Ref No:

Sri Krishna Institute of Technology Bengaluru-560090



COURSE PLAN

Academic Year - 2019-2020

Program:	B E – Electrical&Electronics Engineering
Semester :	6
Course Code:	17EE64
Course Title:	Electrical Machine Design
Credit / L-T-P:	4 / 4-0-0
Total Contact Hours:	50
Course Plan Author:	SHWETA B

Academic Evaluation and Monitoring Cell

#29, Hesaragatta Main Road, Chimney Hills Chikkabanavara Post Bengaluru – 560090, Karnataka, India Phone / Fax :080-23721477/28392221/23721315 Web: www,skit.org , e-mail: skitprinci1@gmail.com

Table of Contents

A. COURSE INFORMATION	4
1. Course Overview	4
2. Course Content	4
3. Course Material	
4. Course Prerequisites	6
5. Content for Placement, Profession, HE and GATE	6
B. OBE PARAMETERS	6
1. Course Outcomes	6
2. Course Applications	7
3. Mapping And Justification	7
4. Articulation Matrix	8
5. Curricular Gap and Content	8
6. Content Beyond Syllabus	9
C. COURSE ASSESSMENT	9
1. Course Coverage	9
2. Continuous Internal Assessment (CIA)	
D1. TEACHING PLAN - 1	10
Module - 1	
Module – 2	11
E1. CIA EXAM – 1	
a. Model Question Paper - 1	
b. Assignment -1	
D2. TEACHING PLAN - 2	16
Module – 3	
Module – 4	
E2. CIA EXAM – 2	
a. Model Question Paper - 2	
b. Assignment – 2	
D3. TEACHING PLAN - 3	22
Module – 5	
E3. CIA EXAM – 3	24
a. Model Question Paper - 3	24
b. Assignment – 3	24
F. EXAM PREPARATION	
1. University Model Question Paper	
2. SEE Important Questions	
G. Content to Course Outcomes	
1. TLPA Parameters	
2. Concepts and Outcomes:	

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:	Electrical Machine Design	Course Code:	17EE64
Credit / L-T-P:	4 / 4-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	50 Hours	SEE Marks:	60 Marks
CIA Marks:	40 Marks	Assignment	1 / Module
Course Plan Author:	Shweta B	Sign	Dt:
Checked By:		Sign	Dt:
CO Targets	CIA Target : 64%	SEE Target:	94%

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

2. Course Content

Content \checkmark 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	Blooms Learning
			Concepts	Levels
1	Fundamental Aspects of Electrical Machine Design: Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques.	10	Fundamental aspects	L2 Understand
	Electrical Engineering Materials: Desirabilities of Conducting Materials, Comparison of Aluminium and Copper wires. Ferromagnetic Materials: Soft Magnetic materials – Solid Core Materials, Electrical Sheet and Strip, Cold Rolled Grain Oriented Steel. Insulating Materials: Desirable Properties, Temperature Rise and Insulating Materials, Classification of Insulating materials based on Thermal Consideration.		Electrical Engineering materials	L2 Understand
2	Design of DC Machines: Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of	10	Armature Dimensions Design	L4 Analyze
	Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings.		Field winding Design	L4 Analyze
3	Design of Transformers: Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross	10	Main dimensions Design	L4 Analyze
	Sectional area of Primary and Secondary Windings, No Load Current. Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes.		performance parameters	L3 Apply
4	Design of Three Phase Induction Motors: Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for	10	Main dimensions Design	L4 Analyze
	Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance.		Rotor design	L4 Analyze
5	Design of Three Phase Synchronous Machines: Output	10	Stator Design	L4

	Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots		Rotors Design	Analyze
	and Winding. Design of Salient and non- salient Pole			L4
	Rotors. Magnetic Circuit and Field Winding.			Analyze
-	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	Chapt	Availabi
es		ers in	lity
		book	
Α	Text books (Title, Authors, Edition, Publisher, Year.)	-	-
1-5	A course in Electrical Machine design, A.K.Sawhney, DhanpatRai ,6 th Edition, 2013	1,2,5,9,	In Lib /
_		10 and	In Dept
		11	
			In Lib/
			In dept
В	Reference books (Title, Authors, Edition, Publisher, Year.)	_	-
	Performance and Design of Alternating Current Machine ,M.G. Say ,CBS		In Lib
	Publisher ,3 rd Edition, 2002		
1-5	Design Data Handbook ,A. Sanmugasundaram Et al ,New Age International,1 st	2,4,5,7	In Lib
	Edition, 2011.		
			In lib
С	Concept Videos or Simulation for Understanding	-	-
Сз	Armature Design:		
	https://www.youtube.com/watch?		
	v=10fLgpFg6Rc&list=PLLQiBbMXygz5Tc0runVg3wQB4s0TkB8lt		
C4	Field Design		
	https://www.youtube.com/watch?		
	v=Z9W0F9I6R2k&list=PLLQiBbMXygz5Tc0runVq3wQB4sOTkB8lt&index=3		
C5	Main Dimensions Design		
	https://www.youtube.com/watch?v=XZMArOR7u1g		
C6	Performace Parameters:		
	https://www.youtube.com/watch?v=XZMArOR7u1g		
C7	Stator Desgn:		
	https://www.youtube.com/watch?v=dZyO5gcWP-		
	o&list=PLLQiBbMXygz7zALKpbP87g4QaS9YGesZ5		
C8	Rotor Design:		
	https://www.youtube.com/watch?		
	<u>v=GayRzjI_imk&list=PLLQiBbMXygz7zALKpbP87g4QaS9YGesZ5&index=4</u>		
C9	Stator Design:		
	https://www.youtube.com/watch?		
	v=b24jORRoxEc&list=PLLQiBbMXygz7zALKpbP87g4QaS9YGesZ5&index=5		
C10	Rotor Design:		
	https://www.youtube.com/watch?		
	v=b24jORRoxEc&list=PLLQiBbMXygz7zALKpbP87g4QaS9YGes25&index=5	ļ	
<u> </u>	Lab : <u>https://www.youtube.com/watch?v=P9e7hUNPGVs</u> -		
D	Software Tools for Design	-	-
		ļ	
E	Recent Developments for Research	-	-
		ļ	
F	Others (Web, Video, Simulation, Notes etc.)	-	-
1			

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.

Modules	Course	Course Name	Topic / Description	Sem	Remarks	Blooms
	Code					Level
2,3,4,5	17EE33	Transformerand	1. Complete syllabus	3		L3
		Generator				
3,4,5	17EE44	Electric motors	2. Complete syllabus	4		L3

Students must have learnt the following Courses / Topics with described Content ...

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
1				Lover
3				
3				

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	Course Outcome	Teach.	Concept	Instr	Assessment	Blooms' Level
	Code.#	At the end of the	Hours		Method	Method	
		course, student should					
		be able to					
1	17EE64.1	Understand the	5	Fundamental	Lecture	Assignment	L2
		fundamental aspects of		Aspects		Unit Test &	Understanding
		machine design.				IA	
1	17EE64.2	Understand the	5	Electrical	Lecture	Assignment	L2
		desirability of		Engineering		Unit Test &	Understanding
		engineering material		materials		IA	0
2	17EE64.3	Design of armature of DC	6	Armature	Lecture	Assignment	L4
		machines.		Design	&	Unit Test &	Analyze
				-	PPT	IA	-
2	17EE64.4	Design of field windings of	4	Field	Lecture	Assignment	L4
		DC machines.		windings	&	Unit Test &	Analyze
				design	PPT	IA	-
3	17EE64.5	Design of core, field winding	7	Main	Lecture	Assignment	L4
		and tank of transformer.		Dimensions	&	Unit Test &	Analyze
				Design	PPT	IA	
3	17EE64.6	Analyze the performance	3	Performance	Lecture	Assignment	L4
		of transformer		Parameters	&	Unit Test &	Analyze
					PPT	IA	
4	17EE64.7	Design of stator of induction	6	Stator Design	Lecture	Assignment	L4
		motor.			&	Unit Test &	Analyze
					PPT	IA	
4	17EE64.8	Design of rotor of induction	4	Rotor Design	Lecture	Assignment	L4
		motor.			&	Unit Test &	Analyze
					PPT	IA	
5	17EE64.9	Design of stator of	6	Stator Design	Lecture	Assignment	L4
		synchronous machines.		_	&	Unit Test &	Analyze

					PPT	IA	
5	17EE64.10	Design of rotor of synchronous machines.	4	Rotor Design	Lecture & PPT	Assignment Unit Test & IA	L4 Analyze
-	-	Total	54	-	-	-	L2-L4

2. Course Applications

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

Madulaa		<u> </u>	Loval
Modules	Application Area	CO	Level
	Compiled from Module Applications.		
1	Wires for magnet coils and windings of machines, laminations	CO1	L2
1	Transformer and rotating electrical machines design	CO2	L2
2	DC Generators - generation of power in small back up & standby generating	CO3	L4
	plants, mini hydro-electric plants		
2	DC Motors – traction system, drives for process industries, battery driven	CO4	L4
	vehicle, machine tools, appliances, automatic control		
3	Isolate two circuits, impedance matching	CO5	L4
3	Step up and step down the voltage level in generation, transmission and	CO6	L4
	distribution		
4	Electric train engine, Printing machines.	CO7	L4
4	Chimneys at power plants, irrigation.	CO8	L4
5	Generation of power	CO9	L4
5	Paper mills, constant speed motor and it is used as reactive power control in	CO10	L4
	large power systems		

3. Mapping and Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair. To attain competency required (as defined in POs) in a specified area and the knowledge & ability required accomplishing it.

Modules	Мар	ping	Mapping Level	Justification for each CO-PO pair	Level
-	со	PO	-	'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'	-
1	CO1	PO1	2	Apply the Knowledge of fundamental aspects of electrical machinein design of electrical machines.	L2
1	CO2	PO1	2	Apply the Knowledge of electrical engineering materials in design of electrical machines.	L2
2	CO3	PO1	2	Apply the knowledge of construction of armature in designing of armature DC machine.	L2
2	CO3	PO2	2	Analysis of design of armature requires working of armature of DC machine.	L4
2	CO3	PO3	2	Design of armature is a part of DC machine design	L4
2	CO4	PO1	2	Apply the knowledge of construction of field winding in designing of field winding.	L2
2	CO4	PO2	2	Analysis of design of field winding requires working of field winding of DC machine.	L4
2	CO4	PO3	2	Design of armature is a part of DC machine design	L4
3	CO5	PO1	2	Apply the knowledge of construction of core and winding in design of transformer.	L2
3	CO5	PO2	2	Analysis of design of core and winding requires working of transformer.	L4
3	CO5	PO3	2	Design of core and winding is a part of transformer design	L4
3	CO6	PO1	2	Apply the knowledge of voltage regulation in design of transformer	L2
3	CO6	PO2	2	Analysis of problem in designing of transformer requires knowledge of voltage regulation.	L4
4	C07	PO1	2	Apply the knowledge of construction of stotor in design of	L2

				induction motor.	
4	CO7	PO2	2	Analysis of design of stator requires working of stator of induction	L4
				motor.	
4	CO7	PO3	2	Design of statoris a part of induction motor design.	L4
4	CO8	PO1	2	Apply the knowledge of construction of rotor in design of induction motor .	L2
4	CO8	PO2	2	Analysis of design of rotor requires working of rotor of induction motor.	L4
4	CO8	PO3	2	Design of rotor is a part of induction motor design	L4
5	CO9	PO1	2	Apply the knowledge of construction of stator in design of	L2
5	CO9	PO2	2	Analysis of design of stator requires working of stator of synchronous machine.	L4
5	CO9	PO3	2	Design of stator is a part of synchronous machine design.	L4
5	CO10	PO1	2	Apply the knowledge of construction of rotor in design of synchronous machine .	L2
5	CO10	PO2	2	Analysis of design of rotor requires working of rotor of synchronous machine.	L4
5	CO10	PO3	2	Design of rotor is a part of synchronous machine design.	L4

4. Articulation Matrix

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

-	-	Course		Program Outcomes										-				
		Outcomes																
Module	CO.#	At the end	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO11	PO1	PSO	PSO	PSO	Leve
S		of the	1	2	3	4	5	6	7	8	9	0		2	1	2	3	l
		course																
		student																
		should be																
		able to																
1	17EE64.1	Understand	2															L2
		the																
		fundamental																
		aspects of																
		machine																
		design.																
1	17EE64.2	Understand	2															L2
		the																
		desirability																
		of																
		engineering																
		material																
2	17EE64.3	Design of	2	2	2													L4
	,	armature of																
		DC machines.																
2	17EE64.4	Design of field	2	2	2													L4
		windings of																
		DC machines.																
		Decise of																
3	1/EE04.5	Design of	2	2	2													L4
		winding and																
		tank of																
		transformer.																
3	17EE64.6	Analyze the	2	2	2													L4
		performance																

COURSE PLAN - CAY 2019-20

		of													
		transformer													
4	17EE64.7	Design of stator of induction motor.	2	2	2										L4
4	17EE64.8	Design of rotor of induction motor.	2	2	2										L4
5	17EE64.9	Design of stator of synchronous machines.	2	2	2										L4
5	17EE64.1 0	Design of rotor of synchronous machines.	2	2	2										L4
-	CS501PC	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; 51.Software Engineering; 52.Data Base Management; 53.Web Design													

5. 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					
2					

6. Content beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

Modules	Gap Topic	Area	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1						
1						

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.		No. of	quest	ion in	Exam		CO	Levels
			Hours	CIA-1	CIA-2	CIA-3	Asg	Extra	SEE		
								Asg			
1	Fundamental Aspect	s of	10	2	-	-	1	1	2	CO1, CO2	L2, L2
	Electrical Machine Desigr	า									
2	Design of DC Machines		10	2	-	-	1	1	2	CO3, CO4	L4, L4
3	Design of Transformers		14	-	2	-	1	1	2	CO5, CO6	L4, L4
4	Design of Three Phase Ir	duction	10	-	2	-	1	1	2	CO7, C08	L4, L4
	Motors										
5	Design of Three	Phase	10	-	-	4	1	1	2	CO9, CO10	L4, L4
	Synchronous Machines										
-	Total		54	4	4	4	5	5	10	-	-

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	CO	Levels
		Marks		
1, 2	CIA Exam – 1	15	CO1, CO2, CO3,Co4	L2, L2, L4, L4
3, 4	CIA Exam – 2	15	CO5, CO6, CO7,C08	L4, L4, L4, L4
5	CIA Exam – 3	15	CO9, CO10	L4, L4
1, 2	Assignment - 1	05	CO1, CO2, CO3,Co4	L2, L2, L4, L4
3, 4	Assignment - 2	05	CO5, CO6, CO7,C08	L2, L4, L2, L4
5	Assignment - 3	05	CO9, CO10	L4, L4
1, 2	Seminar - 1		-	-
3, 4	Seminar - 2		-	-
5	Seminar - 3		-	-
1, 2	Quiz - 1		-	-
3, 4	Quiz - 2		-	-
5	Quiz - 3		-	-
1-5	Other Activities – Mini Project	-	CO9, CO10	L2,L2
	Final CIA Marks	20	-	-

D1. TEACHING PLAN - 1

Module - 1

Title:	1. Fundamental Aspects of Electrical Machine Design	Appr	10 Hrs
	2. Electrical Engineering Materials	Time:	
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Understand the fundamental aspects of machine design.	CO1	L2
2	Understand the desirabilities of engineering material	CO2	L2
b	Course Schedule		-
Class No	Module Content Covered	СО	Level
1	Design of Machines, Design Factors	C01	L2
2	Limitations in design	CO1	L2
3	Modern Trends in design, manufacturing Techniques.	CO1	L2
4	Desirabilities of Conducting Materials	CO2	L2
5	Comparison of Aluminium and Copper wires.	CO2	L2
6	Ferromagnetic Materials: Soft Magnetic materials – Solid Core Materials	CO2	L2
7	Electrical Sheet and Strip, Cold Rolled Grain Oriented Steel.	CO2	L2
8	Insulating Materials: Desirable Properties	CO2	L2
9	Temperature Rise and Insulating Materials	CO2	L2
10	Classification of Insulating materials based on Thermal Consideration.	CO2	L2
с	Application Areas	СО	Level
1	Wires for magnet coils and windings of machines, laminations	CO1	L2
2	Transformer and rotating electrical machines design	CO2	L2
d	Review Questions	-	-
1	What are the considerations to be made while designing a electrical	C01	L2
	machines?		
2	List some limitation of the design.	C01	L2
3	What are the factors that decide the choice of specific magnetic loading?	C01	L2
4	What are the major considerations to evolve a good design of electrical	C01	L2

	machine?		
5	What are the fundamental requirements of high conductivity materials?	C02	L2
6	Why hard drawn copper wires are used in electrical machines?	C02	L2
7	What are the types of magnetic materials? Give examples	C02	L2
8	What is CRGO steel? what are its uses?	C02	L2
9	Discuss briefly about electrical properties of insulating materials.	C02	L2
10	What are the classifications of insulating materials?give examples.	C02	L2
11	Which insulating material is used in modern electric machines?	C02	L2
12	Write a short note on insulating materials for transformer.	C02	L2
е	Experiences	-	-
1			
2			
3			
4			

Module – 2

Title:	Design of DC Machines	Appr	10 Hrs
		Time:	
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Design of armature of DC machines.	CO3	L4
2	Design of field windingof DC machines.	CO4	L4
b	Course Schedule	-	-
Class No	Module Content Covered	СО	Level
1	Output Equation	CO3	L4
2	Choice of Specific Loadings and Choice of Number of Poles	CO3	L4
3	Main Dimensions of armature	CO3	L4
4	Main Dimensions of armature	CO3	L4
5	Design of Armature Slot Dimensions	CO3	L4
6	Design of Commutator and Brushes	CO3	L4
7	Estimation of Ampere Turns for the Magnetic Circuit.	CO4	L4
8	Dimensions of Yoke, Main Pole and Air Gap.	CO4	L4
9	Design of Shunt and Series Field Windings.	CO4	L4
10	Design of Shunt and Series Field Windings.	CO4	L4
С	Application Areas	СО	Level
1	DC Generators - generation of power in small back up & standby generating plants, mini hydro-electric plants	CO3	L4
2	DC Motors – traction system, drives for process industries, battery driven vehicle, machine tools, appliances, automatic control	CO4	L4
d	Review Questions	-	-
1	Explain the concept of determining the temperature gradients in conductors placed in slots. What are the limitations of design of electrical apparatus? Explain them.	CO3	L4
2	Define the terms specific electric loading and specific magnetic loading as applied to electrical machines. What are the considerations in the choice of these for D.C machines?	CO3	L4
3	Explain the real and apparent flux densities. Discuss about the various leakage fluxes.	CO3	L4
4	Discuss quantitatively the effects of slots and ventilating ducts upon the reluctance of the air gap of a D.C machine.	CO3	L4
5	Draw the magnetic circuit of a D.C machine. Derive an expression for the total	CO3	L4

Copyright ©2017. cAAS. All rights reserved.

6 What are the major groups of electrical conducting materials? Describe the methods of measurement of temperature rise in various parts of Co3 L4 7 Describe the methods of measurement of temperature rise in various parts of Co3 L4 8 Explain in detail the various cooling methods of electrical machines. CO3 L4 9 What is the relation between the power developed in armature and the power Co3 L3 10 Write the output equation of a dc machine. CO3 L2 10 What is the range of specific magnetic loading in dc machine? CO3 L2 11 What is the range of specific electric loading in dc machine? CO4 L3 13 What is the purpose of constructing the pole body by laminated sheets? CO3 L4 14 What are the factors to be considered for the selection of number of poles in CO3 L4 16 What are the factors to be considered for the selection of number of poles in CO3 L4 16 What are the factors to be considered for the selection of number of poles in CO3 L4 17 List the disadvantages of large number of poles CO3 L3 17 List the disadvantages of large number of poles CO3 L2 10 Mention		mmf per pole.		
properties and applications of those materials. CO Image: Colored state in the image in the	6	What are the major groups of electrical conducting materials? Describe the	CO3	١⊿
7 Describe the methods of measurement of temperature rise in various parts of an electrical machine. CO3 L4 8 Explain in detail the various cooling methods of electrical machines. CO3 L4 9 What is the relation between the power developed in armature and the power output in the dc machine? CO3 L3 10 Write the output equation of a dc machine. CO3 L2 12 What is the range of specific magnetic loading in a dc machine? CO4 L2 13 What is the range of specific electric loading in dc machine? CO4 L3 14 What is the range of specific electric loading in dc machine? CO4 L4 14 What is the parpose of constructing the pole body by laminated sheets? CO3 L4 16 What are the factors to be considered for the selection of number of poles in dc machine? CO3 L3 17 List the advantages of large number of poles. CO3 L3 18 List the diadvantages of large length of air gap in dc machine? CO3 L3 19 Why square pole is preferred? CO3 L2 10 What are the factors to be considered for setimating the length of air gap in dc machine? CO3 L2 <td></td> <td>properties and applications of those materials.</td> <td></td> <td></td>		properties and applications of those materials.		
an electrical machine CO3 L4 8 Explain in detail the various cooling methods of electrical machines. CO3 L3 9 What is the relation between the power developed in armature and the power CO3 L3 10 Write the output equation of a dc machine. CO3 L2 11 What is the range of specific magnetic loading in dc machine? CO4 L3 13 What is the range of specific electric loading in dc machine? CO4 L3 14 What is the range of specific electric loading in dc machine? CO4 L4 14 What is the range of specific electric loading in dc machine? CO4 L4 15 What is the purpose of constructing the pole body by laminated sheets? CO3 L4 16 What are the factors to be considered for the selection of number of poles in CO3 L4 16 What are the factors to be considered for number of poles CO3 L3 17 List the divantages of large number of poles CO3 L2 18 List the divantages of large number of poles CO3 L2 19 What are the factors to be considered for estimating the length of air gap in CO3 L2 2	7	Describe the methods of measurement of temperature rise in various parts of	CO3	4
8 Explain in detail the various cooling methods of electrical machines. CO3 L4 9 What is the relation between the power developed in armature and the power output in the dc machine? CO3 L3 10 Write the output equation of a dc machine. CO3 L3 11 What is the range of specific magnetic loading in a dc machine? CO3 L2 12 What are the factors to be considered for the choice of specific magnetic loading? CO4 L3 13 What is the range of specific electric loading in dc machine? CO4 L3 14 What are the factors to be considered for the selection of number of poles in CO3 L4 15 What is the purpose of constructing the pole body by laminated sheets? CO3 L4 16 What are the factors to be considered for the selection of number of poles in CO3 L4 16 What are the factors to be considered for unber of poles CO3 L4 20 Mention guiding factors for the selection of number of poles CO3 L2 21 What are the factors to be considered for deciding the length of air gap in CO3 L2 L4 20 Mention guiding factors for the selection of number of armature slots in a dc machine? CO3	,	an electrical machine.		
9 What is the relation between the power developed in armature and the power CO3 L3 0 Write the output equation of a dc machine. CO3 L3 11 What is the range of specific magnetic loading in a dc machine? CO3 L2 12 What is the range of specific magnetic loading in a dc machine? CO4 L3 13 What is the range of specific electric loading in dc machine? CO4 L3 14 What is the range of specific electric loading in dc machine? CO4 L4 15 What is the purpose of constructing the pole body by laminated sheets? CO3 L4 16 What are the factors to be considered for the selection of number of poles in CO3 L4 16 What are the factors to be considered for the selection of number of poles in CO3 L4 17 List the disadvantages of large number of poles CO3 L3 18 List the disadvantages of large number of poles CO3 L2 19 Why square pole is preferred? CO3 L2 20 Mention guiding factors for the selection of number of poles CO3 L2 21 What are the factors to be considered for estimating the length of air gap in C	8	Explain in detail the various cooling methods of electrical machines.	CO3	L4
output in the dc machine? CO3 L3 10 Write the output equation of a dc machine. CO3 L3 11 What is the range of specific magnetic loading in a dc machine? CO3 L2 12 What are the factors to be considered for the choice of specific electric CO4 L3 13 What is the range of specific electric loading in dc machine? CO4 L4 loading? CO3 L4 L4 loading? CO4 L4 L4 loading? CO3 L4 L3 loadinade What are the factors to be considered for the selection of number of poles in C3 L3 list the disadvantages of large number of poles CO3 L4 loadine factors to be considered for estimating the length of air gap in C3 L2 lwhat are the factors to be considered for esti	a	What is the relation between the power developed in armature and the power	CO3	3
10 Write the output equation of a dc machine. CO3 L3 11 What is the range of specific magnetic loading in a dc machine? CO3 L2 12 What is the range of specific electric loading in dc machine? CO4 L3 13 What is the range of specific electric loading in dc machine? CO4 L3 14 What are the factors to be considered for the choice of specific electric CO4 L4 16 What is the purpose of constructing the pole body by laminated sheets? CO3 L4 16 What is the purpose of constructing the pole body by laminated sheets? CO3 L4 17 List the advantages of large number of poles. CO3 L3 18 List the disadvantages of large number of poles. CO3 L4 20 Mention guiding factors for the selection of number of poles CO3 L2 21 What are the factors to be considered for estimating the length of air gap in CO3 L2 22 What are the factors to be considered for deciding the slot dimensions? CO3 L4 22 What are the factors to be considered for deciding the slot dimensions? CO3 L4 23 Mention the factors governing		output in the dc machine?	000	-5
11 What is the range of specific magnetic loading in a dc machine? CO3 L2 12 What are the factors to be considered for the choice of specific magnetic loading? CO4 L3 13 What is the range of specific electric loading in dc machine? CO4 L3 14 What is the range of specific electric loading in dc machine? CO4 L4 15 What is the purpose of constructing the pole body by laminated sheets? CO3 L4 16 What are the factors to be considered for the selection of number of poles in CO3 L4 16 What are the factors to be considered for the selection of number of poles in CO3 L4 17 List the disadvantages of large number of poles. CO3 L3 18 List the disadvantages of large number of poles CO3 L3 19 Why square pole is preferred? CO3 L2 20 Mention guiding factors for the selection of number of poles CO3 L2 21 What are the factors governing the choice of number of armature slots in a dc machine? CO3 L4 23 Mention the factors to be considered for deciding the slot dimensions? CO3 L4 24 What is the purpose of slo	10	Write the output equation of a dc machine.	CO3	L3
12 What are the factors to be considered for the choice of specific magnetic C03 L3 L2 13 What is the range of specific electric loading in dc machine? C04 L3 14 What are the factors to be considered for the choice of specific electric C04 L4 L3 15 What are the factors to be considered for the choice of specific electric C03 L4 L4 16 What are the factors to be considered for the selection of number of poles in C03 L4 L3 17 List the disadvantages of large number of poles C03 L3 18 List the disadvantages of large number of poles C03 L4 20 Mention guiding factors for the selection of number of poles C03 L4 21 What are the factors to be considered for estimating the length of air gap in C03 L4 L2 22 What are the factors to be considered for deciding the slot dimensions? C03 L4 23 Mention the factors to be considered for deciding the slot dimensions? C03 L4 24 What is the purpose of slot insulation? C03 L4 25 What are the factors to be considered for deciding the slot dimensions? C03 L4 26 What is the purpose of slot insulation? C03 L4 27 Mention the factors to be considered for the design of	11	What is the range of specific magnetic loading in a dc machine?	CO3	L2
loading? CO4 L3 13 What is the range of specific electric loading in dc machine? CO4 L3 14 What are the factors to be considered for the choice of specific electric CO4 L4 loading? CO3 L4 15 What is the purpose of constructing the pole body by laminated sheets? CO3 L4 16 What are the factors to be considered for the selection of number of poles in CO3 L4 17 List the advantages of large number of poles CO3 L3 18 List the disadvantages of large number of poles CO3 L4 20 Mention guiding factors for the selection of number of poles CO3 L2 21 What are the advantages of large length of air gap in dc machine? CO3 L4 20 Mention the factors to be considered for estimating the length of air gap in CO3 L4 22 What are the factors to be considered for deciding the slot dimensions? CO3 L4 23 Mention the factors to be considered for deciding the slot dimensions? CO3 L4 24 What is the purpose of slot insulation? CO3 L4 25 What mare the factors to be considered for decidi	12	What are the factors to be considered for the choice of specific magnetic	CO3	L2
13 What is the range of specific electric loading in dc machine? CO4 L3 14 What are the factors to be considered for the choice of specific electric loading? CO3 L4 15 What is the purpose of constructing the pole body by laminated sheets? CO3 L4 16 What are the factors to be considered for the selection of number of poles in dc machine? CO3 L4 17 List the advantages of large number of poles. CO3 L3 19 Why square pole is preferred? CO3 L4 20 Mention guiding factors for the selection of number of poles CO3 L2 21 What are the factors to be considered for estimating the length of air gap in CO3 L4 22 What are the factors to be considered for estimating the length of air gap in CO3 L4 23 Mention the factors governing the choice of number of armature slots in a dc machine? CO3 L4 24 What is the purpose of slot insulation? CO3 L4 25 What are the factors to be considered for deciding the slot dimensions? CO3 L4 26 What is the purpose of slot insulation? CO3 L4 26 What is meant by equalizer connec		loading?	-	
14 What are the factors to be considered for the choice of specific electric loading? CO4 L4 15 What is the purpose of constructing the pole body by laminated sheets? CO3 L4 16 What are the factors to be considered for the selection of number of poles in CO3 L4 17 List the advantages of large number of poles. CO3 L3 18 List the disadvantages of large number of poles CO3 L4 20 Mention guiding factors for the selection of number of poles CO3 L2 21 What are the advantages of large length of air gap in dc machine? CO3 L4 22 What are the factors to be considered for estimating the length of air gap in dc machine? CO3 L4 23 Mention the factors governing the choice of number of armature slots in a dc machine? CO3 L4 24 What is the purpose of slot insulation? CO3 L4 25 What are the factors to be considered for deciding the slot dimensions? CO3 L4 26 What factor decides the minimum number of armature coils? CO3 L4 26 What is meant by equalizer connections? CO4 L4 29 What is the leng	13	What is the range of specific electric loading in dc machine?	CO4	L3
loading? L4 15 What is the purpose of constructing the pole body by laminated sheets? CO3 L4 16 What are the factors to be considered for the selection of number of poles in CO3 L3 17 List the advantages of large number of poles. CO3 L3 18 List the disadvantages of large number of poles CO3 L3 19 Why square pole is preferred? CO3 L4 20 Mention guiding factors for the selection of number of poles CO3 L2 21 What are the factors to be considered for estimating the length of air gap in CO3 L2 22 What is the purpose of slot insulation? CO3 L4 23 Mention the factors to be considered for deciding the slot dimensions? CO3 L4 24 What is the purpose of slot insulation? CO3 L4 25 What factor decides the minimum number of armature coils? CO3 L4 26 What is the length of mean turn of filed coil? CO4 L4 29 What is the length of mean turn of filed coil? CO4 L4 30 Mention the factors to be considered for the design of shunt field coil? CO4 <td>14</td> <td>What are the factors to be considered for the choice of specific electric</td> <td>CO4</td> <td>L4</td>	14	What are the factors to be considered for the choice of specific electric	CO4	L4
15 What is the purpose of constructing the pole body by laminated sheets? CO3 L4 16 What are the factors to be considered for the selection of number of poles in dc machine? CO3 L3 17 List the advantages of large number of poles. CO3 L3 18 List the disadvantages of large number of poles CO3 L3 19 Why square pole is preferred? CO3 L4 20 Mention guiding factors for the selection of number of poles CO3 L2 21 What are the factors to be considered for estimating the length of air gap in CO3 L4 22 What are the factors governing the choice of number of armature slots in a dc machine? CO3 L4 23 Mention the factors to be considered for deciding the slot dimensions? CO3 L4 24 What is the purpose of slot insulation? CO3 L4 25 What factor decides the minimum number of armature coils? CO3 L4 26 What is meant by equalizer connections? CO4 L4 29 What is the length of mean turn of filed coil? CO4 L4 30 Mention the factors to be considered for the design of shunt field coil?		loading?		
16 What are the factors to be considered for the selection of number of poles in CO3 L4 17 List the advantages of large number of poles. CO3 L3 18 List the disadvantages of large number of poles CO3 L3 19 Why square pole is preferred? CO3 L4 20 Mention guiding factors for the selection of number of poles CO3 L2 21 What are the advantages of large length of air gap in dc machine? CO3 L4 20 Mention the factors governing the choice of number of armature slots in a dc machine? CO3 L4 23 Mention the factors to be considered for deciding the slot dimensions? CO3 L4 24 What is the purpose of slot insulation? CO3 L4 25 What factor decides the minimum number of armature coils? CO3 L4 26 What factor decides the minimum number of armature coils? CO4 L4 29 What is the length of mean turn of filed coil? CO4 L4 30 Mention the factors to be considered for the design of shunt field coil? CO4 L4 30 Mention the factors that influence the choice of commutator CO4 <td< td=""><td>15</td><td>What is the purpose of constructing the pole body by laminated sheets?</td><td>CO3</td><td>L4</td></td<>	15	What is the purpose of constructing the pole body by laminated sheets?	CO3	L4
dc machine? CO3 L3 17 List the advantages of large number of poles. CO3 L3 18 List the disadvantages of large number of poles CO3 L3 19 Why square pole is preferred? CO3 L4 20 Mention guiding factors for the selection of number of poles CO3 L2 21 What are the advantages of large length of air gap in dc machine? CO3 L2 22 What are the factors to be considered for estimating the length of air gap in C3 L4 dc machine? CO3 L4 23 Mention the factors governing the choice of number of armature slots in a dc machine. CO3 L4 24 What is the purpose of slot insulation? CO3 L4 25 What factor decides the minimum number of armature coils? CO3 L4 26 What factor decides the minimum number of armature coils? CO3 L4 27 Mention the two types of winding used in the dc machines. CO3 L4 28 What is the length of mean turn of filed coil? CO4 L4 30 Mention the factors to be considered for the design of shunt field coil? CO4	16	What are the factors to be considered for the selection of number of poles in	CO3	L4
17List the advantages of large number of poles.CO3L318List the disadvantages of large number of polesCO3L319Why square pole is preferred?CO3L420Mention guiding factors for the selection of number of polesCO3L221What are the advantages of large length of air gap in dc machine?CO3L222What are the factors to be considered for estimating the length of air gap in dc machine.CO3L423Mention the factors governing the choice of number of armature slots in a dc machine.CO3L424What is the purpose of slot insulation?CO3L425What are the factors to be considered for deciding the slot dimensions?CO3L426What factor decides the minimum number of armature coils?CO3L427Mention the two types of winding used in the dc machines.CO3L429What is meant by equalizer connections?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L430Mention the factors that influence the choice of commutator.CO4L431Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L434What is the need for brushes in dc machines?CO4L435What are the effects of armature reaction?CO4L436What is meant by magnetic circuit calculations		dc machine?		
18 List the disadvantages of large number of poles CO3 L3 19 Why square pole is preferred? CO3 L4 20 Mention guiding factors for the selection of number of poles CO3 L2 21 What are the advantages of large length of air gap in dc machine? CO3 L2 22 What are the factors to be considered for estimating the length of air gap in dc machine? CO3 L4 23 Mention the factors governing the choice of number of armature slots in a dc machine? CO3 L4 24 What is the purpose of slot insulation? CO3 L4 25 What are the factors to be considered for deciding the slot dimensions? CO3 L4 26 What factor decides the minimum number of armature coils? CO3 L4 27 Mention the two types of winding used in the dc machines. CO3 L4 29 What is meant by equalizer connections? CO4 L4 30 Mention the factors to be considered for the design of shunt field coil? CO4 L4 30 Mention the factors that influence the choice of commutator. CO4 L4 30 Mention the factors that influence the choice of commutat	17	List the advantages of large number of poles.	CO3	L3
19Why square pole is preferred?CO3L420Mention guiding factors for the selection of number of polesCO3L221What are the advantages of large length of air gap in dc machine?CO3L222What are the factors to be considered for estimating the length of air gap in dc machine?CO3L423Mention the factors governing the choice of number of armature slots in a dc machine.CO3L424What is the purpose of slot insulation?CO3L425What are the factors to be considered for deciding the slot dimensions?CO3L426What factor decides the minimum number of armature coils?CO3L427Mention the two types of winding used in the dc machines.CO3L429What is meant by equalizer connections?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L431Discuss the parameters governing the length of commutator.CO4L432What are the affects of armature reaction?CO4L433What is the need for brushes in dc machine?CO4L434What are the effects of armature reaction?CO4L435What are the effects of armature reaction?CO4L436What are the effects of armature reaction	18	List the disadvantages of large number of poles	CO3	L3
20Mention guiding factors for the selection of number of polesCO3L221What are the advantages of large length of air gap in dc machine?CO3L222What are the factors to be considered for estimating the length of air gap in dc machine?CO3L423Mention the factors governing the choice of number of armature slots in a dc CO3L424What is the purpose of slot insulation?CO3L425What are the factors to be considered for deciding the slot dimensions?CO3L426What factor decides the minimum number of armature coils?CO3L427Mention the two types of winding used in the dc machines.CO3L429What is meant by equalizer connections?CO4L429What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L431Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machines?CO4L434What are the effects of armature reaction?CO4L435What are the effects of armature reaction?CO4L436What is meant by mag	19	Why square pole is preferred?	CO3	L4
21What are the advantages of large length of air gap in dc machine?CO3L222What are the factors to be considered for estimating the length of air gap in dc machine?CO3L423Mention the factors governing the choice of number of armature slots in a dc machine.CO3L424What is the purpose of slot insulation?CO3L425What are the factors to be considered for deciding the slot dimensions?CO3L426What factor decides the minimum number of armature coils?CO3L427Mention the two types of winding used in the dc machines.CO3L428What is meant by equalizer connections?CO4L429What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L430Mention the factors to be considered for brushes in dc commutator.CO4L430Mention the factors that influence the choice of commutator.CO4L431Discuss the parameters governing the length of commutator.CO4L432What are the materials used for brushes in dc machines?CO4L434What are the effects of armature reaction?CO4L435What are the effects of armature reaction?CO4L436What is meant by magnetic circuit calculations.CO4L236What is meant by magnetic circuit calculations.CO4L236What is the total design steps of D.C.	20	Mention guiding factors for the selection of number of poles	CO3	L2
22What are the factors to be considered for estimating the length of air gap in dc machine?CO3L423Mention the factors governing the choice of number of armature slots in a dc machine.CO3L424What is the purpose of slot insulation?CO3L425What are the factors to be considered for deciding the slot dimensions?CO3L426What factor decides the minimum number of armature coils?CO3L427Mention the two types of winding used in the dc machines.CO3L428What is meant by equalizer connections?CO4L429What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L431Discuss the parameters governing the length of commutator.CO4L432What is the need for brushes in dc machine?CO4L433What are the factors that influence the choice of commutator diameter?CO4L434What are the materials used for brushes in dc machine?CO4L234What are the effects of armature reaction?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L238What is mea	21	What are the advantages of large length of air gap in dc machine?	CO3	L2
dc machine?Image: Comparison of the second system23Mention the factors governing the choice of number of armature slots in a dc machine.CO3L424What is the purpose of slot insulation?CO3L425What are the factors to be considered for deciding the slot dimensions?CO3L426What factor decides the minimum number of armature coils?CO3L427Mention the two types of winding used in the dc machines.CO3L428What is meant by equalizer connections?CO4L429What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L431Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machine?CO4L434What are the effects of armature reaction?CO4L435What are the effects of armature reaction?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L236What is meant by magnetic circuit calculations.CO4L237<	22	What are the factors to be considered for estimating the length of air gap in	CO3	L4
23Mention the factors governing the choice of number of armature slots in a dc machine.CO3L424What is the purpose of slot insulation?CO3L425What are the factors to be considered for deciding the slot dimensions?CO3L426What factor decides the minimum number of armature coils?CO3L427Mention the two types of winding used in the dc machines.CO3L429What is meant by equalizer connections?CO4L429What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L431Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machine?CO4L234What are the materials used for brushes in dc machines?CO4L236What is meant by magnetic circuit calculations.CO4L236What is meant by magnetic circuit calculations.CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L24L24L2L25L2L2L26Experiences <tr <td=""></tr>		dc machine?		
machine.CO3L424What is the purpose of slot insulation?CO3L425What are the factors to be considered for deciding the slot dimensions?CO3L426What factor decides the minimum number of armature coils?CO3L427Mention the two types of winding used in the dc machines.CO328What is meant by equalizer connections?CO4L429What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L431Discuss the parameters governing the length of commutator.CO4L432What is the need for brushes in dc machine?CO4L433What is the need for brushes in dc machine?CO4L234What are the materials used for brushes in dc machines?CO4L236What is meant by magnetic circuit calculations.CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefty describe each stepCO4L24Experiences1	23	Mention the factors governing the choice of number of armature slots in a dc	CO3	L4
24What is the purpose of slot insulation?CO3L425What are the factors to be considered for deciding the slot dimensions?CO3L426What factor decides the minimum number of armature coils?CO3L427Mention the two types of winding used in the dc machines.CO3L428What is meant by equalizer connections?CO4L429What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L431Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machine?CO4L234What are the effects of armature reaction?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L236Faperiences1		machine.		
25What are the factors to be considered for deciding the slot dimensions?CO3L426What factor decides the minimum number of armature coils?CO3L427Mention the two types of winding used in the dc machines.CO328What is meant by equalizer connections?CO4L429What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L431Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machine?CO4L234What are the materials used for brushes in dc machines?CO4L235What is meant by magnetic circuit calculations.CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L236 Experiences 1	24	What is the purpose of slot insulation?	CO3	L4
26What factor decides the minimum number of armature coils?CO3L427Mention the two types of winding used in the dc machines.CO328What is meant by equalizer connections?CO4L429What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L431Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machine?CO4L234What are the materials used for brushes in dc machines?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L244444437Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L2444444544446444471111724444844449444494444944449444494444	25	What are the factors to be considered for deciding the slot dimensions?	CO3	L4
26What factor decides the minimum number of armature coils?CO3L427Mention the two types of winding used in the dc machines.CO328What is meant by equalizer connections?CO4L429What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L431Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machine?CO4L234What are the materials used for brushes in dc machines?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L24212				
27Mention the two types of winding used in the dc machines.CO328What is meant by equalizer connections?CO4L429What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO431Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machine?CO4L234What are the materials used for brushes in dc machines?CO4L235What are the effects of armature reaction?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L21	26	What factor decides the minimum number of armature coils?	CO3	L4
28What is meant by equalizer connections?CO4L429What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO4L431Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machine?CO4L234What are the materials used for brushes in dc machines?CO4L235What are the effects of armature reaction?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L21	27	Mention the two types of winding used in the dc machines.	CO3	
29What is the length of mean turn of filed coil?CO4L430Mention the factors to be considered for the design of shunt field coil?CO431Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machine?CO4L234What are the materials used for brushes in dc machines?CO4L435What are the effects of armature reaction?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L21	28	What is meant by equalizer connections?	CO4	L4
30Mention the factors to be considered for the design of shunt field coil?CO431Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machine?CO4L234What are the materials used for brushes in dc machines?CO4L435What are the effects of armature reaction?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L24212	29	What is the length of mean turn of filed coil?	CO4	L4
31Discuss the parameters governing the length of commutator.CO4L432What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machine?CO4L234What are the materials used for brushes in dc machines?CO4L435What are the effects of armature reaction?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L21	30	Mention the factors to be considered for the design of shunt field coil?	CO4	-
32What are the factors that influence the choice of commutator diameter?CO4L433What is the need for brushes in dc machine?CO4L234What are the materials used for brushes in dc machines?CO4L435What are the effects of armature reaction?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L26Experiences11112111	31	Discuss the parameters governing the length of commutator.	CO4	L4
33What is the need for brushes in dc machine?CO4L234What are the materials used for brushes in dc machines?CO4L435What are the effects of armature reaction?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L2eExperiences11112111	32	What are the factors that influence the choice of commutator diameter?	CO4	L4
34What are the materials used for brushes in dc machines?CO4L435What are the effects of armature reaction?CO4L236What is meant by magnetic circuit calculations.CO4L237Discuss the total design steps of D.C.machines. Briefly describe each stepCO4L2eExperiences1	33	What is the need for brushes in dc machine?	CO4	L2
35 What are the effects of armature reaction? CO4 L2 36 What is meant by magnetic circuit calculations. CO4 L2 37 Discuss the total design steps of D.C.machines. Briefly describe each step CO4 L2 e Experiences - - 1	34	What are the materials used for brushes in dc machines?	CO4	L4
36 What is meant by magnetic circuit calculations. CO4 L2 37 Discuss the total design steps of D.C.machines. Briefly describe each step CO4 L2 e Experiences - - 1	35	What are the effects of armature reaction?	CO4	L2
37 Discuss the total design steps of D.C.machines. Briefly describe each step CO4 L2 e Experiences - - 1 - - - 2 - - -	36	What is meant by magnetic circuit calculations.	CO4	L2
e Experiences - - 1	37	Discuss the total design steps of D.C.machines. Briefly describe each step	CO4	L2
1 2 I	е	Experiences	-	-
2	1			
	2			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs	Code:	17EE64	Sem:	6	Marks:	30	Time:	75 minute	es	
Col	irse:	Electrical M	achine Desi	gn						
-	-	Note: Answ	er any 3 qu	estions, eac	ch carry equ	ıal marks.		Marks	СО	Level
1	а	List the rec assigned to	cognized cla them. Mention	isses of ins on at least tv	ulating mate vo examples	erials and for each ty	the temperatu pe.	ire 7	C01	L2
	b	What are t electrical m	he major c achines? W	consideration	ns accounte e factors th	d for the ose limit t	good design he design of	of 8 a	C01	L2

		machine?			
		OR			
2	а	Make a brief comparison chart between copper and aluminium when used in electrical machine windings. Discuss briefly about electrical properties of insulating materials.	8	C02	L2
	b	What is CRGO steel? What are its uses? Explain briefly with the help of directional properties of CRGO transformer steel.	7	C02	L2
3	а	With usual notations derive the output equation of a D.C machines. Mention the various factors that affect the choice of number of poles of a D.C machine.	9	C03	L3
	b	A 5KW, 250V, 4 pole, 1500rpm shunt generator is designed to have a square pole face. The loadings are average flux density in the air gap = 0.42 wb/m ² , ampere conductors /meter = 15000. Find the main dimensions of the machine. Assume full load efficiency = 0.87 and ratio of pole arc to pole pitch is 0.66.	6	C03	L4
		OR			
4	а	Define specific loadings and discuss in brief the factors influencing the choice of specific electric and magnetic loadings in D.C machines.	8	C04	L3
	b	Calculate the diameter and length of armature for a 7.5kw, 4pole, 1000rpm, 220v shunt motor. Given: full load efficiency = 0.83; maximum gap flux density = $0.9Wb/m^2$; specific electric loading =30000ampere conductors per meter; field form factor = 0.7. Assume that the maximum efficiency occurs at full load and the fie3ld current is 2.5% of rated current. The pole face is square.	7	C03	L4

b. Assignment -1

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

	Model Assignment Questions								
Crs C	ode: 17EE64	Sem:	6	Marks:	5	Time:	90 - 120	minute	S
Cours	se: Electrica	al Machine De	esign						
Note	: Each student	to answer 2-	3 assigr	iments. Each as	signme	ent carries equal ma	ark.		
SNo	USN		A	Assignment Des	scriptio	n	Marks	СО	Level
1	1KT16EE001	What are the lectrical ma	ne cons achines	iderations to b ?	e made	e while designing	a 7	C01	L2
2	1KT16EE003	List some lir	nitation	of the design.			5	C01	L2
3	1KT16EE004	What are t magnetic loa	the fact ading?	tors that decid	de the	choice of specif	c 8	C01	L3
4	1KT16EE006	What are the electrical ma	e major achine?	considerations	to evol	ve a good design (of 5	C01	L3
5	1KT16EE007	What are th materials?	ie funda	imental require	ments	of high conductivit	У 5	CO2	L2
6	1KT16EE011	Why hard dra	awn cop	per wires are us	ed in el	ectrical machines?	5	CO2	L3
7	1KT16EE013	What are the	e types o	of magnetic mate	erials?	Give examples	8	CO2	L3
8	1KT16EE014	What is CRG	SO steel	? what are its us	ses?		6	CO2	L3
9	1KT16EE016	Discuss brief	fly about	electrical prope	erties of	insulating materials	. 6	CO2	L3
10	1KT16EE017	What are examples.	the cla	assifications of	insula	ating materials?giv	e 8	CO2	L3
11	1KT16EE020	Which insula	ting mat	terial is used in r	nodern	electric machines?	8	CO2	L3
12	1KT16EE021	Write a short	t note or	insulating mate	rials for	transformer.	5	CO2	L3
13	1KT16EE023	Explain the r	real and age flux	apparent flux o es.	densitie	s. Discuss about th	e 6	CO3	L3
14	1KT16EE025	Discuss qua upon the rel	ntitative .uctance	ely the effects of the air gap of th	f slots a of a D.C	nd ventilating duc machine.	.s 7	CO3	L3
15	1KT16EE026	Draw the r expression f	magneti for the to	c circuit of a otal mmf per po	D.C n ole.	nachine. Derive a	n 8	CO3	L3
16	1KT16EE005	What are the Describe the	e major e proper	groups of elect ties and applica	trical co ations o	onducting materials of those materials.	5? 7	CO3	L3

17	1KT16EE019	Describe the methods of measurement of temperature rise in various parts of an electrical machine.	5	CO3	L3
18	1KT14EE030	Explain in detail the various cooling methods of electrical	8	CO3	L3
10		What is the relation between the newer developed in	F	<u> </u>	10
19	11/1140034	armature and the power output in the dc machine?	5	003	∟3
20	1KT15EE011	Write the output equation of a dc machine	5	CO3	14
21	1KT15EE013	What are the factors to be considered for estimating the	5	CO3	
		length of air gap in dc machine?		003	<u> </u>
22	1K115EE015	Mention the factors governing the choice of number of armature slots in a dc machine.	8	CO3	L4
23	1KT15EE017	Mention the factors to be considered for the design of shunt field coil?	6	CO3	L4
24	1KT16EE402	Discuss the parameters governing the length of commutator.	6	CO3	L4
25	1KT16EE404	What are the factors that influence the choice of commutator	8	CO3	L4
26	1KT16EE410	What is the need for brushes in dc machine?	8	CO2	14
27	1KT16FE001	What are the materials used for brushes in dc machines?	5	CO_{2}	
28	1KT16EE001	What are the effects of armature reaction?	6	CO3	12
20	1KT16EE003	What is meant by magnetic circuit calculations	7	CO_3	 2
20	1KT16EE004	Discuss the total design steps of D.C. machines. Briefly describe		CO_3	<u> </u>
		each step	0	003	L2
31	1K 16EE007	What are the advantages of large length of air gap in dc machine?	7	CO3	L2
32	1KT16EE011	What are the factors to be considered for estimating the length of air gap in dc machine?	5	CO3	L3
33	1KT16EE013	Mention the factors governing the choice of number of armature slots in a dc machine.	8	CO3	L4
34	1KT16EE014	What is the purpose of slot insulation?	5	CO3	L4
35	1KT16EE016	What are the factors to be considered for deciding the slot dimensions?	5	CO3	L4
36	1KT16EE017	What factor decides the minimum number of armature coils?	5	CO3	L3
37	1KT16EE020	Mention the two types of winding used in the dc machines.	8	CO3	
38	1KT16EE021	What is meant by equalizer connections?	6	CO3	<u>_</u>
30	1KT16EE023	What is the length of mean turn of filed coil?	6	CO3	L2
40	1KT16EE025	Mention the factors to be considered for the design of shunt	8	CO3	L2
41	1KT16EE026	What are the factors to be considered for estimating the	8	CO3	L4
42	1KT16EE005	Mention the factors governing the choice of number of	5	CO4	L4
		armature slots in a dc machine.	0	00.	1
43	1K116EE019	What is the purpose of slot insulation?	6	CO4	L4
44	1KT14EE030	what are the factors to be considered for deciding the slot dimensions?	7	C04	
45	1KT14EE034	Mention guiding factors for the selection of number of poles	8	CO4	L4
46	1KT15EE011	Explain the concept of determining the temperature gradients in conductors placed in slots. What are the limitations of	7	CO4	L4
		design of electrical apparatus? Explain them.			1 .
47	1K115EE013	Define the terms specific electric loading and specific magnetic loading as applied to electrical machines. What are	7	CO4	L4
40		Une considerations in the choice of these for U.C. Machines?			1.4
48		Explain the exponent of determining the terms with the	5	CO4	
49	1K115EE017	in conductors placed in slots. What are the limitations of design of electrical apparatus? Explain them.	Ø	04	∟4
50	1KT16EE402	What are the factors to be considered for deciding the slot dimensions?	5	CO4	L2
52	1KT16EE404	What factor decides the minimum number of armature coils?	5	CO4	L4

D2. TEACHING PLAN - 2

Module - 3

Title:	Design of Transformers	Appr Time:	10 Hrs
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Design of core, field winding and tank of transformer.	CO5	L4
2	Analyze the performance of transformer	CO6	L3
b	Course Schedule		
Class NO	Module Content Covered		Level
1	Chaine of Specific Loadings, Expression for Volte (Turn	<u> </u>	
2	Choice of Specific Loadings, Expression for Volls/Turn,	005	L4
3	Determination of Main Dimensions of the Core	CO5	L4
4	Determination of Main Dimensions of the Core	CO5	L4
5	Determination of Main Dimensions of the Core	<u>CO5</u>	L4
6	and Secondary Windings	05	L4
7	No Load Current.	CO6	L3
8	Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation.	CO6	L3
9	Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation.	CO6	L3
10	Design of Tank and Cooling (Round and Rectangular) Tubes.	CO6	L3
С	Application Areas	CO	Level
1	Isolate two circuits, impedance matching	<u>CO5</u>	L4
2	Step up and step down the voltage level in generation, transmission and distribution	CO6	L4
al	Deview Overstiens		
<u>a</u>	What are the various types of Transformers?		-
		005	L2
2	Derive an expression of leakage reactance of a transformer with primary and secondary coils of equal length.	CO5	L2
3	Explain the determination of temperature rise in a transformer with plain walled tank and the transformer with tank with oil tubes and the determination of number of oil tubes required.	CO5	L2
4	Derive the equation for calculation of no load current of single phase transformer.	CO5	L2
5	What is the range of efficiency of transformers?	CO5	7
6	What are distribution transformers?	CO5	5
7	What are power transformers?	CO5	8
8	Distinguish between core and shell type transformer.	CO5	5
9	What are the advantages of shell type transformer over core type transformers?	CO5	5
10	In transformers, why the low voltage winding placed near the core?	CO5	5
11	What is window space factor?	CO5	8
12	Write down the output equation for the1phase and 3 phase transformer.	CO5	6
13	How will you select the emf per turn of a transformer?	<u>CO5</u>	6
14	Why circular coils are preterred in transformers?	<u>CO5</u>	8
15	What are the advantages of stepped cores?	CO5	8
16	what are the disadvantages of stepped cores?	005	5
17	What do you meant by stacking factor (iron space factor)?		6
18	type transformer?	005	/

19	List some methods of cooling of transformers.	CO5	8
20	What are the factors to be considered for choosing the method of cooling?	CO5	L3
21	How the heat dissipates in a transformer?	CO6	L2
22	Why transformer oil is used as a cooling medium?	CO6	L4
23	Why cooling tubes are provided?	CO6	L2
24	How the heat dissipation is improved by providing the cooling tubes?	CO6	L2
25	What is a breather?	CO6	L2
26	Why silica gel is used in breather?	CO6	L4
27	What is conservator?	CO6	L3
28	How the leakage reactance of the transformer is reduced?	CO6	L2
29	Discuss the importance of the choice of value of k= $\sqrt{2}$ 4.44 f ($_{ m as}$ m /AT) x 10 3	CO6	L4
	$_{\blacksquare}$ in a transformer design with respect to, type, service conditions, cost and		
	losses.		
30	Calculate the proportions of the cruciform section of minimum area for the	CO6	L4
	core of a transformer. Show that the gross area of a core of a cruciform		
	section is 79% of the area of the circum circle.		
е	Experiences	-	-
1		CO1	L2
2			

Module – 4

Title:	Design of Three Phase Induction Motors	Appr	10 Hrs
		Time:	
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Design of stator of induction motor.	CO7	L4
2	Design of rotor of induction motor.	CO8	L4
b			
Class No	Module Content Covered	СО	Level
1	Output Equation	CO7	L3
2	Choice of Specific Loadings,Main Dimensions of Stator.	C07	L3
3	Main Dimensions of Stator	CO7	L4
4	Design of stator slots and Winding	CO7	L3
5	Design of stator slots and Winding	CO7	L4
6	Design of Rotor Bars and End Ring.	CO8	L4
7	Design of Slip Ring rotor	CO8	L4
8	Choice of Length Air Gap	CO8	L3
9	Estimation of Number of Slots for Squirrel Cage Rotor.	CO8	L4
10	Estimation of No Load Current and Leakage Reactance.	CO8	L3
С	Application Areas	CO	Level
1	Electric train engine, Printing machines.	CO7	L4
2	Chimneys at power plants, irrigation.	CO8	L4
d	Review Questions	-	-
1	What are the different types of induction motor and how differ from each other?	C07	L2
2	Why wound rotor construction is adopted?	CO7	
3	What is rotating transformer?	CO7	L2
4	What are the advantages of cage rotor over slip ring induction motor?	CO7	L2
5	Name the materials used to insulate the laminations of the core of induction motor.	C07	L4
6	What are the advantages of slip ring motor over squirrel cage motor?	C07	L2
7	Write the expression for the output equation and output coefficient of induction motor.	C07	L2

8	What are the factors to be considered for choosing the specific magnetic loading?	C07	L4
9	What are the factors to be considered for the choice of specific electric loading?	C07	L4
10	What are the main dimensions of an induction motor?	CO7	L2
11	How the induction motor can be designed for best power factor?	CO7	L2
12	What types of slots are preferred for the induction motor?	CO7	L2
13	What are the factors to be considered for selecting number of slots in induction machine stator?	CO8	L2
14	Which part of induction motor has the maximum flux density? What is the maximum flux density in that part?	CO8	L4
15	What are the factors to be considered for estimating the length of air gap.	CO8	L2
16	What are the advantages and disadvantages of large air gap length in induction motor?	CO8	L2
17	List out the methods to improve the power factor of the induction motor.	CO8	L1
18	Why the air gap of an induction motor is made as small as possible?	CO8	L2
19	Discuss the relative merits and demerits of open and closed slots for induction motor.	CO8	L2
20	What is crawling and cogging?	CO8	L2
21	What are the methods adopted to reduce harmonic torques?	CO8	L2
22	What is skewing?	CO8	L2
23	Explain the design of rotor bars and end rings of induction motor.	CO8	L2
24	Explain the design of induction motor using circle diagram.	CO8	L2
25	Discuss the various factors to be considered in the design of induction motor. Discuss the end ring current briefly	CO8	L4
26	Derive an expression for the equivalent resistance of cage rotor referred to stator per phase of three-phase induction motor.	CO8	L4
27	State and discuss the factors, which influence the ratio of length to diameter of the armature core of a 3phase induction motor.	CO8	L4
28	Write the step-by-step design procedure for a wound rotor. Discuss various considerations to be taken into account while selecting the number of rotor slots in squirrel cage induction motor.	CO8	L4
29	Derive an expression for the rotor resistance in terms of its stator winding for a squirrel cage induction motor.	CO8	L4
	Experiences		
1 1			
1 2			
2			
3			
1 5		1	

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs (Code:	17EE64	'EE64 Sem: 6 Marks: 30 Time: 75 minutes							
Cou	rse:	Design and	Analysis	of Algorith	ms					
-	-	Note: Answ	er any 2	questions,	each carry eq	ual ma	arks.	Marks	СО	Level
1	а	Show that F conductor.	or minim	num cost de	esign of transfo	ormer, (cost of iron =cost of	5	CO5	L2
	b	For minimu density in s	For minimum copper loss, current density in primary winding=currer density in secondary winding							L3
	С	Determine 11000/3300 Volts/turn i of core is current den	the main DOV, sta is 11 V, M D.62d , w Isity is 25	dimension r- delta (laximum flu rindow spac 0 A/cm2.	s of a 3 limb c 3 phase, 50 1x density is 1.2 ce factor is 0.2	eore tra Hz t 5 wb/ 7, wind	nsformer of 350KV, ransformer. Assum m², net cross sectio dow proportion is 3	A, 5 ie on 1,	CO5	L4
					OR					

2	а	Derive output equation for a 1 and 3 phase transformer with the details of symbols used.	5	CO5	L2
	b	Show that: 1) Losses in transformer are proportional to the cube of its linear dimensions. 2) For a stepped core type Ratio = $\frac{Netcorearea}{Areaofcircumscribing}$ = 0.71	5		L3
	С	Show that the output of 3 phase core type transformer is 5.23fB _m Hd ² H _w X10 ⁻³ KVA where 'f' is the frequency, 'Bm' the maximum value of flux density in Weber/m ² , 'd'is the effective diameter of the core in meters, 'H' is the magnetic potential gradient in the limit in amperes/meter and 'H _w ' is the height of the window in meters.	5	CO5	L3
3	а	With usual notations derive the output equation of a 3-phase Induction motor.	5	CO8	L3
	b	Discuss the factors to be considered while deciding the length of air gap and number of stator slots.	5	CO8	L2
	С	Determine the main dimensions, turns per phase, number of slots, conductor cross-section and slot area of a 250hp, 3 phase, 50hz, 400v, 1410rpm slip ring induction motor. Assume B _{av} = 0.5Wb/m ² , ac=30000A/m, efficiency=0.9, and power factor= 0.9, winding factor=0.955, current density= 3.5 A/mm ² . The slot space factor is 0.4 and the ratio of core length to pole pitch is 1.2. The machine is delta connected.	5	CO8	L4
		OR			
4	а	Define specific magnetic loading and specific electric loading for three phase AC machines. Explain with briefly.	5	CO8	L3
	b	Write the step-by-step design procedure for a wound rotor. Discuss various considerations to be taken into account while selecting the number of rotor slots in squirrel cage induction motor.	5	CO8	L3
	С	A single phase, 400volts, 50 Hz, transformer is built from stampings having a relative permeability of 1000. The length of flux path is 2.5m, the area of cross-section of the core is 2.5x10 ⁻³ m ² and the primary winding has 800 turns. Estimate the maximum flux and no load current of the transformer. The iron loss at the working flux density is 2.6W/kg. Iron weighs 5.8x10 ⁻³ kg/m ³ , stocking factor is 0.9.	5	CO8	L4

b. Assignment – 2

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

	Model Assignment Questions								
Crs C	ode:	17EE64	Sem: 6	Marks:	10 / 10	Time:	90 – 120	minute	S
Cours	ourse: Electrical Machine Design								
Note	: Each	student	to answer 2-3 assignmer	nts. Each ass	ignment car	ries equal m	ark.		
SNo	I	USN	Assig	nment Des	cription		Marks	СО	Level
1	1KT16	6EE001	What are the	e various typ	es of Transf	ormers?	3	CO7	L2
2	1KT16	6EE003	Derive an e transformer equal length	expression o with primar 1.	f leakage re y and seco	eactance of ndary coils (a 8 of	CO7	L2
3	1KT16	6EE004	Explain the determination with plain walled tank a tubes and the determina	on of temper and the tran ation of num	rature rise in sformer with ber of oil tub	a transforme tank with c bes required.	ər 8 bil	CO7	L2
4	1KT16	6EE006	Derive the current of si	equation fo	r calculation ransformer.	n of no loa	id 6	C07	L3
5	1KT16	SEE007	What is the r	range of effic	ciency of trar	nsformers?	2	CO7	L2
6	1KT16	6EE011	What are dis	stribution tra	nsformers?		2	CO7	L2
7	1KT16	6EE013	What are power transfo	rmers?			2	CO7	L2
8	1KT16	6EE014	Distinguish between cor	re and shell	type transfor	mer.	3	CO7	L2
9	1KT16	6EE016	What are the advantage	es of shell ty	be transform	er over core	3	CO7	L2

		type transformers?			
10	1KT16EE017	In transformers, why the low voltage winding placed near the	2	CO7	L2
11	1KT16EE020	What is window space factor?	1	CO7	L2
12	1KT16EE021	Write down the output equation for the1phase and 3 phase transformer.	2	CO7	L2
13	1KT16EE023	How will you select the emf per turn of a transformer?	2	CO7	L2
14	1KT16EE025	Why circular coils are preferred in transformers?	2	CO7	
15	1KT16EE026	What are the advantages of stepped cores?	2	CO7	L2
16	1KT16EE005	What are the disadvantages of stepped cores?	2	CO7	L2
17	1KT16EE019	What do you meant by stacking factor (iron space factor)?	1	CO7	L2
18	1KT14EE030	What are the factors to be considered for choosing the type winding for a core type transformer?	2	CO7	L2
19	1KT14EE034	List some methods of cooling of transformers.	2	CO7	L2
20	1KT15EE011	What are the factors to be considered for choosing the method of cooling?	4	CO7	L2
21	1KT15EE013	How the heat dissipation is improved by providing the cooling tubes?	2	CO7	L2
22	1KT15EE015	What is a breather?	1	CO7	L2
23	1KT15EE017	Why silica gel is used in breather?	1	CO7	L2
24	1KT16EE402	What is conservator?	1	CO7	L2
25	1KT16EE404	How the leakage reactance of the transformer is reduced?	1	CO7	L2
26	1KT16EE410	Discuss the importance of the choice of value of $k = \sqrt{2}$, 4.44 f ($_{\Xi H}$ m /AT) x 10 3 $_{\Xi}$ in a transformer design with respect to, type, service conditions, cost and losses.	5	CO7	L3
27	1KT16EE001	Calculate the proportions of the cruciform section of minimum area for the core of a transformer. Show that the gross area of a core of a cruciform section is 79% of the area of the circum circle.	5	CO8	L4
28	1KT16EE003	Name the materials used to insulate the laminations of the core of induction motor.	5	CO8	L2
29	1KT16EE004	What are the advantages of slip ring motor over squirrel cage motor?	5	CO8	L3
30	1KT16EE006	Write the expression for the output equation and output coefficient of induction motor.	5	CO8	L2
31	1KT16EE007	What are the factors to be considered for choosing the specific magnetic loading?	5	CO8	L3
32	1KT16EE011	What are the factors to be considered for the choice of specific electric loading?	5	CO8	L2
33	1KT16EE013	What are the main dimensions of an induction motor?	2	CO8	L3
34	1KT16EE014	How the induction motor can be designed for best power factor?	2	CO8	L2
35	1KT16EE016	What types of slots are preferred for the induction motor?	5	CO8	L3
36	1KT16EE017	What are the factors to be considered for selecting number of slots in induction machine stator?	5	CO8	L2
37	1KT16EE020	Which part of induction motor has the maximum flux density? What is the maximum flux density in that part?	5	CO8	L3
38	1KT16EE021	What are the factors to be considered for estimating the length of air gap.	5	CO8	L2
39	1KT16EE023	What are the advantages and disadvantages of large air gap length in induction motor?	5	CO8	L3
40	1KT16EE025	List out the methods to improve the power factor of the induction motor.	5	CO8	L2
41	1KT16EE026	Why the air gap of an induction motor is made as small as possible?	5	CO8	L2

42	1KT16EE005	Discuss the relative merits and demerits of open and closed	5	CO8	L3
		slots for induction motor.			
43	1KT16EE019	What is crawling and cogging?	5	CO8	L2
44	1KT14EE030	What are the methods adopted to reduce harmonic torques?	5	CO8	L3
45	1KT14EE034	What is skewing?	2	CO8	L2
46	1KT15EE011	Explain the design of rotor bars and end rings of induction	8	CO8	L3
		motor.			
47	1KT15EE013	Explain the design of induction motor using circle diagram.	8	CO8	L2
48	1KT15EE015	Discuss the various factors to be considered in the design of	6	CO8	L2
		induction motor. Discuss the end ring current briefly			
49	1KT15EE017	Derive an expression for the equivalent resistance of cage	8	CO8	L3
		rotor referred to stator per phase of three-phase induction			
		motor.			
50	1KT16EE402	State and discuss the factors, which influence the ratio of	5	CO8	L2
		length to diameter of the armature core of a 3phase induction			
		motor.			
51	1KT16EE404	Write the step-by-step design procedure for a wound rotor.	6	CO8	L3
		Discuss various considerations to be taken into account while			
		selecting the number of rotor slots in squirrel cage induction			
		motor.			

D3. TEACHING PLAN - 3

Module – 5

Title:	Design of Three Phase Synchronous Machines	Appr	10 Hrs
		Time:	
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Design of stator of synchronous machines.	CO9	L4
2	Design of rotor of synchronous machines.	CO10	L4
b	Course Schedule		
Class No	Module Content Covered	СО	Level
1	Output Equation,Choice of Specific Loadings	CO9	L3
2	Main Dimensions of Stator	CO9	L3
3	Main Dimensions of Stator	CO9	L4
4	Short Circuit Ratio	CO9	L3
5	Design of stator slots and Winding.	CO9	L4
6	Design of stator slots and Winding.	CO9	L4
7	Design of Salient Rotors	CO10	L4
8	Design of non- salient Pole Rotors	CO10	L4
9	Magnetic Circuit and Field Winding.	CO10	L3
10	Magnetic Circuit and Field Winding.	CO10	L4
C	Application Areas	CO	Level
1	Generation of power	CO9	L4
2	Paper mills, constant speed motor and it is used as reactive power control in large power systems	CO10	L4
d	Review Questions	-	-
1	Name the two types of synchronous machines.	CO9	L3
2	Distinguish between cylindrical pole and salient pole construction.	CO9	L3
3	Mention the uses of damper windings in a synchronous machine?	CO9	L3
4	List the factors to be considered for separation of D and L for salient pole	CO9	L3

	machines.		
5	Define pitch factor	CO9	L3
6	Define distribution factor.	CO9	L3
7	What are the factors to be considered for the choice of specific magnetic loading?	CO9	L3
8	What are the factors to be considered for the choice of specific electric loading?	CO9	L3
9	What is short circuit ratio?	CO9	L3
10	How the value of SCR affects the design of alternator?	CO9	L3
11	What are the advantages of large air gap in synchronous machines?	CO9	L3
12	Write the expression for length of air gap in salient pole synchronous machine	CO9	L3
13	List the influence of the air gap length on the performance of the synchronous machine.	CO9	L3
14	List the factors to be considered for the choice of slot in synchronous machines	CO9	L3
15	What is the limiting factor for the diameter of synchronous machine?	CO9	L3
16	Write the expression for air gap length in cylindrical rotor machines.	CO9	L3
17	What are the factors to be considered for selecting the number of poles in an alternator?	CO9	L3
18	Discuss how the ventilation and cooling of large high speed alternator is carried out.	CO9	L3
19	Mention the factors that govern the design of field system of the alternator.	CO9	L3
20	Mention the advantages of fractional slot winding.	CO9	L3
21	Write the output equation of a synchronous machine.	CO10	L3
22	Discuss briefly the factors, which influence the air gap length of a 3phase synchronous machine.	CO10	L3
23	Explain the factors taken into account in the design of field winding of a salient pole alternator.	CO10	L3
24	Describe the important constructional features of the rotating field systems of slow speed alternators and turbo alternators.	CO10	L3
25	List the considerations in the design of field windings of salient pole alternator.	CO10	L3
26	Explain what steps are taken to ensure that an alternator shall generate an emf, the waveform of which shall be close to approximation to a sine wave.	CO10	L3
27	Explain how the open circuit characteristics is to be obtained from the design data for a salient pole alternator.	CO10	L3
28	What is a short circuit ratio as connected with synchronous machines?	CO10	L3
29	Mention the usual values and also explain how this ratio affect the cost and performance of an alternator.	CO10	L3
30	In the case of alternators how to decide the length of air gap?	CO10	L3
е	Experiences	-	-
1			
2			
3			
4			
5			

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs (Code:	17EE64	Sem:	6	Marks:	30	Time:	75 minut	es	
Cou	ourse: Electrical Machine Design									
-	-	Note: Answ	: Answer any 2 questions, each carry equal marks. Marks CO Level							
1	а	List the fact machines.	ist the factors to be considered for separation of D and L for salient pole nachines.						CO9	L2
	b	What are th loading?	e factors t	o be conside	red for the o	choice of sp	ecific magne	tic 4	CO9	L2

	С	Determine suitable stator dimensions for a 500KVA, 50Hz, 3 Φ , alternator to run at 375 rpm. Take mean gap density over the pole pitch as 0.55T, the electric loading as 250 amp. conductors per cm and assume a peripheral speed not exceeding 35m/s.	7	CO10	L4
		or			
2	а	What are the factors to be considered for the choice of specific electric loading?	5	CO9	L2
	b	What is short circuit ratio? How the value of SCR affects the design of alternator?	5	CO9	L2
	С	Determine for a 250KVA, 12 pole, 1100V, 500 rpm, 3-phase alternator i) air gap diameter ii) core length iii) no. of stator conductors iv) no. of stator slots v) cross section of stator conductors. Assume average gap density as 0.6wb/m2 and the specific electric loading 30,000 a.c/m. Assume L/ \overline{r} = 1.5	5	CO10	L4
3	а	What are the advantages of large air gap in synchronous machines?	5	CO9	L2
	b	List the influence of the air gap length on the performance of the synchronous machine.	5	CO9	L2
	С	A 500KVA, 3.3kV, 50Hz, 600 rpm, 3 Phase salient pole alternator ahs 200 turns per phase. Estimate the length of the air gap if the average flux density is 0.55T, the ratio of pole arc to pole pitch is 0.65, short circuit ratio is 1.5, gap expansion factor is 1.15, mmf required for the gap is 80% of no0 load field mmf and the winding factor is 0.955.	5	CO10	L4
		OR			
4	а	List the factors to be considered for the choice of slot in synchronous machines.	5	CO9	L2
	b	What is the limiting factor for the diameter of synchronous machine? What are the factors to be considered for selecting the number of poles in an alternator?	5	CO9	L2
	С	A 2-pole 3000-rpm alternator has a core length of 2m. Selecting a mean flux density over the pole pitch of 0.55wb/m 2, a specific loading of 260 amp. Conductors/cm, a peripheral velocity of 100m/sec and an air gap of 2.5cm determine the output obtainable when the average span of the stator coil is 2/3 of pole pitch.	5	CO10	L4

b. Assignment – 3

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

	Model Assignment Questions									
Crs C	ode:	17EE64	Sem:	6	Marks:	5 / 10	Time:	90 – 120 minutes		
Cours	Course: Electrical Machine Design									
Note	: Each	student	to answer 2	2-3 assignme	nts. Each as	signment ca	arries equal m	ark.		
SNo		USN		Assi	gnment Des	cription		Marks	СО	Level
1	1KT1	6EE001	How the va	lue of SCR a	ffects the des	sign of altern	ator?	5	CO9	L2
2	1KT1	6EE003	What are machines?	the advanta	ges of larg	e air gap i	in synchronou	s 5	COg	L2
3	1KT1	6EE004	Write the synchronoเ	expression	for length c	of air gap	in salient po	e 4	COg	L4
4	1KT1	6EE006	List the infl synchronol	uence of the us machine.	air gap lengt	h on the per	formance of th	e 4	CO9	L2
5	1KT1	6EE007	List the fa	actors to be us machines	considered	for the ch	oice of slot	n 4	COg	L2
6	1KT1	6EE011	What is th machine?	ne limiting fa	actor for the	diameter o	of synchronou	ıs 5	COg	L2
7	1KT1	6EE013	Write the machines.	expression	for air gap	length in o	cylindrical roto	or 6	COg	L2
8	1KT1	6EE014	What are th poles in an	ne factors to b alternator?	e considered	d for selectin	g the number	of 6	COg	L2

9	1KT16EE016	Discuss how the ventilation and cooling of large high speed alternator is carried out.	5	CO9	L2
10	1KT16EE017	Mention the factors that govern the design of field system of the alternator	5	CO9	L2
11	1KT16EE020	Mention the advantages of fractional slot winding.	5	COg	L2
12	1KT16EE021	Write the output equation of a synchronous machine.	6	CO9	L2
13	1KT16EE023	Discuss briefly the factors, which influence the air gap length of a 3phase synchronous machine.	6	CO9	L2
14	1KT16EE025	Explain the factors taken into account in the design of field winding of a salient pole alternator.	5	CO9	L2
15	1KT16EE026	Describe the important constructional features of the rotating field systems of slow speed alternators and turbo alternators.	8	CO9	L2
16	1KT16EE005	List the considerations in the design of field windings of salient pole alternator.	6	CO9	L2
17	1KT16EE019	Explain what steps are taken to ensure that an alternator shall generate an emf, the waveform of which shall be close to approximation to a sine wave.	8	CO9	L2
18	1KT14EE030	Explain how the open circuit characteristics is to be obtained from the design data for a salient pole alternator.	8	CO9	L2
19	1KT14EE034	What is a short circuit ratio as connected with synchronous machines?	6	CO9	L2
20	1KT15EE011	Mention the usual values and also explain how this ratio affect the cost and performance of an alternator.	5	CO9	L2
		Distinguish between evilation note and collections	5	cog	
22	1K115EE015	Distinguish between cylindrical pole and salient pole construction.	6	009	L2
23	1K115EE017	Mention the uses of damper windings in a synchronous machine?	4	009	L2
24	1K116EE402	List the factors to be considered for separation of D and L for salient pole machines.	6	CO9	L2
25	1KT16EE404	Define pitch factor	2	CO9	L2
26	1KT16EE410	Define distribution factor.	2	CO9	L2
27	1KT16EE001	What are the factors to be considered for the choice of specific magnetic loading?	5	CO10	L2
28	1KT16EE003	What are the factors to be considered for the choice of specific electric loading?	5	CO10	L2
29	1KT16EE004	What is short circuit ratio?	3	CO10	L2
30	1KT16EE006	How the value of SCR affects the design of alternator?	4	CO10	L2
31	1KT16EE007	Write the output equation of a synchronous machine.	6	CO10	L2
32	1KT16EE011	Discuss briefly the factors, which influence the air gap length of a 3phase synchronous machine.	5	CO10	L2
33	1KT16EE013	Explain the factors taken into account in the design of field winding of a salient pole alternator.	5	CO10	L2
34	1KT16EE014	Describe the important constructional features of the rotating field systems of slow speed alternators and turbo alternators.	7	CO10	L2
35	1KT16EE016	List the considerations in the design of field windings of salient pole alternator.	5	CO10	L2
36	1KT16EE017	Explain what steps are taken to ensure that an alternator shall generate an emf, the waveform of which shall be close to approximation to a sine wave.	7	CO10	L2
37	1KT16EE020	Explain how the open circuit characteristics is to be obtained from the design data for a salient pole alternator.	5	CO10	L2
38	1KT16EE021	What is a short circuit ratio as connected with synchronous machines?	5	CO10	L2
39	1KT16EE023	Mention the usual values and also explain how this ratio affect the cost and performance of an alternator.	6	CO10	L2
40	1KT16EE025	In the case of alternators how to decide the length of air gap?	4	CO10	L2
41	1KT16EE026	What are the advantages of large air gap in synchronous machines?	5	CO10	L2
·					

	41/T 40				
42	1K116EE005	Write the expression for length of air gap in salient pole	6	CO10	L2
		synchronous machine			
43	1KT16EE019	List the influence of the air gap length on the performance of the	5	CO10	L2
		synchronous machine.			
44	1KT14EE030	List the factors to be considered for the choice of slot in	4	CO10	L2
		synchronous machines			
45	1KT14EE034	What is the limiting factor for the diameter of synchronous	5	CO10	L2
		machine?			
46	1KT15EE011	Write the expression for air gap length in cylindrical rotor	5	CO10	L2
		machines.			
47	1KT15EE013	What are the factors to be considered for selecting the number of	5	CO10	L2
		poles in an alternator?			
48	1KT15EE015	Discuss how the ventilation and cooling of large high speed	5	CO10	L2
.		alternator is carried out.			
49	1KT15EE017	Mention the factors that govern the design of field system of the	5	CO10	L2
		alternator.			
50	1KT16EE402	Mention the advantages of fractional slot winding.	6	CO10	L2
51	1KT16EE404	What are the advantages of large air gap in synchronous	6	CO10	12
		machines?			
52	1KT16EE410	Write the expression for length of air gap in salient pole	7	CO10	12
		synchronous machine	•		

F. EXAM PREPARATION

1. University Model Question Paper

Cours	se:	Electrical Machine Design			Month /	′ Year	May /	2018
Crs C	ode:	17EE64 Sem: 6	Marks:	100	Time:		180 mi	inutes
-	Note	Answer all FIVE full questions	a All questions carry e	qual marks.		Marks	СО	Level
1	а	List the recognized classes a lassigned to them. Mention at la	of insulating materials east two examples for e	and the ter each type.	nperature	4	CO1	L2
	b	What are the major conside electrical machines?	erations accounted for	r the good o	design of	4	CO1	L2
	С	What are the factors those lim steel? What are its uses?	nit the design of a mad	chine? What	is CRGO	4	CO1	L2
	d	Make a brief comparison chart electrical machine windings.	between copper and a	luminium whe	en used in	4	CO1	L2
			OR					
-	а	Discuss briefly about electrical	properties of insulating	materials.		4	CO2	L2
	b	Explain briefly with the help o steel.	f directional properties	of CRGO tra	ansformer	4	CO2	L2
	С	What are the major groups on the properties and application the properties and application the properties and application the properties and application the properties are structured as the properties as the properties are structured as the properties as the properties are structured as the properties as the properti	of electrical conductin ns of those materials.	g materials?	Describe	4	CO2	L2
	d	What are the limitations of de	sign of electrical appa	iratus? Explai	n them.	4	CO2	L2
2	а	With usual notations derive the the various factors that affect machine.	e output equation of a l t the choice of numb	D.C machines per of poles	. Mention of a D.C	6	CO4	L3
	b	Define specific loadings and choice of specific electric and r	discuss in brief the nagnetic loadings in D.	factors influe C machines.	ncing the	5	CO4	L3
	С	A 5KW, 250V, 4 pole, 1500r square pole face. The loading 0.42wb/m ² , ampere conductors the machine. Assume full load pitch is 0.66.	pm shunt generator i gs are average flux de /meter = 15000. Find efficiency = 0.87 and i	s designed to ensity in the the main dime ratio of pole a	o have a air gap = ensions of rc to pole	5	CO3	L4
		-	OR					
-	а	Discuss the total design steps	of D.C.machines. Briefl	y describe ea	ch step	5	CO4	L3
	b	What are the factors to be co	nsidered for deciding	the slot dime	nsions?	5	CO4	L3
	С	Calculate the diameter and ler	oth of armature for a	7.5kw. 4pole.	1000rpm.	6	CO3	L4

220v shunt motor. Given: full load efficiency = 0.83; maximum gap flux			
density = 0.9Wb/m ² ; specific electric loading =30000ampere conductors per meter; field form factor = 0.7. Assume that the maximum efficiency occurs at full load and the fie3ld current is 2.5% of rated current. The pole face is square.			
3 a Show that For minimum cost design of transformer, cost of iron =cost of conductor.	4	CO6	L4
b For minimum copper loss, current density in primary winding=current density in secondary winding	4	CO5	L4
c Determine the main dimensions of a 3 limb core transformer of 350KVA, 8 11000/33000V, star- delta 3 phase, 50 Hz transformer. Assume Volts/turn is 11 V, Maximum flux density is 1.25 wb/m ² , net cross section of core is 0.62d , window space factor is 0.27, window proportion is 3:1, current density is 250 A/cm2.	8	CO5	L4
OR			
a Derive output equation for a 1 and 3 phase transformer with the details of symbols used.	5	CO6	L4
- b Show that: 1) Losses in transformer are proportional to the cube of its linear dimensions. 2) For a stepped core type Ratio = $\frac{Netcorearea}{Areaofcircumscribing} = 0.71$	4	CO5	L4
c Show that the output of 3 phase core type transformer is 5.23fB _m Hd ² H _w X10 ⁻ / ₃ KVA where 'f' is the frequency, 'Bm' the maximum value of flux density in Weber/m ² , 'd'is the effective diameter of the core in meters, 'H' is the magnetic potential gradient in the limit in amperes/meter and 'H _w ' is the height of the window in meters.	7	CO5	L4
4 a With usual notations derive the output equation of a 3-phase Induction g	5	CO8	L3
b Discuss the factors to be considered while deciding the length of air gap and unmber of stator slots.	5	CO8	L3
c Determine the main dimensions, turns per phase, number of slots, conductor cross-section and slot area of a 250hp, 3 phase, 50hz, 400v, 1410rpm slip ring induction motor. Assume $B_{av} = 0.5Wb/m^2$, ac=30000A/m, efficiency=0.9, and power factor= 0.9, winding factor=0.955, current density= 3.5 A/mm ² . The slot space factor is 0.4 and the ratio of core length to pole pitch is 1.2. The machine is delta connected.	6	CO7	L4
OR			
- a Define specific magnetic loading and specific electric loading for three phase AC machines. Explain with briefly.	4	CO8	L3
b Write the step-by-step design procedure for a wound rotor. Discuss various considerations to be taken into account while selecting the number of rotor slots in squirrel cage induction motor.	4	CO8	L3
c A single phase, 400volts, 50 Hz, transformer is built from stampings having a relative permeability of 1000. The length of flux path is 2.5m, the area of cross-section of the core is 2.5x10 ⁻³ m ² and the primary winding has 800 turns. Estimate the maximum flux and no load current of the transformer. The iron loss at the working flux density is 2.6W/kg. Iron weighs 5.8x10 ⁻³ kg/m ³ , stocking factor is 0.9.	8	CO7	L4
5 a List the factors to be considered for separation of D and L for salient pole	5	CO10	L3
b What are the factors to be considered for the choice of specific magnetic loading?	5	CO10	L3
C Determine suitable stator dimensions for a 500KVA, 50Hz, 3Φ, alternator to run at 375 rpm. Take mean gap density over the pole pitch as 0.55T, the electric loading as 250 amp. conductors per cm and assume a peripheral speed not exceeding 35m/s.	6	CO9	L4
or			

a	What are the factors to be considered for the choice of specific electric loading?	5	CO10	L3
b	What is short circuit ratio? How the value of SCR affects the design of alternator?	5	CO10	L3
C	Determine for a 250KVA, 12 pole, 1100V, 500 rpm, 3-phase alternator i) air gap diameter ii) core length iii) no. of stator conductors iv) no. of stator slots v) cross section of stator conductors. Assume average gap density as 0.6wb/m2 and the specific electric loading 30,000 a.c/m. Assume $L/^{7} = 1.5$	6	CO9	L4

2. SEE Important Questions

Course:		Electrical I	Machine De	sign				Month	/ Year	May / 20	/2019-
Crs Cod	e:	17EE64	Sem:	6	M	arks:	100	Time:		20 180 m	inutes
	Note	Answer all	FIVE full qu	uestions. A	Il question	is carry	equal mark	S.	-	-	
Module	Qno.	Important	Question		•		•		Marks	CO	Year
1	1	List the re assigned to	cognized cla them. Men	asses of ir tion at leas	nsulating r st two exan	naterials oples for	and the te reach type.	mperature	4	CO1	2016
	2	What are electrical m	the major on the major of the m	considerati	ons accou	nted fo	r the good	design of	4	CO1	2017
	3	What are t steel? Wha	he factors th at are its use	nose limit th s?	he design (of a mad	chine? Wha	t is CRGO	4	CO2	2010
	4	What are Describe t	the majo he propertie	r groups es and app	of elect olications c	rical co of those	onducting materials.	materials?	4	CO2	2015
	5	What are them.	the limitat	ions of de	esign of e	electrica	al apparatus	? Explain	4	CO2	2017
2	1	Discuss th step	e total desi	ign steps	of D.C.ma	chines.	Briefly deso	cribe each	6	CO4	2018
	2	What are dimension	the facto s?	ors to be	e conside	red fo	r deciding	the slot	5	CO4	2017
	3	With usua Mention th D.C machi	I notations e various fa ne.	derive the ctors that a	e output e affect the c	quation hoice o	of a D.C f number of	machines. poles of a	5	CO4	2018
	4	Define spe choice of s	ecific loading pecific elect	gs and dis	cuss in br gnetic load	ief the t ings in l	factors influe D.C machine	encing the s.	5	CO4	2015
	5	Calculate 1000rpm, 2 gap flux c conductors efficiency c The pole fa	the diameter 220v shunt i lensity = 0 per meter; poccurs at full ace is square	er and len motor. Giv .9Wb/m ² ; s field form load and t e.	ngth of a en: full loa specific el factor = 0 he fie3ld c	rmature d efficie ectric lo 7. Assu urrent is	for a 7.5k ency = 0.83 ; bading = 300 me that the 2.5% of rate	xw, 4pole, maximum 00ampere maximum ed current.	5	CO3	2016
3	1	Show that conductor.	For minimur	n cost desi	ign of trans	former,	cost of iron :	=cost of	4	CO6	2014
	2	For minimu density in s	um copper lo secondary w	oss, curren inding	it density ii	וס ו	rimary windir	ng=current	4	CO6	2015
	3	Derive out	out equation sed.	for a 1 an	d 3 phase	transfor	mer with the	e details of	4	CO6	2017
	4	Show that: linear dime Ratio = $\frac{1}{Ar}$	1) Losses nsions. 2) F Netcore reaofcircum	in transfor or a steppe earea scribing	rmer are p ed core typ = 0.71	e e	onal to the c	ube of its	4	CO5	2017
	5	Show tha 5.23fB _m Hd ² value of flu meters, 'H'	at the out ² H _w X10 ⁻³ KV/ x density in is the magr	put of 3 A where 'f Weber/m ² , netic poten	3 phase f' is the fr , 'd'is the e tial gradier	core equenc ffective it in the	type trans y, 'Bm' the diameter of limit in ampo	former is maximum the core in eres/meter	8	CO5	2018

		and ' H_w ' is the height of the window in meters.			
4	1	With usual notations derive the output equation of a 3-phase Induction motor.	4	CO8	2017
	2	Discuss the factors to be considered while deciding the length of air gap and number of stator slots.	4	CO8	2016
	3	Define specific magnetic loading and specific electric loading for three phase AC machines. Explain with briefly.	4	CO8	2015
	4	Write the step-by-step design procedure for a wound rotor. Discuss various considerations to be taken into account while selecting the number of rotor slots in squirrel cage induction motor.	4	CO8	206
	5	A single phase, 400volts, 50 Hz, transformer is built from stampings having a relative permeability of 1000. The length of flux path is 2.5m, the area of cross-section of the core is 2.5×10^{-3} m ² and the primary winding has 800 turns. Estimate the maximum flux and no load current of the transformer. The iron loss at the working flux density is 2.6W/kg. Iron weighs 5.8×10^{-3} kg/m ³ , stocking factor is 0.9.	8	CO7	2012
				0010	
5	1	phase AC machines. Explain with briefly.	5	CO10	2016
	2	Write the step-by-step design procedure for a wound rotor. Discuss various considerations to be taken into account while selecting the number of rotor slots in squirrel cage induction motor.	5	CO10	2014
	3	A single phase, 400volts, 50 Hz, transformer is built from stampings having a relative permeability of 1000. The length of flux path is 2.5m, the area of cross-section of the core is 2.5×10^{-3} m ² and the primary winding has 800 turns. Estimate the maximum flux and no load current of the transformer. The iron loss at the working flux density is 2.6W/kg. Iron weighs 5.8×10^{-3} kg/m ³ , stocking factor is 0.9.	6	CO9	2014
	4	What are the factors to be considered for the choice of specific electric loading?	5	CO10	2016
	5	What is short circuit ratio? How the value of SCR affects the design of alternator?	5	CO10	2018

G. Content to Course Outcomes

1. TLPA Parameters

Table 1: TLPA – Example Course

Module-	Course Content or Syllabus	Content	Blooms'	Final	Identified	Instruction	Assessment
#	(Split module content into 3	Teaching	Learning	Blooms'	Action	Methods	Methods to
π	split module content into 2				Vorbs for	for	Moncuro
	parts which have similar	HOUIS	Levels	Level	Verbsitor		I e e reiner
	concepts		IOr		Learning	Learning	Learning
			Content				
A	В	С	D	E	F	G	H
1	Design of Machines, Design	5	- L1	L2	-	Lecture	Assignment
	Factors, Limitations in design,		- L2		Remember		Unit Test &
	Modern Trends in design.				_		IA
	manufacturing Techniques.				Understand		
1	Desirability of Conducting	5	- 1	12	-Remember	Lecture	Assianment
-	Materials Comparison of	5	-12		-	Lootaro	Unit Test &
	Aluminium and Copper wires				Inderstand		
	Eorromagnotic Materials: Soft				Onderstand		
	Magnetia materiala Calid						
	Magnetic materials - Solid						
	Core Materials, Electrical						
	Sheet and Strip, Cold Rolled						
	Grain Oriented Steel.						
	Insulating Materials: Desirable						
	Properties, Temperature Rise						
	and Insulating Materials,						

	Classification of Insulating materials based on Thermal Consideration.						
2	Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes.	7	- L2 - L3 -L4	L4	- Understand -Apply -Analyze	Lecture & PPT	Assignment Unit Test & IA
2	Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings.	6	- L2 - L3 -L4	L4	- Understand -Apply -Analyze	Lecture & PPT	Assignment Unit Test & IA
3	Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, No Load Current.	8	- L2 - L3 -L4	L4	- Understand -Apply -Analyze	Lecture & PPT	Assignment Unit Test & IA
3	Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes.	6	- L2 - L3 -L4	L4	- Understand -Apply -Analyze	Lecture & PPT	Assignment Unit Test & IA
4	Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding,	8	- L2 - L3 -L4	L4	- Understand -Apply -Analyze	Lecture & PPT	Assignment Unit Test & IA
4	Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance.	6	- L2 - L3 -L4	L4	- Understand -Apply -Analyze	Lecture & PPT	Assignment Unit Test & IA
5	Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding.	8	- L2 - L3 -L4	L4	- Understand -Apply -Analyze	Lecture & PPT	Assignment Unit Test & IA
5	Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding	6	- L2 - L3 -L4	L4	- Understand -Apply -Analyze	Lecture & PPT	Assignment Unit Test & IA

2. Concepts and Outcomes:

Table 2: Conce	pt to Outcome – Exam	ple Course

Module-	Learning or	Identified	Final Concept	Concept	CO	Course
#	Outcome from	Concepts from		Justification	Components	Outcome
	study of the	Content		(What all	(1.Action Verb.	
	Content or			Learning	2.Knowledge.	
	Syllabus			Happened from	3.Condition /	Student
				the study of	Methodology	Should be
				Content /	⊿ Benchmark)	able to
				Syllabus Ashort	4.2 01101111a110	
				word for		
				learning or		
				outcome)		
A	1	1	K		М	N
1	- Study of	- Limitations	Fundamental	Limitations in	1 Understand	Understand
-	Limitations in	-Modern	Aspects	design and new	2 the	the
	desian	Trendz	Aspects	trends in	fundamental	fundamental
	-Study of	TICHUZ		designing of	aspects of	aspects of
	Modern Trends			oloctrical	machine	machine
	in design			machines	desian	desian
	manufacturing			rnaerinies	acsign	acsign.
	Techniques					
1	-Study	-ferromagnetic	Flectrical	Study of	1 Understand	Understand
-	ofDesirabilities	Material	Engineering	different	2 the	the
	of Conducting	-Insulating	materials	magnetic and	desirabilities	desirability of
	Materials	Materials	materials	insulating	of engineering	engineering
	-Study of			materials	material	material
	ferromagnetic			materials.	materiat	materiat
	Material					
	-Study of					
	Insulating					
	Materials					
2	- Choice of	-Specific	ArmatureDesign	Study of choice	1 Design	Design of
2	Specific	loading s	AnnatureDesign	of specific	2 armature of	armature of DC
	Specific Loadings and	-Main		oloctric and	DC machines	machines.
	Choice of	dimonsions		magnetic and	DC machines.	
	Number of	desian		loading as what		
		-Commutator		as number of		
	-Main	and Brushes				
	Dimensions of	design		Determination of		
	armature	acsign.		D and I of		
	-Design of			armature		
	Commutator					
	and Brushes					
2	-Estimation of	-Design of	Field windings	Design of series	1 Design	Design of field
	Ampere Turns	voke and nole	desian	and shunt field	2 Field of DC	windings of DC
	for the	-Design of	acoigii	winding	machine	machines.
	Magnetic	Shunt and		in ion ig.		
	Circuit	Series Field				
	-Dimensions of	Windings				
	Yoke Main Pole					
	and Air Gan					
	-Design of					
	Shunt and					
	Series Field					
	Windinas					
2	-Choice of	-Core design	Main	Design of	1 Design	Design of core
3	Specific 01	-Winding	Dimensions	square	2 various narte	field winding
	Loadings -	design	Desian	rectangular and	of	and tank of
	Determination	-No Load	Design	stepped core.	transformers	transformer.
						1

	of Main Dimensions of the Core -Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings -Estimation of No Load Current.	Current.				
3	-Expression for the Leakage Reactance of core type transformer -calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes.	-Leakage Reactance -Voltage Regulation. -Tank design	Performance Parameters	Derivation of leakage reactance and voltage regulation.Tank Design	1.Analyze 2.the performance of transformer	Analyze the performance of transformer
4	-Choice of Specific Loadings, -Main Dimensions of Stator. -Design of stator slots and Winding,	-Main dimension design -Slot and winding design	Stator Design	Determination ofmain Dimensions of Stator. Design of stator slots and Winding	1.Design 2.various parts of induction motor.	Design of stator of induction motor.
4	-Estimation of Number of Slots for Squirrel Cage Rotor. -Design of Rotor Bars and End Ring. -Design of Slip Ring rotor. -Estimation of No Load- Current and Leakage Reactance.	-Squirrel Cage Rotor design -Slip Ring rotor design	Rotor Design	Design of rotor and estimation of no liad current and leakage reactance.	1.Analyze 2.the performance of induction motor.	Design of rotor of induction motor.
5	-Choice of Specific Loadings, Short Circuit Ratio, -Main Dimensions of Stator. -Design of stator slots and Winding.	-specific loadings -main dimensions -slot and winding design	Stator Design	Determination ofmain Dimensions of Stator. Design of stator slots and Winding	1.Design 2.various parts of synchronous machines.	Design of stator of synchronous machines.

5	-Design o	fRotor design	Rotor Design	Design of Salient	1.Analyze	Design of rotor
	Salient and	l-fileld winding		and non- salient	2.the	of synchronous
	non- salien	tdesign		Pole Rotors.	performance	machines.
	Pole Rotors.				of	
	-Field Winding				synchronous	
					machines	