and a Half Circuit Breaker Arrangement, Ring Main	CO2	L3
20	Single Line Diagrams: Single Line Diagrams of Generating Stations	CO2	L4
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Substation Equipments	CO2	L4
2	Layout of Substation and generating station	CO2	L4
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Draw a single line Diagram of connections of hydroelectric station having the following equipment a. Alternators: 12MVA, 3Φ, 50 Hz, 11KV, Y-connected, Five. b. Step-up transformers: 5000 KVA, 3Φ, 50 Hz, 11/110KV, Δ/Y-connected, Five. c. Bus: 110 KV double bus with bus coupler. d. Outgoing transmission lines:110KV,two e. Station Auxiliary Tranformers:750 KVA , 3, 50 Hz ,11KV Δ/Y.Two f. Also indicate positions of CT, PT, Isolating Switches, Lightning arrestors, Circuit Breakers.	CO2	L4
2	Draw a single line diagram of a 66KV MUSS with the following details. a. 66KV incoming lines, 2 nos b. Step down transformer 66KV/11KV ,2 nos c. OCB's for transformer bank on L.T side – 2 nos d. Duplicate bus bars for H.T and L.T side to be provided e. Bus couplers for HT side only f. Feeders, 11 KV radiating from L.T bus bars 4 nos g. L.T circuit breakers for feeders-4nos h. Position of lightning arrestors, isolators, CT's and PT's are to be indicated.	CO2	L4
3	Draw the single line diagram of a generating station having the following details a. Generators :50MVA,11KV,3Φ.-Two nos b. Transformers: 50MVA, 11/132KV, 3Φ. –Two nos c. Transformers(auxiliary):500 KVA , 11000/400 V. – 2 nos d. Transformers(reverse) : 1 MVA , 132/11 KV , 1 no e. Outgoing lines: 132 KV, 3Φ. 2 nos	CO2	L4

	f. Also indicate positions of CT, PT, Isolating Switches, lightning Arrestors, Circuit Breakers.		
4	Draw the single line diagram of a generating station having the following equipment. a. Incoming lines : 110 KV , 50 Hz. – 2nos b. Outgoing lines: 110KV,50 Hz. -1 no 60KV, 50 Hz. -1 no 11KV, 50 Hz. -1 c. Transformers: 15MVA, 110/66KV, 3Φ, Y- . -2nos 10MVA,110/11KV,3Φ,Y/Y.-1no 3 MVA, 11/400 KV, 3Φ, Y/Y. -1 no d. Bus Bars : 110 KV.-2nos 66 KV. -1 no 11 KV.- 1no 400 KV. – 1 no Show the positions of CT , PT , Isolating Switches , Lightning arrestors , Circuit Breakers.	CO2	L4
5	Draw the single line diagram of a generating station having the following equipment. a. Incoming lines : 110 KV , 50 Hz. – 2nos b. Outgoing lines: 110KV,50 Hz. -1 no 11KV, 50 Hz. -8 nos c. Transformers: 5MVA,110/11KV ,3Φ, - . -2nos 15MVA, 110/220KV,3Φ, - .-1no 500 MVA, 11/400 KV, 3Φ, /Y. -1 no. One Auxiliary station Transformers	CO2	L4
6	Draw the single line diagram of a generating station having the following equipment. a. Incoming lines: 110 KV, 50 Hz. – 1 no b. Outgoing lines: 13.2 KV,50 Hz. -3 nos 11KV, 50 Hz. -4 nos c. Transformers: 15MVA,110/13.2KV ,3Φ, Δ/ Y. -1no 8 MVA,110/11KV,3Φ,Δ/Y.-1no d. Auxiliary Station transformer : 750 KVA , 11 KV/400 V , Δ/Y.-1no e. Bus Bars : 110 KV.-1no 11 KV.- 1no Show the positions of CT, PT, Isolating Switches , Lightning arrestors , Circuit Breakers.	CO2	L4
7	Draw the single line diagram of a substation having the following equipment. a. Incoming lines : 11KV , 50 Hz. – 2 nos b. Outgoing lines : 33 KV , 50 Hz.-- 4 nos c. Transformer: 11/33 KV, 3Φ , Y- . 2 nos d. Bus bars :11 KV , 1 no 33 KV, 2 nos Show the positions of CT, PT, Isolating Switches, Lightning arrestors, circuit breakers.	CO2	L4
8	Draw the single line diagram of a 66 KV sub-station indicating a bus coupler, and also mentioning all major parts and equipments.	CO2	L4
9	Draw the single line diagram of a typical substation with the data of the equipment given below: a. Two incoming lines 110 KV b. Two transformers of 110/11KV c. Double bus bars for high tension and low tension sides have to indicated d. Bus couplers on the high tension side only. e. Feeders of 11KV at low tension side total no=6. In appropriate position indicate lightning arrestors, CT , PT , earthing switches , wave traps and coupling . Condensers at incoming lines and station auxiliary transformers of 11 KV/415 V.	CO2	L4
10	Draw a neat Single line diagram for a 110KV/11KV MUSS with following details:	CO2	L4

	a. 110 KV incoming lines. – 2 nos b. Line O.C.B 110KV.-2nos c. Transformer stepdown 110KV/11KV. – 2 nos d. Lowtension O.C.B for transformer : 2 nos e. Duplicate bus bars on HT & LT sides to be indicated. f. Bus Coupler on H.T side only. g. Feeders 11 KV at LT bus :6 nos h. Station supply transformer 11 KV / 415 V to be shown at Low tension side. i. Low tension circuit breakers for feeders : 6 nos j. In appropriate positions indicate Lightning arrestors , P.T's & C.T's.		
11	Draw the single line diagram of a 33KV/11 KV substation with necessary equipments.	CO2	L4
12	Draw a single line diagram (SLD) of a generating station having the following details. a. Generators: 50 MVA , 11 KV , 3Φ, 2 nos. b. Transformers: 50 MVA , 11/132kV , 3Φ, 2 nos. c. HT bus bar in 2 sections d. LT bus bar in 2 sections e. Auxiliary Transfomers:500kVA , 11kV/400V , 1 no. f. Outgoing lines:132kV,3Φ,4nos Indicate positions of CBs , Isolating switches , lightning Arrestors, Instrument transformers etc.	CO2	L4
13	Draw a neat single line diagram , for a 110/11kV Main Unit Sub Station (MUSS) with the following details : a. Duplicate incoming lines 110 kV b. Transformer step-down 110/11 kV – 2 nos c. Duplicate bus-bars on H T and LT Sides d. Station supply Transformer 11kV/415V e. Feeder 11kV at LT bus:6 nos f. Earth switch, Wave traps and coupling condensers are to be provided at incoming lines. Also indicate the position of CTs , PTs , isolators and LAs	CO2	L4
e	**Experiences**	-	-
1			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	17EE651	Sem:	VI	Marks:	30	Time:	75 minutes		
Course:	CAED								
-	**-**	**Note: Answer all questions, each carry equal marks. Module : 1, 2**					**Marks**	**CO**	**Level**
1		Draw a single line diagram of a 66KV MUSS with the following details. a. 66KV incoming lines, 2 nos b. Step down transformer 66KV/11KV ,2 nos c. OCB's for transformer bank on L.T side – 2 nos d. Duplicate bus bars for H.T and L.T side to be provided e. Bus couplers for HT side only f. Feeders, 11 KV radiating from L.T bus bars 4 nos g. L.T circuit breakers for feeders-4nos h. Position of lightning arrestors, isolators, CT's and PT's are to be indicated.						10	CO2	L4
		OR							
2		Draw the single line diagram of a generating station having the following details a. Generators :50MVA,11KV,3Φ.-Two nos b. Transformers: 50MVA, 11/132KV, 3Φ. –Two nos c. Transformers(auxiliary):500 KVA , 11000/400 V. – 2 nos d. Transformers(reverse) : 1 MVA , 132/11 KV , 1 no						10	CO2	L4

	e. Outgoing lines: 132 KV, 3Φ. 2 nos f. Also indicate positions of CT, PT, Isolating Switches, lightning Arrestors, Circuit Breakers.			
3	Draw a developed winding diagram for an AC machine having 24 slots, one conductor per slots 4 poles & delta connected	20	CO1	L3
	OR			
4	Develop a double layer winding for a DC machine having 16 slots and 4 poles. Mark the poles. Draw the sequence diagram. Indicate the position of the brushes; show the direction of induced emf give equalizer connection.	20	CO1	L3

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	17EE651	Sem:	VI	Marks:	10	Time:	90 – 120 minutes
Course:	CAED				Module : 1, 2		
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	Assignment Description	Marks	CO	Level
1	Draw the armature winding of a DC machine with 4 poles, 14 slots, double layer progressive lap show the position of brush & direction of induced emf. Draw the sequence diagram	10	CO1	L3
2	Develop a double layer winding for a DC machine having 16 slots and 4 poles. Mark the poles. Draw the sequence diagram. Indicate the position of the brushes; show the direction of induced emf give equalizer connection	10	CO1	L3
3	Draw the developed diagram of a DC machine with the following details. no of poles =4, no of slots=26 the winding is double layer lap type, fix the poles draw the sequence diagram ,fix the position of polarity of the brush	10	CO1	L3
4	Design & draw the developed double layer lap winding of DC armature with 24 conductor and 4 poles. Also show the direction current in the coils and brush position. Draw the sequence diagram.	10	CO1	L3
5	Draw the developed winding diagram of a six pole eighteen armature slots double layer full pitch lap wound DC generator fix the poles. Draw the sequence diagram. fix the position and polarity of brushes. Mark the direction of rotation of armature.	10	CO1	L3
6	Draw the developed winding diagram of a 4 pole 15 slots double layer lap wound DC generator; show the position and polarity of brush by sequence diagram	10	CO1	L3
7	Design and draw a duplex winding diagram of a Dc machine with 32 conductors and 4 poles. Draw the sequence diagram. Fix the position and polarity of brushes.	10	CO1	L3
8	Design and draw a wave winding (progressive) for an armature with 34 conductors accommodated 17 slots, Draw the sequence diagram show position of brush, direction of current etc.	10	CO1	L3
9	Draw the simplex retrogressive wave winding with a 4 pole DC machine having 42 armature conductors, 21 slots. The winding is double layer. Draw the sequence diagram show position of brush, direction of current etc	10	CO1	L3
10	Draw the developed winding diagram of the armature of the DC machine with the following data. Number of poles=4, Number of Slots=12,Type of winding: Simplex wave	10	CO1	L3
11	Draw the developed winding diagram for an AC machine with following details: a) Poles = 4 b) phases= 3 c) Slots =24 d) winding = single coil short pitched by one slot lap winding star connected	10	CO1	L3

12	Draw the developed winding diagram of a 3 phase induction motor, which have 18 slots 2 poles, winding is chorded by 2 slots, double layer lap delta connection	10	CO1	L3
13	Design and draw the developed winding diagram for an alternator with following details No. of poles =2 No. of phase =3 No .of slots =15 Winding = double layer, lap short pitched by one slot	10	CO1	L3
14	Draw the developed winding diagram for an diagram for AC three phase rotating machine with the following details 4 poles, 36 slots each slots contains one coil side lap winding connected in star& bring out the details as A,B,C & N winding be full pitched	10	CO1	L3
15	Draw a developed winding diagram for an AC machine having 24 slots, one conductor per slots 4 poles & delta connected	10	CO1	L3
16	Design and draw developed winding diagram of an AC machine with following details: No of poles= 4 No of slots= 36 No. of phase=3 Single layer lap, star connected	10	CO1	L3
17	Design and draw developed 3 phase full pitched AC lap winding for 24 conductor, double layer, 4poles, also show winding in star connection	10	CO1	L3
18	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots= 36 full pitch lap winding double layer and delta connected.	10	CO1	L3
19	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots = 24 full pitch wave winding	10	CO1	L3
20	Design and draw the developed winding diagram of an AC motor having the following details. No. of phase= 3 No. of slots = 12 No. of poles = 4 double layer full pitch wave with star connections.	10	CO1	L3
21	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots = 24 wave winding chorded by one slot	10	CO1	L3
22	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots = 24 Un-bifurcated winding in 2 tiers.	10	CO1	L3
23	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 6 No. of slots = 36 Un bifurcated winding in 2 tiers	10	CO1	L3
24	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots = 24 mush winding.	10	CO1	L3
25	Draw the developed winding diagram of an AC machine having the following details. No. of phase = 3 No. of poles = 4 No. of slots = 24 single layer bifurcated winding arranged in 3 tiers.	10	CO1	L3
26	Draw the developed winding diagram for an AC machine with following details: a) Poles = 4 b) phases= 3 c) Slots =24 d) winding = single coil short pitched by one slot lap winding star connected	10	CO1	L3
27	Draw the developed winding diagram of a 3 phase induction motor, which have 18 slots 2 poles, winding is chorded by 2 slots, double layer lap delta connection	10	CO1	L3
28	Draw a single line Diagram of connections of hydroelectric station having the following equipment a. Alternators: 12MVA, 3Φ, 50 Hz, 11KV, Y-connected, Five. b. Step-up transformers: 5000 KVA, 3Φ, 50 Hz, 11/110KV, Δ/Y-connected, Five. c. Bus: 110 KV double bus with bus coupler. d. Outgoing transmission lines:110KV,two e. Station Auxiliary Tranformers:750 KVA , 3, 50 Hz ,11KV Δ/Y.Two f. Also indicate positions of CT, PT, Isolating Switches, Lightning arrestors, Circuit Breakers.10	10	CO2	L4
29	Draw a single line diagram of a 66KV MUSS with the following details. a. 66KV incoming lines, 2 nos	10	CO2	L4

	b. Step down transformer 66KV/11KV ,2 nos c. OCB's for transformer bank on L.T side – 2 nos d. Duplicate bus bars for H.T and L.T side to be provided e. Bus couplers for HT side only f. Feeders, 11 KV radiating from L.T bus bars 4 nos g. L.T circuit breakers for feeders-4nos h. Position of lightning arrestors, isolators, CT's and PT's are to be indicated.			
30	Draw the single line diagram of a generating station having the following details a. Generators :50MVA,11KV,3Φ.-Two nos b. Transformers: 50MVA, 11/132KV, 3Φ. –Two nos c. Transformers(auxiliary):500 KVA , 11000/400 V. – 2 nos d. Transformers(reverse) : 1 MVA , 132/11 KV , 1 no e. Outgoing lines: 132 KV, 3Φ. 2 nos f. Also indicate positions of CT, PT, Isolating Switches, lightning Arrestors, Circuit Breakers.	10	CO2	L4
31	Draw the single line diagram of a generating station having the following equipment. a. Incoming lines : 110 KV , 50 Hz. – 2nos b. Outgoing lines: 110KV,50 Hz. -1 no 60KV, 50 Hz. -1 no 11KV, 50 Hz. -1 c. Transformers: 15MVA, 110/66KV, 3Φ, Y- . -2nos 10MVA,110/11KV,3Φ,Y/Y.-1no 3 MVA, 11/400 KV, 3Φ, Y/Y. -1 no d. Bus Bars : 110 KV.-2nos 66 KV. -1 no 11 KV.- 1no 400 KV. – 1 no Show the positions of CT , PT , Isolating Switches , Lightning arrestors , Circuit Breakers.	10	CO2	L4
32	Draw the single line diagram of a generating station having the following equipment. a. Incoming lines : 110 KV , 50 Hz. – 2nos b. Outgoing lines: 110KV,50 Hz. -1 no 11KV, 50 Hz. -8 nos c. Transformers: 5MVA,110/11KV ,3Φ, - . -2nos 15MVA, 110/220KV,3Φ, - .-1no 500 MVA, 11/400 KV, 3Φ, /Y. -1 no. One Auxiliary station Transformers	10	CO2	L4
33	Draw the single line diagram of a generating station having the following equipment. a. Incoming lines: 110 KV, 50 Hz. – 1 no b. Outgoing lines: 13.2 KV,50 Hz. -3 nos 11KV, 50 Hz. -4 nos c. Transformers: 15MVA,110/13.2KV ,3Φ, Δ/ Y. -1no 8 MVA,110/11KV,3Φ,Δ/Y.-1no d. Auxiliary Station transformer : 750 KVA , 11 KV/400 V , Δ/Y.-1no e. Bus Bars : 110 KV.-1no 11 KV.- 1no Show the positions of CT, PT, Isolating Switches , Lightning arrestors , Circuit Breakers.	10	CO2	L4
34	Draw the single line diagram of a substation having the following equipment. a. Incoming lines : 11KV , 50 Hz. – 2 nos b. Outgoing lines : 33 KV , 50 Hz.-- 4 nos c. Transformer: 11/33 KV, 3Φ , Y- . 2 nos d. Bus bars :11 KV , 1 no 33 KV, 2 nos Show the positions of CT, PT, Isolating Switches, Lightning arrestors, circuit breakers.	10	CO2	L4

35	Draw the single line diagram of a 66 KV sub-station indicating a bus coupler, and also mentioning all major parts and equipments.	10	CO2	L4
36	Draw the single line diagram of a typical substation with the data of the equipment given below: a. Two incoming lines 110 KV b. Two transformers of 110/11KV c. Double bus bars for high tension and low tension sides have to indicated d. Bus couplers on the high tension side only. e. Feeders of 11KV at low tension side total no=6. In appropriate position indicate lightning arrestors, CT , PT , earthing switches , wave traps and coupling . Condensers at incoming lines and station auxiliary transformers of 11 KV/415 V.	10	CO2	L4
37	Draw a neat Single line diagram for a 110KV/11KV MUSS with following details: a. 110 KV incoming lines. – 2 nos b. Line O.C.B 110KV.-2nos c. Transformer stepdown 110KV/11KV. – 2 nos d. Lowtension O.C.B for transformer : 2 nos e. Duplicate bus bars on HT & LT sides to be indicated. f. Bus Coupler on H.T side only. g. Feeders 11 KV at LT bus :6 nos h. Station supply transformer 11 KV / 415 V to be shown at Low tension side. i. Low tension circuit breakers for feeders : 6 nos j. In appropriate positions indicate Lightning arrestors , P.T's & C.T's.	10	CO2	L4

D2. TEACHING PLAN - 2

Module – 3

Title:	Electrical Machine Assembly Drawings Using Design Data, Sketches or Both (Transformers)	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Talk about and development of sectional views of Transformers, DC machines, Alternators and its parts using the design data, sketches.	CO3	L4
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
21	Transformers - Sectional Views Of Single Core Type Transformers.	CO3	L3
22	Transformers - Sectional Views Of Single Shell Type Transformers.	CO3	L3
23	Problems	CO3	L4
24	Problems	CO3	L4
25	Problems	CO3	L4
26	Transformers - Sectional Views Of Three Phase Core Type Transformers.	CO3	L3
27	Transformers - Sectional Views Of Three Phase Shell Type Transformers.	CO3	L3
28	Problems	CO3	L4
29	Problems	CO3	L4
30	Problems	CO3	L4
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Supply power	CO3	L4
2	Electrical Grids	CO3	L4
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-

1	Following are the details of 3 Φ , core type transformer draw to suitable scale a. Front elevation of transformer assembly right half in section b. Plan of Transformer assembly showing right half in section Core: Laminated steel plates of 0.35 mm Cross section of core = 3 stepped core Diameter of circumscribing circle = 230 mm Overall width = overall height of the core = 980 mm Window height = 470 mm Secondary winding (L.T): Number of turns = 25 Inside Diameter & outside diameter are 250 mm and 271 mm respectively Secondary conductor = 6 strips in parallel, 3 axially and 2 radially each 9.5 mm× 3.2 mm Tape insulation = 0.5 mm Primary Winding (H.T): Number of turns = 750 (8 coils of 83 turns Each , Arranged in 7 layers , height 37.5 mm, 2 coils of 43 turns each , height 23.5 mm) Inside Diameter = 320 mm Outside Diameter = 370 mm Primary Conductor – 2.64 mm , Dia : 3 mm with insulation	CO3	L4
2	Draw to suitable scale , the half sectional elevation and plan of 10 KVA , 50 Hz , 1100/110V single phase , shell type transformer with the following data: Magnetic Circuit Central leg = 70 mm×93.5mm Outer leg = 70 mm × 46.7 mm Yoke = 70 mm × 57.2 mm Window = 200 mm × 75 mm HV Winding Number of turns = 1000 Number of layers =12 Dimensions of insulated conductor = 2.1 mm × 2.1 mm Height of the coil = 178.5 mm The coil is divided into two sections with 6.35 mm duct in between , through which the H V leads are brought out. Dept of each section = 15.6 LV Winding No of turns =100 Wound in 2 sections, layers/ section = 2 Dimensions of insulated conductors = 4.67 mm × 7 mm Height of the insulated coil = 182 mm Depth of each section = 9.94 mm Insulation: Between layers = 0.6 mm Between core and LV winding = 2.5 mm Between LV & HV winding =3.81 mm Between yoke and end of coils ; for LV coils 4 mm mica pad & 5 mm pressboard spacer blocks, for HV coils 3.175 mm mica pad & 7.575 mm press Board spacer blocks.	CO3	L4
3	Draw the following views of a 3Φ , core type , 250 KVA , 11KV / 400 V transformer: a. Front elevation full in section b. Plan in full section Dimensions of various parts are given below: Core: Cross section of the core = 3 stepped core Diameter of the circumscribing circle = 24 cm Distance between adjacent core centers = 42.5 cm Yoke: height of the yoke 25 cm **LV Winding:** Outer diameter of LV Coil = 28.3 cm	CO3	L4

	Inner diameter of LV coil = 25 cm Height of LV winding = 43.5 cm Number of turns per phase = 12 **HV Winding:** Outer diameter of HV Coil = 41.5 cm Inner Diameter of HV coil = 34.3 cm height of HV winding = 43.5 cm Number of turns / phase = 572 Total Height of the transformer = 100 cm		
4	Draw the front elevation left half in section and sectional plan of a 15 KVA , 50 Hz distribution transformer Details of magnetic circuits: Cross section of the core = 63mm×91.6mm window= 298.5mm ×114.5mm Yoke height = 63.5 mm LV winding: Number of coils on each leg = 1 Number of turns / coil = 72 Number of layers /coil = 3 Section of conductor = 2.79mm×10.6mm HV winding: Number of coils on each leg = 1 Number of turns / coil = 720 Number of layers /coil = 8 Cross Section of wire = 2.59mm dia Insulation details: Air space around the core = 1.66 mm Insulation between core and LT = 1.6mm Insulation on H T = 3 mm Insulation at the top and bottom winding and insulation between layer = 0.35 mm Provide 10 mm bolt with sleeve at suitable spacing	CO3	L4
5	Following are the details of a 500 KVA single phase , 6600 / 400 V Transformer: Core: Laminated steel plates of 0.35 mm Width of the largest stamping = 280 mm Width of the smallest stamping = 175 mm Height of the core = 430 mm Distance between the centre of the core = 490 mm Core laminations are fixed by means of 2 end plates 3 mm thickness by a bolt of Diameter - 12mm Yoke : Construction – cruciform, yoke height = 250 mm, Yoke length = 770 mm, Total height of the transformer = 930 mm. LV Winding: Helical type Number of turns = 22 Number of turns / limb = 11 ; Number of layers / limb = 1 Section of Conductor = made of 20 square strips of size 5 mm × 5 mm bare and 5.5 mm ×5.5 mm with insulation Height of one turn = 28.5 mm Total height of the core occupied by the LV winding = 362 mm Inside diameter & outside diameter of LV winding are 337.5 mm and 383 mm respectively HV Winding: Concentric type – arranged in 2 layers on each limb Number of turns = 378 ; Number of turns / limb = 189 Inside diameter of HV 1 st layer = 415 mm Outside diameter of 1 st layer = 433 mm Inside diameter of HV 2 nd layer = 450 mm Outside diameter of HV 2 nd layer = 468 mm	CO3	L4

	Draw the front elevation right half of right limb in section and right half section plan.		
6	Draw the longitudinal sectional view of a limb of a single phase transformer with the following details Diameter of circumscribing circle= 22.6 cm Diameter of LV Winding in 2 layers: inside = 25 cm, outside = 28 cm Height of LV winding = 41.2 cm Diameter of HV Winding: inside = 32 cm, outside =36.8 cm Height of HV winding = 40 cm	CO3	L4
7	Draw the detailed drilling of each part of 500 KVA , 6600/400 V, single phase power transformer with the following data. Show full assembled plan and elevation Dimension of the core: core construction is cruciform Diameter = 33cm Width of the largest stamping = 33cm Width of the smallest stamping 17.5 cm Height of the core = 43 cm Centre to centre distance between cores = 49 cm Core laminations are used by means of 2 end plates – 3 mm thick by a bolt of dia 1.2 cm Yoke: Yoke height = 25cm Yoke length = 77 cm Total height of transformer = 9.3cm Winding: L.V winding: total turns = 22 No of turns / limb = 11 Inside dia of LV Winding = 33.75cm Outside dia of LV winding =38.35 cm Total height of the core occupied by the LV winding = 36.2cm H.T winding: 2 layers Inside dia of HT 1 st layer = 41.5 cm Outside dia of H.T nd 1 st layer = 43.3 cm Inside dia of HT 2 layer = 45 cm Outside dia of H.T 2 nd layer = 46.8 cm	CO3	L4
8	Draw the sectional plan and elevation of 500 KVA 6600/400 V single phase power transformer with the following details Core: Diameter = 33cm Width of the largest stamping = 28cm Width of the smallest stamping 17.5 cm Height of the core = 43 cm Centre to centre distance between cores = 49 cm Yoke: Construction : cruciform Yoke height = 25cm Yoke length (49+0.85×33=77cm) Winding: Height of the core occupied by the LV Winding = 36.2cm Inside dia of LV Winding = 33.75cm Outside dia of LV winding =38.35 cm Inside dia of HT 1 st layer = 41.5 cm Outside dia of H.T nd 1 st layer = 43.3 cm Inside dia of HT 2 layer = 45 cm Outside dia of H.T 2 nd layer = 46.8 cm	CO3	L4
9	Draw to a suitable scale the longitudinal cross section of a limb of a 3Φ oil	CO3	L4

	cooled power transformer showing the H.T and L.T windings Diameter of circumscribing iron core circle = 22.6 cm Diameter of Secondary winding in 2 concentric layers, inside = 25 cm, outside 28.1 cm, height of secondary winding = 41.2 cm. Diameter of primary winding, inside = 32 cm, outside 36.8cm, height of Primary winding including 10 spacers= 40cm.		
10	Draw the sectional plan of 1 limb showing the winding on a core of an oil-immersed, 12000/550 V, 3phase transformer. The core is 24 cm in diameter and has 3 steps. Internal & External diameters of low tension Windings are 25.4 cm & 29.8 cm respectively and of high tension 2.3cm thick and outer diameter 40.5 cm. Show the arrangements for keeping the coils in position and the oil ducts.	CO3	L4
11	The following are the details of three phase core type Transformer. Draw to a suitable scale. a. Elevation of the 3 transformer assembly showing one limb in section b. Plan of Transformer assembly showing one limb in section Core: Step construction, Core diameter = 220mm Height of the core = 480mm Height of the yoke = 250mm centre to centre distance between the limbs =350mm LV winding: Inside diameter = 231 mm Winding is two layer total radial former = 13.3 mm Radial thickness of one layer = 7.4mm Thickness of LV former = 3 mm number of turns / layer = 13 Total height of LV Winding = 427 mm H V winding: outside diameter = 340 mm, total number of coils = 12 a. Two coils of end gun metal ring each of 14mm thickness b. Ten coils of 56 turns each , total height of winding = 427 mm , average and clearance 33mm from top and 200 mm from bottom of the yoke.	CO3	L4
12	Draw the front elevation left half in section and sectional plan of a 15 kVA , single phase distribution transformer having the following details of magnetic circuits : a. Cruciform cross sectional core = 63mm ×91.6mm b. Window = 298.5mm × 114.5 mm c.. Height of the yoke = 63.5 mm Assume suitable value for insulation between between core and LV Winding, LV Winding and H V winding and other data suitably.	CO3	L4
e	**Experiences**	-	-

Module – 4

Title:	Electrical Machine Assembly Drawings Using Design Data, Sketches or Both (DC Machines)	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Talk about and development of sectional views of Transformers, DC machines, Alternators and its parts using the design data, sketches.	CO3	L4

b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
31	Introduction	CO3	L2
32	D.C. Machine - Sectional Views of Yoke with Poles, Armature and Commutator dealt separately.	CO3	L3
33	Problems	CO3	L4
34	Problems	CO3	L4
35	Problems	CO3	L4
36	Problems	CO3	L4
37	Problems	CO3	L4
38	Problems	CO3	L4
39	Problems	CO3	L4
40	Problems	CO3	L4
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Sectional views	CO3	L3
2	Source and loads	CO3	L4
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Draw the i)half sectional elevation and ii)half sectional end view of a DC machine, with the following details: Shaft diameter = 5 cm Axial length of armature = 25 cm Number of poles = 4 Thickness of the yoke = 3.5 cm Pole width = 12 cm Outside diameter of armature = 36 cm Diameter of commutator = 23 cm Number of interpoles = 4 Pole height = 16 cm Indicate all the parts	CO3	L4
2	Draw to a suitable scale half sectional end view and longitudinal end view of a 60 H.P, 4 Pole DC shunt motor, with the following details: **Armature:** Outside diameter =18.5 cm Length = 13.5cm Number of slots = 24 Size of slot = 0.7cm x 2 cm Main pole (laminated): Total height =11 cm Width = 7cm Pole arc = 10 cm Length of pole =14 cm Air gap =0.5 cm Interpole (solid):Size=2x10.8cm Length=11cm **Commutator:** Diameter =13cm Length =10cm **Brush:** Total no of spindles=4 **Winding:** Main pole=2cm, thick (Shunt winding) Interpole winding = 1 cm thick The armature is directly mounted on the shaft and is held between two end plates. The shaft is supported by means of end shields bearings in the end	CO3	L4

	cover		
3	Draw to a suitable scale end and longitudinal elevation (top half in section) of a100 KW, 500V, 1250 R.P.M 6 Pole DC shunt generator. The armature is supported over the spider and the shaft is supported by means of pedestal bearing for the dimensions given below. Armature: Outside diameter= 75 cm Length = 27.8 cm Number of slots = 86 Size of slot = 1.11 cm x 5.24 cm Depth of iron behind the slot = 9.26 cm Ventilating ducts= 3, each 1 cm width Air gap length below main pole = 0.5 cm Main pole (laminated): Total height = 24 cm with shoe Width = 17.75 cm Length = 25.7 cm Interpole (solid): Breadth=4.63 cm Length=20 cm Air gap length below Interpole = 0.8 cm Yoke: Thickness of yoke = 7.5 cm Length of yoke = 40 cm Commutator: Number of commutator segments = 344 Diameter =56 cm Segment pitch = 0.51 Length =12.35 cm Number of brushes per spindle=3 Shaft: Shaft diameter below armature = 9 cm Shaft length between bearings centers = 120 cm	CO3	L4
4	Draw to a suitable scale end view and elevation with top half in section of a DC machine, with the following details: Yoke: Outside diameter = 49.6cm Inner diameter = 40 cm Axial Length = 16 cm Main pole: Number of poles = 4 Total height = 12.6 cm Width =6 cm Air gap = 1.6 mm Interpole : Number of poles= 4 Total height= 11 cm Width =9.5 cm Air gap = 2.5 mm	CO3	L4
5	Following are the details of a main pole of a DC machine. Draw to suitable scale a) Elevation with right half in section b) Plan with right half in section Number of poles- 4 Height of pole-140mm Width of the pole-127mm Length of the pole -170mm Armature diameter-400mm Pole arc/ pole pitch =0.67	CO3	L4

	Number of turns per pole -1890 Conductor area -1.77mm 2 Depth of the winding-45mm Height of the winding-110mm (Missing data may be proportionally assumed)		
6	Draw the plan and elevation (right-half section) of an inter pole or communicating pole used for machine with following dimensions: Height of the pole-130 Width of the pole=50 Length of inter pole=170 No of turns=23 Height of winding =110 Area of conductor =50x3 All dimensions are in mm	CO3	L4
7	Draw to half scale sectional end elevation and sectional front elevation of a main pole of Dc machine with following dimensions: Width of the pole=168mm Pole arc=240mm Radius of pole arc =336mm Height of pole with shoe=228mm Height of the pole core=192mm Diameter of rivet used = 9mm Axial length of pole arc=216mm Thickness of yoke=114mm Show the arrangement of fixing pole to yoke.	CO3	L4
8	With the reference to the above problem gives the details of a DC machine. Draw the following assembled view of it, to full scale. a) Half sectional front elevation, showing top half section b) End elevation showing top half in section.	CO3	L4
9	With the problem no.3 show the parts and other details of an armature of a 15kw Dc generator. Draw the assembly of the armature: a) Half sectional front elevation (top half in section) b) Half sectional end view Scale full size.	CO3	L4
10	Following are the design details of an armature used for small DC motor. Diameter of the shaft =5.4cm Collar diameter =6.3 cm Length of the hub =24.75 cm Outer dia. Of armature core =39.6cm Inner dia. Armature core= 20.5 cm Outer dia. Of end ring =34.2 cm Thickness of the end ring = 1.35 cm Thickness of the flange = 0.67 cm Axial length of the core = 24.75 cm Number of armature slot = 48 Area of parallel slot= 2.4 x 1.04 cm Draw to 1/4 the full size assembled 1. Half sectional front elevation 2. Half sectional end view Other missing data should be suitably assumed	CO3	L4
11	Draw the suitable scale: a) End view with quarter half in section b) Front elevation with top half in section With following main dimensions of a commutator used for dc machine. Commutator dia = 83.5 Length of commutator	CO3	L4

	=86 Length of riser = 10 Width of the riser =5.1 Thickness of mica = 1.25 Shaft dia. = 29.2 Segment pitch with mica = 5 Outer dia of sleeve =78 Height of segment = 19 Sleeve is fixed by V ring & collar other missing data's may be proportionally assumed (All dimensions are in mm)		
12	Draw to ¼ the scale half sectional elevation of a rotor assembly of DC machine show method of fixing commutator, armature stampings etc, with following main dimensions. Armature core is directly mounted over the shaft. Dia Of shaft = 72 mm Dia Of armature = 325mm Axial length of arm core=162mm Coil over hang =108mm each side One radial ventilating duct=11mm Six axial ventilating duct =11mm Spacing between commutator and armature =50mm Dia. Of the commutator =202mm No of segments =153 Length of commutator with riser =72mm	CO3	L4
13	Draw to suitable scale a) end view b) Longitudinal view Both top half in section for a DC motor Details of yoke – outer dia. =49.6cm Inner dia = 40cm Length =16cm Details of main poles – number-4 Width- 6.08cm Height=9.6cm Length =12.8cm Air gap length = 1.6mm Details of inter pole- number = 4 Width = 9.5cm Height= 11 Air gap= 2.5mm	CO3	L4
14	Following are the details of 4 pole, 100kW, and DC motor Main pole inter pole Height =148.5mm height=145.8mm Width= 94.5mm length=148.5mm Pole arc= 135mm thickness of winding =27mm Length =190mm Air gap=5mm Thickness of winding =27mm Commutator Diameter =175.5mm Armature outer dia. = 250mm Length =135mm Brush spindle =4 No of brush/ spindle=3 inner dia. =98mm length =182.2mm	CO3	L4

	Depth of the slot =27mm Width of the slot = 9.4mm Coil over hangs=103mm Outer dia of complete machine =720mm Width of the bed plate =830mm Length of the bed plate=573mm Thickness of bed plate=61mm Length of the yoke=337.5 Armature is directly mounted over the shaft. Draw end view & elevation with half section.		
15	Draw to a suitable scale, the following as per main dimensions given below in centimeter scale DC 6 pole, 150HP Motor, Armature diameter = 55cm, Air gap length (radial) 0.5 at main poles and 0.6 at interpoles. a. Main poles laminated , Breath =14 cm, Arc=20cm, Height with shoes = 21cm b. Yoke thickness =8.5cm c. Interpole breath = 4 cm d. d. Outside diameter of yoke =115cm The method of fixing the pole lamination and pole to the yoke is to be shown, draw the half-sectional end view (with top half in section) looking from the shaft end. Assume any additional data necessary.	CO3	L4
e	**Experiences**	-	-
1			

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	17EE651	Sem:	VI	Marks:	30	Time:	75 minutes
Course:	CAED						

-	**Note: Answer all questions, each carry equal marks. Module : 3, 4**	**Marks**	**CO**	**Level**
1	Draw to suitable scale , the half sectional elevation and plan of 10 KVA , 50 Hz , 1100/110V single phase , shell type transformer with the following data: Magnetic Circuit Central leg = 70 mm×93.5mm Outer leg = 70 mm × 46.7 mm Yoke = 70 mm × 57.2 mm Window = 200 mm × 75 mm HV Winding Number of turns = 1000 Number of layers =12 Dimensions of insulated conductor = 2.1 mm × 2.1 mm Height of the coil = 178.5 mm The coil is divided into two sections with 6.35 mm duct in between , through which the H V leads are brought out. Dept of each section = 15.6 LV Winding No of turns =100 Wound in 2 sections, layers/ section = 2 Dimensions of insulated conductors = 4.67 mm × 7 mm Height of the insulated coil = 182 mm Depth of each section = 9.94 mm Insulation: Between layers = 0.6 mm Between core and LV winding = 2.5 mm Between LV & HV winding =3.81 mm	15	CO3	L4

		Between yoke and end of coils ; for LV coils 4 mm mica pad & 5 mm pressboard spacer blocks, for HV coils 3.175 mm mica pad & 7.575 mm press Board spacer blocks.			
		OR			
2		Draw the following views of a 3Φ , core type , 250 KVA , 11KV / 400 V transformer: a. Front elevation full in section b. Plan in full section Dimensions of various parts are given below: Core: Cross section of the core = 3 stepped core Diameter of the circumscribing circle = 24 cm Distance between adjacent core centers = 42.5 cm Yoke: height of the yoke 25 cm **LV Winding:** Outer diameter of LV Coil = 28.3 cm Inner diameter of LV coil = 25 cm Height of LV winding = 43.5 cm Number of turns per phase = 12 **HV Winding:** Outer diameter of HV Coil = 41.5 cm Inner Diameter of HV coil = 34.3 cm height of HV winding = 43.5 cm Number of turns / phase = 572 Total Height of the transformer = 100 cm	15	CO3	L4
3	a	Draw to a suitable scale, the following as per main dimensions given below in centimeter scale DC 6 pole, 150HP Motor, Armature diameter = 55cm, Air gap length (radial) 0.5 at main poles and 0.6 at interpoles. a. Main poles laminated , Breath =14 cm, Arc=20cm, Height with shoes=21cm b. Yoke thickness =8.5cm c. Interpole breath = 4 cm d. d. Outside diameter of yoke =115cm The method of fixing the pole lamination and pole to the yoke is to be shown, draw the half- sectional end view (with top half in section) looking from the shaft end. Assume any additional data necessary.	15	CO3 & CO3	L4
		OR			
4	a	Draw to 1⁄4 the scale half sectional elevation of a rotor assembly of DC machine show method of fixing commutator, armature stampings etc, with following main dimensions. Armature core is directly mounted over the shaft. Dia Of shaft = 72 mm Dia Of armature = 325mm Axial length of arm core=162mm Coil over hang =108mm each side One radial ventilating duct=11mm Six axial ventilating duct =11mm Spacing between commutator and armature =50mm Dia. Of the commutator =202mm No of segments =153 Length of commutator with riser =72mm	15	CO3 & CO3	L4

b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	17EE651	Sem:	VI	Marks:	10	Time:	90 – 120 minutes
Course:	CAED				Module : 3, 4		
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level

1	Following are the details of 3 Φ , core type transformer draw to suitable scale a. Front elevation of transformer assembly right half in section b. Plan of Transformer assembly showing right half in section Core: Laminated steel plates of 0.35 mm Cross section of core = 3 stepped core Diameter of circumscribing circle = 230 mm Overall width = overall height of the core = 980 mm Window height = 470 mm Secondary winding (L.T): Number of turns = 25 Inside Diameter & outside diameter are 250 mm and 271 mm respectively Secondary conductor = 6 strips in parallel, 3 axially and 2 radially each 9.5 mm × 3.2 mm Tape insulation = 0.5 mm Primary Winding (H.T): Number of turns = 750 (8 coils of 83 turns Each , Arranged in 7 layers , height 37.5 mm, 2 coils of 43 turns each , height 23.5 mm) Inside Diameter = 320 mm Outside Diameter = 370 mm Primary Conductor – 2.64 mm , Dia : 3 mm with insulation	10	CO3	L4
2	Draw to suitable scale , the half sectional elevation and plan of 10 KVA , 50 Hz , 1100/110V single phase , shell type transformer with the following data: Magnetic Circuit Central leg = 70 mm×93.5mm Outer leg = 70 mm × 46.7 mm Yoke = 70 mm × 57.2 mm Window = 200 mm × 75 mm HV Winding Number of turns = 1000 Number of layers =12 Dimensions of insulated conductor = 2.1 mm × 2.1 mm Height of the coil = 178.5 mm The coil is divided into two sections with 6.35 mm duct in between , through which the H V leads are brought out. Dept of each section = 15.6 LV Winding No of turns =100 Wound in 2 sections, layers/ section = 2 Dimensions of insulated conductors = 4.67 mm × 7 mm Height of the insulated coil = 182 mm Depth of each section = 9.94 mm Insulation: Between layers = 0.6 mm Between core and LV winding = 2.5 mm Between LV & HV winding =3.81 mm Between yoke and end of coils ; for LV coils 4 mm mica pad & 5 mm pressboard spacer blocks, for HV coils 3.175 mm mica pad & 7.575 mm press Board spacer blocks.	10	CO3	L4
3	Draw the following views of a 3Φ , core type , 250 KVA , 11KV / 400 V transformer: a. Front elevation full in section b. Plan in full section Dimensions of various parts are given below: Core: Cross section of the core = 3 stepped core Diameter of the circumscribing circle = 24 cm	10	CO3	L4

	Distance between adjacent core centers = 42.5 cm Yoke: height of the yoke 25 cm **LV Winding:** Outer diameter of LV Coil = 28.3 cm Inner diameter of LV coil = 25 cm Height of LV winding = 43.5 cm Number of turns per phase = 12 **HV Winding:** Outer diameter of HV Coil = 41.5 cm Inner Diameter of HV coil = 34.3 cm height of HV winding = 43.5 cm Number of turns / phase = 572 Total Height of the transformer = 100 cm			
4	Draw the front elevation left half in section and sectional plan of a 15 KVA , 50 Hz distribution transformer Details of magnetic circuits: Cross section of the core = 63mm×91.6mm window= 298.5mm ×114.5mm Yoke height = 63.5 mm LV winding: Number of coils on each leg = 1 Number of turns / coil = 72 Number of layers /coil = 3 Section of conductor = 2.79mm×10.6mm HV winding: Number of coils on each leg = 1 Number of turns / coil = 720 Number of layers /coil = 8 Cross Section of wire = 2.59mm dia Insulation details: Air space around the core = 1.66 mm Insulation between core and LT = 1.6mm Insulation on H T = 3 mm Insulation at the top and bottom winding and insulation between layer = 0.35 mm Provide 10 mm bolt with sleeve at suitable spacing	10	CO3	L4
5	Following are the details of a 500 KVA single phase , 6600 / 400 V Transformer: Core: Laminated steel plates of 0.35 mm Width of the largest stamping = 280 mm Width of the smallest stamping = 175 mm Height of the core = 430 mm Distance between the centre of the core = 490 mm Core laminations are fixed by means of 2 end plates 3 mm thickness by a bolt of Diameter - 12mm Yoke : Construction – cruciform, yoke height = 250 mm, Yoke length = 770 mm, Total height of the transformer = 930 mm. LV Winding: Helical type Number of turns = 22 Number of turns / limb = 11 ; Number of layers / limb = 1 Section of Conductor = made of 20 square strips of size 5 mm × 5 mm bare and 5.5 mm ×5.5 mm with insulation Height of one turn = 28.5 mm Total height of the core occupied by the LV winding = 362 mm Inside diameter & outside diameter of LV winding are 337.5 mm and 383 mm respectively HV Winding: Concentric type – arranged in 2 layers on each limb Number of turns = 378 ; Number of turns / limb = 189	10	CO3	L4

	Inside diameter of HV 1 st layer = 415 mm Outside diameter of 1 st layer = 433 mm Inside diameter of HV 2 nd layer = 450 mm Outside diameter of HV 2 nd layer = 468 mm Draw the front elevation right half of right limb in section and right half section plan.			
6	Draw the longitudinal sectional view of a limb of a single phase transformer with the following details Diameter of circumscribing circle= 22.6 cm Diameter of LV Winding in 2 layers: inside = 25 cm, outside = 28 cm Height of LV winding = 41.2 cm Diameter of HV Winding: inside = 32 cm, outside =36.8 cm Height of HV winding = 40 cm	10	CO3	L4
7	Draw the detailed drilling of each part of 500 KVA , 6600/400 V, single phase power transformer with the following data. Show full assembled plan and elevation Dimension of the core: core construction is cruciform Diameter = 33cm Width of the largest stamping = 33cm Width of the smallest stamping 17.5 cm Height of the core = 43 cm Centre to centre distance between cores = 49 cm Core laminations are used by means of 2 end plates – 3 mm thick by a bolt of dia 1.2cm Yoke: Yoke height = 25cm Yoke length = 77 cm Total height of transformer = 9.3cm Winding: L.V winding: total turns = 22 No of turns / limb = 11 Inside dia of LV Winding = 33.75cm Outside dia of LV winding =38.35 cm Total height of the core occupied by the LV winding = 36.2cm H.T winding: 2 layers Inside dia of HT 1 st layer= 41.5 cm Outside dia of H.T nd 1 st layer = 43.3 cm Inside dia of HT 2 layer = 45 cm Outside dia of H.T 2 nd layer = 46.8 cm	10	CO3	L4
8	Draw the sectional plan and elevation of 500 KVA 6600/400 V single phase power transformer with the following details Core: Diameter = 33cm Width of the largest stamping = 28cm Width of the smallest stamping 17.5 cm Height of the core = 43 cm Centre to centre distance between cores = 49 cm Yoke: Construction : cruciform Yoke height = 25cm Yoke length (49+0.85×33=77cm) Winding: Height of the core occupied by the LV Winding = 36.2cm Inside dia of LV Winding = 33.75cm Outside dia of LV winding =38.35 cm Inside dia of HT 1 st layer = 41.5 cm Outside dia of H.T nd 1 st layer = 43.3 cm Inside dia of HT 2 layer = 45 cm	10	CO2	L4

	Outside dia of H.T 2 nd layer = 46.8 cm			
9	Draw to a suitable scale the longitudinal cross section of a limb of a 3Φ oil cooled power transformer showing the H.T and L.T windings Diameter of circumscribing iron core circle = 22.6 cm Diameter of Secondary winding in 2 concentric layers, inside = 25 cm, outside 28.1 cm, height of secondary winding = 41.2 cm. Diameter of primary winding, inside = 32 cm, outside 36.8cm, height of Primary winding including 10 spacers= 40cm.	10	CO3	L3
10	Draw the sectional plan of 1 limb showing the winding on a core of an oil-immersed, 12000/550V, 3phase transformer. The core is 24 cm in diameter and has 3 steps. Internal & External diameters of low tension Windings are 25.4 cm & 29.8 cm respectively and of high tension 2.3cm thick and outer diameter 40.5 cm. Show the arrangements for keeping the coils in position and the oil ducts.	10	CO3	L3
11	Draw the i)half sectional elevation and ii)half sectional end view of a DC machine, with the following details: Shaft diameter = 5 cm Axial length of armature = 25 cm Number of poles = 4 Thickness of the yoke = 3.5 cm Pole width = 12 cm Outside diameter of armature = 36 cm Diameter of commutator = 23 cm Number of interpoles = 4 Pole height = 16 cm Indicate all the parts	10	CO3 & CO3	L4
12	Draw to a suitable scale half sectional end view and longitudinal end view of a 60 H.P, 4 Pole DC shunt motor, with the following details: **Armature:** Outside diameter =18.5 cm Length = 13.5cm Number of slots = 24 Size of slot = 0.7cm x 2 cm Main pole (laminated): Total height =11 cm Width = 7cm Pole arc = 10 cm Length of pole =14 cm Air gap =0.5 cm Interpole (solid):Size=2x10.8cm Length=11cm **Commutator:** Diameter =13cm Length =10cm **Brush:** Total no of spindles=4 **Winding:** Main pole=2cm, thick (Shunt winding) Interpole winding = 1 cm thick The armature is directly mounted on the shaft and is held between two end plates. The shaft is supported by means of end shields bearings in the end cover	10	CO3 & CO3	L4
13	Draw to a suitable scale end and longitudinal elevation (top half in section) of a100 KW, 500V, 1250 R.P.M 6 Pole DC shunt generator. The armature is supported over the spider and the shaft is supported by means of pedestal bearing for the dimensions given below. Armature:	10	CO3 & CO3	L4

	Outside diameter= 75 cm Length = 27.8 cm Number of slots = 86 Size of slot = 1.11 cm x 5.24 cm Depth of iron behind the slot = 9.26 cm Ventilating ducts= 3, each 1 cm width Air gap length below main pole = 0.5 cm Main pole (laminated): Total height = 24 cm with shoe Width = 17.75 cm Length = 25.7 cm Interpole (solid): Breadth=4.63 cm Length=20 cm Air gap length below Interpole = 0.8 cm Yoke: Thickness of yoke = 7.5 cm Length of yoke = 40 cm Commutator: Number of commutator segments = 344 Diameter =56 cm Segment pitch = 0.51 Length =12.35 cm Number of brushes per spindle=3 Shaft: Shaft diameter below armature = 9 cm Shaft length between bearings centers = 120 cm			
14	Draw to a suitable scale end view and elevation with top half in section of a DC machine, with the following details: Yoke: Outside diameter = 49.6cm Inner diameter = 40 cm Axial Length = 16 cm Main pole: Number of poles = 4 Total height = 12.6 cm Width =6 cm Air gap = 1.6 mm Interpole : Number of poles= 4 Total height= 11 cm Width =9.5 cm Air gap = 2.5 mm	10	CO3 & CO3	L4
15	Following are the details of a main pole of a DC machine. Draw to suitable scale a) Elevation with right half in section b) Plan with right half in section Number of poles- 4 Height of pole-140mm Width of the pole-127mm Length of the pole -170mm Armature diameter-400mm Pole arc/ pole pitch =0.67 Number of turns per pole -1890 Conductor area -1.77mm 2 Depth of the winding-45mm Height of the winding-110mm (Missing data may be proportionally assumed)	10	CO3 & CO3	L4
16	Draw the plan and elevation (right-half section) of an inter pole or communicating pole used for machine with following dimensions:	10	CO3 & CO3	L4

	Height of the pole-130 Width of the pole=50 Length of inter pole=170 No of turns=23 Height of winding =110 Area of conductor =50x3 All dimensions are in mm			
17	Draw to half scale sectional end elevation and sectional front elevation of a main pole of Dc machine with following dimensions: Width of the pole=168mm Pole arc=240mm Radius of pole arc =336mm Height of pole with shoe=228mm Height of the pole core=192mm Diameter of rivet used = 9mm Axial length of pole arc=216mm Thickness of yoke=114mm Show the arrangement of fixing pole to yoke.	10	CO3 & CO3	L4
18	With the reference to the above problem gives the details of a DC machine. Draw the following assembled view of it, to full scale. a) Half sectional front elevation, showing top half section b) End elevation showing top half in section.	10	CO3 & CO3	L4
19	With the problem no.3 show the parts and other details of an armature of a 15kw Dc generator. Draw the assembly of the armature: a) Half sectional front elevation (top half in section) b) Half sectional end view Scale full size.	10	CO3 & CO3	L4
20	Following are the design details of an armature used for small DC motor. Diameter of the shaft =5.4cm Collar diameter =6.3 cm Length of the hub =24.75 cm Outer dia. Of armature core =39.6cm Inner dia. Armature core= 20.5 cm Outer dia. Of end ring =34.2 cm Thickness of the end ring = 1.35 cm Thickness of the flange = 0.67 cm Axial length of the core = 24.75 cm Number of armature slot = 48 Area of parallel slot= 2.4 x 1.04 cm Draw to 1⁄4 the full size assembled 1. Half sectional front elevation 2. Half sectional end view Other missing data should be suitably assumed	10	CO3 & CO3	L4
21	Draw the suitable scale: a) End view with quarter half in section b) Front elevation with top half in section With following main dimensions of a commutator used for dc machine. Commutator dia = 83.5 Length of commutator =86 Length of riser = 10 Width of the riser =5.1 Thickness of mica = 1.25 Shaft dia. = 29.2 Segment pitch with mica = 5 Outer dia of sleeve =78 Height of segment = 19 Sleeve is fixed by V ring & collar other missing data's may be proportionally assumed (All dimensions are in mm)	10	CO3 & CO3	L4

D3. TEACHING PLAN - 3

Module – 5

Title:	Electrical Machine Assembly Drawings Using Design Data, Sketches or Both (Alternators)	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Talk about and development of sectional views of Transformers, DC machines, Alternators and its parts using the design data, sketches.	CO3	L4
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
41	Introduction	CO3	L2
42	Alternator – Sectional Views of Stator	CO3	L3
43	Alternator – Sectional Views of Rotor	CO3	L3
44	Problems	CO3	L4
45	Problems	CO3	L4
46	Problems	CO3	L4
47	Problems	CO3	L4
48	Problems	CO3	L4
49	Problems	CO3	L4
50	Problems	CO3	L4
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	show interior detail that is too complicated to be shown clearly and dimensioned by the traditional orthographic views and hidden lines.	CO3	L3
2	Generate electric power at power station. Use in paper mills, refineries and numerous other applications	CO3	L4
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Draw the armature core and housing assembly of an alternator having the following data: Stamping OD = 405mm Stamping ID = 240mm Housing OD = 455mm Core length = 180mm No of slots = 48 Dimension of slots: Shape = Trapezoidal Total height = 44.3mm Lip Height = 4mm Slot opening = 3mm Slot width at the top = 16mm slot width at bottom (over lips) = 10.76mm Show the fixing of the armature to the housing in both views.	CO3 & CO3	L4
2	Salient pole rotor – 4 pole with integral pole stamping Draw the 4 pole salient pole rotor made of integral pole stamping with the following data – Rotor OD = 225mm Rotor ID = 60mm Pole arc/Pole pitch = 0.74 Pole width = 65mm Damper bars = 5 no. of 10mm diameter. Field winding – 2 stepped in cross section the dimensions are 29mmX10mm and 22mmX8mm Steel rods on each pole body = 44mmX11mm.	CO3 & CO3	L4
3	Draw to scale half sectional end view and front view of alternator with the following data:	CO3 &	L4

	Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	CO3	
4	Draw the armature core and housing assembly of an alternator having the following data: Stamping OD = 405mm Stamping ID = 240mm Housing OD = 455mm Core length = 180mm No of slots = 48 Dimension of slots: Shape = Trapezoidal Total height = 44.3mm Lip Height = 4mm Slot opening = 3mm Slot width at the top = 16mm slot width at bottom (over lips) = 10.76mm Show the fixing of the armature to the housing in both views.	CO3	L4
5	Salient pole rotor – 4 pole with integral pole stamping Draw the 4 pole salient pole rotor made of integral pole stamping with the following data – Rotor OD = 225mm Rotor ID = 60mm Pole arc/Pole pitch = 0.74 Pole width = 65mm Damper bars = 5 no. of 10mm diameter. Field winding – 2 stepped in cross section the dimensions are 29mmX10mm and 22mmX8mm Steel rods on each pole body = 44mmX11mm.	CO3	L4
6	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	CO3	L4
7	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	CO3	L4
8	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10	CO3	L4

	Length of stator = 16cm		
9	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	CO3	L4
10	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	CO3	L4
e	**Experiences**	-	-
1			

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code:	17EE651	Sem:	VI	Marks:	30	Time:	75 minutes
Course:	MICROWAVE AND ANTENNAS						

-	**Note: Answer all questions, each carry equal marks. Module : 5**	**Marks**	**CO**	**Level**
1	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	15	CO3	L4
	OR			
2	Draw the armature core and housing assembly of an alternator having the following data: Stamping OD = 405mm Stamping ID = 240mm Housing OD = 455mm Core length = 180mm No of slots = 48 Dimension of slots: Shape = Trapezoidal Total height = 44.3mm Lip Height = 4mm Slot opening = 3mm Slot width at the top = 16mm slot width at bottom (over lips) = 10.76mm Show the fixing of the armature to the housing in both views.	15	CO3	L4
3	Salient pole rotor – 4 pole with integral pole stamping Draw the 4 pole salient pole rotor made of integral pole stamping with the following data – Rotor OD = 225mm			

	Rotor ID = 60mm Pole arc/Pole pitch = 0.74 Pole width = 65mm Damper bars = 5 no. of 10mm diameter. Field winding – 2 stepped in cross section the dimensions are 29mmX10mm and 22mmX8mm Steel rods on each pole body = 44mmX11mm.			
	OR			
4	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	15	CO3	L4

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	17EE651	Sem:	VI	Marks:	10	Time:	90 – 120 minutes
Course:	CAED				Module : 5		
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	Assignment Description	Marks	CO	Level
1	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	10	CO3	L4
2	Draw the armature core and housing assembly of an alternator having the following data: Stamping OD = 405mm Stamping ID = 240mm Housing OD = 455mm Core length = 180mm No of slots = 48 Dimension of slots: Shape = Trapezoidal Total height = 44.3mm Lip Height = 4mm Slot opening = 3mm Slot width at the top = 16mm slot width at bottom (over lips) = 10.76mm Show the fixing of the armature to the housing in both views.	10	CO3	L4
3	Salient pole rotor – 4 pole with integral pole stamping Draw the 4 pole salient pole rotor made of integral pole stamping with the following data – Rotor OD = 225mm Rotor ID = 60mm Pole arc/Pole pitch = 0.74 Pole width = 65mm Damper bars = 5 no. of 10mm diameter. Field winding – 2 stepped in cross section the dimensions are	10	CO3	L4

	29mmX10mm and 22mmX8mm Steel rods on each pole body = 44mmX11mm.			
4	Draw the armature core and housing assembly of an alternator having the following data: Stamping OD = 405mm Stamping ID = 240mm Housing OD = 455mm Core length = 180mm No of slots = 48 Dimension of slots: Shape = Trapezoidal Total height = 44.3mm Lip Height = 4mm Slot opening = 3mm Slot width at the top = 16mm slot width at bottom (over lips) = 10.76mm Show the fixing of the armature to the housing in both views.	10	CO3	L4
5	Salient pole rotor – 4 pole with integral pole stamping Draw the 4 pole salient pole rotor made of integral pole stamping with the following data – Rotor OD = 225mm Rotor ID = 60mm Pole arc/Pole pitch = 0.74 Pole width = 65mm Damper bars = 5 no. of 10mm diameter. Field winding – 2 stepped in cross section the dimensions are 29mmX10mm and 22mmX8mm Steel rods on each pole body = 44mmX11mm.	10	CO3	L4
6	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	10	CO3	L4
7	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	10	CO3	L4
8	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	10	CO3	L4
9	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm	10	CO3	L4

	Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm			
10	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	10	CO3	L4
11	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	10	CO3	L4
12	Draw the armature core and housing assembly of an alternator having the following data: Stamping OD = 405mm Stamping ID = 240mm Housing OD = 455mm Core length = 180mm No of slots = 48 Dimension of slots: Shape = Trapezoidal Total height = 44.3mm Lip Height = 4mm Slot opening = 3mm Slot width at the top = 16mm slot width at bottom (over lips) = 10.76mm Show the fixing of the armature to the housing in both views.	10	CO3	L4
13	Salient pole rotor – 4 pole with integral pole stamping Draw the 4 pole salient pole rotor made of integral pole stamping with the following data – Rotor OD = 225mm Rotor ID = 60mm Pole arc/Pole pitch = 0.74 Pole width = 65mm Damper bars = 5 no. of 10mm diameter. Field winding – 2 stepped in cross section the dimensions are 29mmX10mm and 22mmX8mm Steel rods on each pole body = 44mmX11mm.	10	CO3	L4

F. EXAM PREPARATION

1. University Model Question Paper

Course:	CAED					Month / Year	May /2018	
Crs Code:	17EE651	Sem:	VI	Marks:	100	Time:	180 minutes	
Module	**Note**	Answer Question 1 and Question 2 From Part-A. Answer Question 3 or Question 4 From Part-B. Use CAD tool that satisfies the requirements of syllabus is permitted. Suitable data may be assumed if not given.				**Marks**	**CO**	**Level**
		Part - A						
1		Design & draw the developed double layer lap winding of DC armature				30	CO1	L3

	with 24 conductor and 4 poles. Also show the direction current in the coils and brush position. Draw the sequence diagram.			
	OR			
	Draw a developed winding diagram for an AC machine having 24 slots, one conductor per slots 4 poles & delta connected	30	CO1	L3
2	Draw a neat single line diagram , for a 110/11kV Main Unit Sub Station (MUSS) with the following details : a. Duplicate incoming lines 110 kV b. Transformer step-down 110/11 kV – 2 nos c. Duplicate bus-bars on H T and LT Sides d. Station supply Transformer 11kV/415V e. Feeder 11kV at LT bus:6 nos f. Earth switch, Wave traps and coupling condensers are to be provided at incoming lines. Also indicate the position of CTs , PTs , isolators and LAs	20	CO2	L4
	Part - B			
3	Draw the front elevation left half in section and sectional plan of a 15 KVA , 50 Hz distribution transformer Details of magnetic circuits: Cross section of the core = 63mm×91.6mm window= 298.5mm ×114.5mm Yoke height = 63.5 mm LV winding: Number of coils on each leg = 1 Number of turns / coil = 72 Number of layers /coil = 3 Section of conductor = 2.79mm×10.6mm HV winding: Number of coils on each leg = 1 Number of turns / coil = 720 Number of layers /coil = 8 Cross Section of wire = 2.59mm dia Insulation details: Air space around the core = 1.66 mm Insulation between core and LT = 1.6mm Insulation on H T = 3 mm Insulation at the top and bottom winding and insulation between layer = 0.35 mm Provide 10 mm bolt with sleeve at suitable spacing	50	CO3	L4
4	Draw the armature core and housing assembly of an alternator having the following data: Stamping OD = 405mm Stamping ID = 240mm Housing OD = 455mm Core length = 180mm No of slots = 48 Dimension of slots: Shape = Trapezoidal Total height = 44.3mm Lip Height = 4mm Slot opening = 3mm Slot width at the top = 16mm slot width at bottom (over lips) = 10.76mm Show the fixing of the armature to the housing in both views.	50	CO3	L4

2. SEE Important Questions

Course:	CAED					Month / Year	May /2018	
Crs Code:	17EE651	Sem:	6	Marks:	80	Time:	180 minutes	
	Note	Answer all FIVE full questions. All questions carry equal marks.				-	-	
Module	Qno.	Important Question				**Marks**	**CO**	**Year**
1	1	Develop a double layer winding for a DC machine having 16 slots and 4 poles. Mark the poles. Draw the sequence diagram. Indicate the position of the brushes; show the direction of induced emf give equalizer connection				30	CO1	2015
	2	Draw the developed diagram of a DC machine with the following details. no of poles =4, no of slots=26 the winding is double layer lap type, fix the poles draw the sequence diagram ,fix the position of polarity of the brush				30	CO1	2016
	3	Design & draw the developed double layer lap winding of DC armature with 24 conductor and 4 poles. Also show the direction current in the coils and brush position. Draw the sequence diagram.				30	CO1	2017
	4	Design and draw developed winding diagram of an AC machine with following details: No of poles= 4 No of slots= 36 No. of phase=3 Single layer lap, star connected				30	CO1	2017
	5	Design and draw developed 3 phase full pitched AC lap winding for 24 conductor, double layer, 4poles, also show winding in star connection				30	CO1	2018
2	1	Draw a single line diagram of a 66KV MUSS with the following details. a. 66KV incoming lines, 2 nos b. Step down transformer 66KV/11KV ,2 nos c. OCB's for transformer bank on L.T side – 2 nos d. Duplicate bus bars for H.T and L.T side to be provided e. Bus couplers for HT side only f. Feeders, 11 KV radiating from L.T bus bars 4 nos g. L.T circuit breakers for feeders-4nos h. Position of lightning arrestors, isolators, CT's and PT's are to be indicated.				20	CO2	2015
	2	Draw the single line diagram of a generating station having the following details a. Generators :50MVA,11KV,3Φ.-Two nos b. Transformers: 50MVA, 11/132KV, 3Φ. –Two nos c. Transformers(auxiliary):500 KVA , 11000/400 V. – 2 nos d. Transformers(reverse) : 1 MVA , 132/11 KV , 1 no e. Outgoing lines: 132 KV, 3Φ. 2 nos f. Also indicate positions of CT, PT, Isolating Switches, lightning Arrestors, Circuit Breakers.				20	CO2	2017
	3	Draw the single line diagram of a generating station having the following equipment. a. Incoming lines : 110 KV , 50 Hz. – 2nos b. Outgoing lines: 110KV,50 Hz. -1 no 11KV, 50 Hz. -8 nos c. Transformers: 5MVA,110/11KV ,3Φ, - . -2nos 15MVA, 110/220KV,3Φ, - .-1no 500 MVA, 11/400 KV, 3Φ, /Y. -1 no. One Auxiliary station Transformers				20	CO2	2016
	4	Draw the single line diagram of a generating station having the following equipment. a. Incoming lines: 110 KV, 50 Hz. – 1 no b. Outgoing lines: 13.2 KV,50 Hz. -3 nos 11KV, 50 Hz. -4 nos c. Transformers: 15MVA,110/13.2KV ,3Φ, Δ/ Y. -1no 8 MVA,110/11KV,3Φ,Δ/Y.-1no d. Auxiliary Station transformer : 750 KVA , 11 KV/400 V , Δ/Y.-1no e. Bus Bars : 110 KV.-1no 11 KV.- 1no				20	CO2	2018

		Show the positions of CT, PT, Isolating Switches , Lightning arrestors , Circuit Breakers.			
	5	Draw the single line diagram of a substation having the following equipment. a. Incoming lines : 11KV , 50 Hz. – 2 nos b. Outgoing lines : 33 KV , 50 Hz.-- 4 nos c. Transformer: 11/33 KV, 3Φ , Y- . 2 nos d. Bus bars :11 KV , 1 no 33 KV, 2 nos Show the positions of CT, PT, Isolating Switches, Lightning arrestors, circuit breakers.	20	CO2	2017
3	1	Draw the following views of a 3Φ , core type , 250 KVA , 11KV / 400 V transformer: a. Front elevation full in section b. Plan in full section Dimensions of various parts are given below: Core: Cross section of the core = 3 stepped core Diameter of the circumscribing circle = 24 cm Distance between adjacent core centers = 42.5 cm Yoke: height of the yoke 25 cm **LV Winding:** Outer diameter of LV Coil = 28.3 cm Inner diameter of LV coil = 25 cm Height of LV winding = 43.5 cm Number of turns per phase = 12 **HV Winding:** Outer diameter of HV Coil = 41.5 cm Inner Diameter of HV coil = 34.3 cm height of HV winding = 43.5 cm Number of turns / phase = 572 Total Height of the transformer = 100 cm	50	CO3	2016
	2	Draw the front elevation left half in section and sectional plan of a 15 KVA , 50 Hz distribution transformer Details of magnetic circuits: Cross section of the core = 63mm×91.6mm window= 298.5mm ×114.5mm Yoke height = 63.5 mm LV winding: Number of coils on each leg = 1 Number of turns / coil = 72 Number of layers /coil = 3 Section of conductor = 2.79mm×10.6mm HV winding: Number of coils on each leg = 1 Number of turns / coil = 720 Number of layers /coil = 8 Cross Section of wire = 2.59mm dia Insulation details: Air space around the core = 1.66 mm Insulation between core and LT = 1.6mm Insulation on H T = 3 mm Insulation at the top and bottom winding and insulation between layer = 0.35 mm Provide 10 mm bolt with sleeve at suitable spacing	50	CO3	2016
	3	Draw the longitudinal sectional view of a limb of a single phase transformer with the following details Diameter of circumscribing circle= 22.6 cm Diameter of LV Winding in 2 layers: inside = 25 cm, outside = 28 cm Height of LV winding = 41.2 cm Diameter of HV Winding: inside = 32 cm, outside =36.8 cm Height of HV winding = 40 cm	50	CO3	2017

	4	Draw the detailed drilling of each part of 500 KVA , 6600/400 V, single phase power transformer with the following data. Show full assembled plan and elevation Dimension of the core: core construction is cruciform Diameter = 33cm Width of the largest stamping = 33cm Width of the smallest stamping 17.5 cm Height of the core = 43 cm Centre to centre distance between cores = 49 cm Core laminations are used by means of 2 end plates – 3 mm thick by a bolt of dia 1.2 cm Yoke: Yoke height = 25cm Yoke length = 77 cm Total height of transformer = 9.3cm Winding: L.V winding: total turns = 22 No of turns / limb = 11 Inside dia of LV Winding = 33.75cm Outside dia of LV winding =38.35 cm Total height of the core occupied by the LV winding = 36.2cm H.T winding: 2 layers Inside dia of HT 1 st layer = 41.5 cm Outside dia of H.T nd 1 st layer = 43.3 cm Inside dia of HT 2 layer = 45 cm Outside dia of H.T 2 nd layer = 46.8 cm	50	CO3	2015
	5	Draw to a suitable scale the longitudinal cross section of a limb of a 3Φ oil cooled power transformer showing the H.T and L.T windings Diameter of circumscribing iron core circle = 22.6 cm Diameter of Secondary winding in 2 concentric layers, inside = 25 cm, outside 28.1 cm, height of secondary winding = 41.2 cm. Diameter of primary winding, inside = 32 cm, outside 36.8cm, height of Primary winding including 10 spacers= 40cm.	50	CO3	2015
			50		
4	1	Draw to a suitable scale half sectional end view and longitudinal end view of a 60 H.P, 4 Pole DC shunt motor, with the following details: **Armature:** Outside diameter =18.5 cm Length = 13.5cm Number of slots = 24 Size of slot = 0.7cm x 2 cm Main pole (laminated): Total height =11 cm Width = 7cm Pole arc = 10 cm Length of pole =14 cm Air gap =0.5 cm Interpole (solid):Size=2x10.8cm Length=11cm **Commutator:** Diameter =13cm Length =10cm **Brush:** Total no of spindles=4 **Winding:** Main pole=2cm, thick (Shunt winding)	50	CO3	2016

		Interpole winding = 1 cm thick The armature is directly mounted on the shaft and is held between two end plates. The shaft is supported by means of end shields bearings in the end cover			
	2	Draw to a suitable scale end view and elevation with top half in section of a DC machine, with the following details: Yoke: Outside diameter = 49.6cm Inner diameter = 40 cm Axial Length = 16 cm Main pole: Number of poles = 4 Total height = 12.6 cm Width =6cm Air gap = 1.6 mm Interpole : Number of poles= 4 Total height= 11 cm Width =9.5 cm Air gap = 2.5 mm	50	CO3	2017
	3	Following are the details of a main pole of a DC machine. Draw to suitable scale a) Elevation with right half in section b) Plan with right half in section Number of poles- 4 Height of pole-140mm Width of the pole-127mm Length of the pole -170mm Armature diameter-400mm Pole arc/ pole pitch =0.67 Number of turns per pole -1890 Conductor area -1.77mm 2 Depth of the winding-45mm Height of the winding-110mm (Missing data may be proportionally assumed)	50	CO3	2016
	4	Draw the plan and elevation (right-half section) of an inter pole or communicating pole used for machine with following dimensions: Height of the pole-130 Width of the pole=50 Length of inter pole=170 No of turns=23 Height of winding =110 Area of conductor =50x3 All dimensions are in mm	50	CO3	2017
	5	Draw to half scale sectional end elevation and sectional front elevation of a main pole of Dc machine with following dimensions: Width of the pole=168mm Pole arc=240mm Radius of pole arc =336mm Height of pole with shoe=228mm Height of the pole core=192mm Diameter of rivet used = 9mm Axial length of pole arc=216mm Thickness of yoke=114mm Show the arrangement of fixing pole to yoke.	50	CO3	2018
			50		
5	1	Salient pole rotor – 4 pole with integral pole stamping Draw the 4 pole salient pole rotor made of integral pole stamping with	50	CO3	2018

		the following data – Rotor OD = 225mm Rotor ID = 60mm Pole arc/Pole pitch = 0.74 Pole width = 65mm Damper bars = 5 no. of 10mm diameter. Field winding – 2 stepped in cross section the dimensions are 29mmX10mm and 22mmX8mm Steel rods on each pole body = 44mmX11mm.			
	2	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	50	CO3	2017
	3	Draw to scale half sectional end view and front view of alternator with the following data: Diameter of shaft = 7.6 cm Height of pole = 7.6 cm Diameter of frame (outer) = 92 cm Length of yoke = 22 cm Diameter of rotor = 46 cm outer diameter of the stator = 76 cm Number of poles = 10 Length of stator = 16cm	50	CO3	2018