

Ref No:

< Sri Krishna Institute of Technology, Bangalore >



COURSE PLAN

Academic Year 2019-20

Program:	B E – Electrical and Electronics Engineering
Semester :	7
Course Code:	15EE752
Course Title:	Testing and Commissioning of power system Apparatus
Credit / L-T-P:	4 / 4-0-0
Total Contact Hours:	50
Course Plan Author:	Chaitra A S

Academic Evaluation and Monitoring Cell

Sri Krishna Institute of Technology
#29, Hesaraghatta Main Road
Chimney Hills, Chikkabanavara Post
Bangalore– 560090, Katakana, India.
Phone / Fax :+91-STD-080
Web: skit.org.in, e-mail:

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

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	EE
Semester:	7	Academic Year:	2019
Course Title:	Testing and Commissioning of power system Apparatus	Course Code:	15EE752
Credit / L-T-P:	4-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	50 Hours	SEE Marks:	80 Marks
CIA Marks:	20 Marks	Assignment	1 / Module
Course Plan Author:	Chaitra A S	Sign ..	Dt:
Checked By:		Sign ..	Dt:
CO Targets	CIA Target : %	SEE Target: %

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

2. Course Content

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

Module	Content	Teaching Hours	Identified Module Concepts	Blooms Learning Levels
1	<p>Electrical Tools, accessories: Tools, Accessories and Instruments required for Installation, Maintenance and Repair Work, India Electricity Rules, Safety Codes Causes and Prevention of Accidents, Artificial Respiration, Workmen's Safety Devices.</p> <p>Transformers: Installation, Location Site Selection, Foundation Details, Code of Practice for Terminal Plates, Polarity and Phase Sequence, Oil Tanks, Drying of Winding sand General Inspection. Commissioning Tests As Per National and International Standards - Volts Ratio Earth Resistance, Oil Strength, Insulation Tests, Impulse Tests Polarizing Index, Load Temperature Rise Tests. Specific Tests for Determination of Performance Curves like Efficiencies, Regulation Etc., Determination Mechanical Stress Under Normal and Abnormal Conditions.</p>	10	Commissioning Performance specification of Transformer	L2, L3
2	<p>Synchronous Machines: Specifications as per BIS Standards. Installation - Physical Inspection, Foundation Details, Alignments, Excitation Systems, Cooling and Control Gear, Drying Out. Commissioning Tests - Insulation, Resistance Measurement of Armature and Field Windings, Wave Form and Telephone Interference Tests, Line Charging Capacitance. Performance Tests -Various Tests to Estimate the Performance of Generator Operations, Slip Test, Maximum Lagging Current, Maximum Reluctance Power Tests, Sudden Short Circuit Tests, Transient Sub Transient Parameters, Measurement of Sequence Impedances, Capacitive Reactance, and Separation Of Losses, Temperature Rise Test, and Retardation Tests. Factory Tests -Gap Length, Magnetic Eccentricity, Balancing Vibrations, Bearing Performance.</p>	12	Performance specification of Synchronous machine. Testing of Synchronous machine	L2,L3
3	<p>Induction Motor: Specifications. Installation- Location of Motors and its Control Apparatus, Shaft Alignment for Various Coupling, Fitting of Pulleys and Coupling, Drying of Windings. Commissioning Tests -Mechanical Tests For Alignment, Air Gap Symmetry, Tests for Bearings,</p>	12	Performance specification of Induction motor Testing of	L2,L5

	Vibrations and Balancing. Specific Tests -Performance and Temperature Raise Tests, Stray Load Losses, Shaft Alignment, Re-Writing and Special Duty Capability, Site Test		Induction motor	
4	Laying of Underground Cables: Inspection, Storage, Transportation and Handling of Cables, Cable Handling Equipment, Cable Laying Depths and Clearances from other Services such as Water Sewerage, Gas, Heating and other Mains, Series of Power and Telecommunication Cables and Coordination with these Services, Excavation of Trenches, Cable Jointing and Terminations Testing and Commissioning. Location of Faults using Megger, Effect of Open or Loose Neutral Connections, of Proper Fuses on Service Lines and Their Effect on System, Causes and Dim, and Flickering Lights.	12	Installation of Underground cables Monitoring of underground cables	L4,L3
5	Switchgear and Protective Devices: Standards, Types, Specification, Installation, Commissioning Tests, Maintenance Schedule, Type and Routine Tests. Domestic Installation: Introduction, Testing of Electrical Installation of a Building, Testing of Insulation Resistance to Earth, Testing of Insulation and Resistance between Conductors Continuity or Open Circuit Test, Short Circuit Test, Testing of Earthing Continuity, Location of Faults, IE Rules for Domestic Installation.	10	Fault Detection Domestic Installation	L4,L5
-	Total	56	-	-

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 es	Details	Chapters in book	Availability
A	Text books (Title, Authors, Edition, Publisher, Year.)	-	-
1, 2, 3, 4, 5	Testing, Commissioning, Operation and Maintenance of Electrical Equipment by S. Rao, Khanna Publishers, 6 th Edition, 19th Reprint, 2015	1, 2, 3, 4, 5	In Lib
B	Reference books (Title, Authors, Edition, Publisher, Year.)	-	-
1, 2,3,5	Testing and Commissioning of Electrical Equipment, R.L.Chakrasali, Prism Books Pvt Ltd, 1 st Edition, 2014	1, 2,3,5	In Lib
4,5	Preventive Maintenance of Electrical Apparatus, S.K.Sharotri, Katson Publishing House, 1 st Edition, 1980.	4,5	In Lib
2,3	Handbook of Switchgears, BHEL, McGraw Hill, 1 st Edition, 2005	2,3	In Lib
3,4	Transformers, BHEL, McGraw Hill, 1 st Edition, 2003	3,4	In Lib
C	Concept Videos or Simulation for Understanding	-	-
C1	https://www.youtube.com/watch?v=JPhCxbxPHbo Lecture on testing of transformers		
C2	https://www.youtube.com/watch?v=DZpQgieOwS8		
C3	https://www.youtube.com/watch?v=b24jORRoxEc		
C4	https://www.youtube.com/watch?v=Vk2jDXxZlhs		
C5	https://www.youtube.com/watch?v=dZyO5gcWP-o		
C6	https://www.youtube.com/watch?v=FPoxOyfd5Jo		

C7	https://www.youtube.com/watch?v=u0jAVR-j60o		
C8	https://www.youtube.com/watch?v=MienxfvByvw		
C9	https://www.youtube.com/watch?v=cozz_fv9cs4		
C10	https://www.youtube.com/watch?v=W0_1xRqT8uU Domestic Installation		
D	Software Tools for Design	-	-
1	Auto CAD		
E	Recent Developments for Research	-	-
	https://ieeexplore.ieee.org/document/7836860		
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.

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

Mod ules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	15EE33	Transformer and Generators	Knowledge on Transformers and Synchronous generators	3		L3
2	15EE44	Electric Motors	Knowledge on basics of DC motors, Induction motors and Synchronous motors	4		L3

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.

Mod ules	Topic / Description	Area	Remarks	Blooms Level
1	Load Forecasting Grounding Types of Transmission and Distribution Systems Testing of insulators	Advanced Topics		L3,L4
3	Characteristics of Transmission Line Methods of voltage Control	Advanced Topics		L3,L4
5	Electrical Distribution system analysis	Certificate Courses		L3,L4

B. OBE PARAMETERS

1. Course Outcomes

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

Modules	Course Code.#	Course Outcome At the end of the course, student should be able to ...	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
1	15EE752.1	Understand the process to plan, control and implement commissioning of electrical equipments.	10	Commissioning	Lecture	unit Test and Assignment	L2 Understand
1	15EE752.2	Demonstrate the routine test for transformers to ensure smooth functioning and continuity in the power supply as per national and international standards	06	Performance specification of Transformer	Lecture /PPT	unit Test and Assignment	L3 Apply
2	15EE752.3	Understand the installation, foundation details of synchronous machine according to specification as per BIS standards.	07	Performance specification of Synchronous machine.	Lecture	unit Test and Assignment	L2 Understand
2	15EE752.4	Demonstrate the routine test for synchronous machines to ensure the required performance under practical conditions.	06	Testing of Synchronous machine	Lecture / PPT	unit Test and Assignment	L3 Apply
3	15EE752.5	Understand the selection of an induction motor for specific application is decided by considering the rating of induction motor.	09	Performance specification of Induction motor	Lecture /PPT	unit Test and Assignment	L2 Understand
3	15EE752.6	Demonstrate the routine test for induction motor to ensure proper manufacturing and smooth operation under practical conditions.	06	Testing of Induction motor	Lecture and Tutorial	unit Test and Assignment	L5 Evaluate
4	15EE752.7	Analyze the tools and equipments used for installation of Underground cables knowing its mechanical considerations.	04	Installation of Underground cables	Lecture	unit Test and Assignment	L4 Analyze
4	15EE752.8	Identify the tools and equipments used for installation and maintenance of electrical equipments.	09	Monitoring of underground cables	Lecture	unit Test and Assignment	L3 Apply
5	15EE752.9	Analyze the operation of an electrical equipments such as isolators, circuit breakers, insulators and switch gears for fault detection.	05	Fault Detection	Lecture	unit Test and Assignment	L4 Analyze
5	15EE752.10	Demonstrate the testing of electrical installation of a building considering IE rules for domestic installation.		Domestic Installation	Lecture	unit Test and Assignment	L5 Evaluate
-	-	Total	62	-	-	-	L2-L5

2. Course Applications

Write 1 or 2 applications per CO.

Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	The main application of Transformer is to Step up (Increase) or Step down (Decrease) the level of Voltage in substations, Industries, domestic applications	CO1	L2
1	Transformers can isolate two circuits electrically	CO2	L2
2	Synchronous machines are sometimes used as constant-speed motors, or as compensator for reactive power control in large power systems.	CO3	L3
2	One of the most important application of synchronous machines is to generate electric power at power station. Synchronous motors are also used in paper mills, refineries and numerous other applications	CO4	L2
3	Induction motor used in Electric Train engine, cooling fans used to cool large machines like alternators etc.	CO5	L3
3	Induction motor used in chimneys at power plants,printing machines, Rolling mills.	CO6	L2
4	Underground cables are widely used in densely populated urban areas, in factories, and even to supply power from the overhead posts to the consumer premises.	CO7	L5
4	Underground cables are used in cross country cables, Submarine cables etc	CO8	L2
5	Switchgear are used to isolate electric circuits from the power supply to enable a safe execution of maintenance activities or to clear faults. Used in Metering Equipment, panel board etc.	CO9	L3
5	Electrical Installation refers to any electrical wiring, fitting or apparatus used for the conveyance and control of electricity in any premises.	CO10	L2

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 to accomplish it.

Modules	Mapping CO	Mapping PO	Mapping Level	Justification for each CO-PO pair	Level
-	CO	PO	-	'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'	-
1	CO1	PO1	L2	Knowledge on different electrical equipments, electricity rules and safety codes is required for the commissioning of electrical equipments.	L2
1	CO1	PO2	L2	Identify the tools, accessories and instrument required for the installation and maintenance of electrical equipment.	L2
1	CO2	PO1	L2	Knowledge on transformer, different types and its working is required to demonstrate the performance of the transformer.	L2
1	CO2	PO2	L4	Analyse the performance of the transformer by conducting routine test as per the national and international standards	L4
1	CO2	PO4	L4	Investigation and testing on Resistance, Oil Strength, Insulation, Polarizing Index, Load Temperature Rise, Efficiencies, Regulation Etc on transformer is done under Normal and Abnormal Conditions.	L4
2	CO3	PO1	L2	Knowledge on synchronous machine, different types and its working is required to demonstrate the performance of the synchronous machine.	L2
2	CO3	PO2	L2	Identify the tools, accessories and instrument required for the installation and foundation of synchronous machines..	L2
2	CO4	PO1	L2	Knowledge on different types of test conducted on synchronous machine is required to ensure the performance of the machine.	L2
2	CO4	PO2	L4	Analyse the performance of the synchronous machine by conducting routine test as per the BIS standards.	L4
3	CO4	PO4	L4	Investigation and testing on Resistance, slip, Insulation, Polarizing Index, Load Temperature Rise, capacitive reactance, Gap Length, Magnetic Eccentricity, Bearing Etc on synchronous machine is done under Normal and Abnormal Conditions.	L4
3	CO5	PO1	L2	Knowledge on induction motor, different types and its working is required to demonstrate the performance of the induction motor.	L2

3	CO5	PO2	L2	Identify the tools, accessories and instrument required for the installation and foundation of induction motor.	L2
3	CO6	PO1	L2	Knowledge on different types of test conducted on induction motor is required to ensure the performance of the machine.	L2
3	CO6	PO2	L4	Analyse the performance of the induction motor by conducting routine test as per the standards.	L4
3	CO6	PO4	L4	Investigation and testing on Alignment, Air Gap Symmetry, Bearings,Vibrations and Balancing, Temperature Raise, Stray Load Losses, Shaft Alignment Etc on induction motor is done under Normal and Abnormal Conditions.	L4
4	CO7	PO1	L2	Knowledge on Underground cables and its mechanical considerations is required to analyze the tools and equipments used for installation of Underground cables	L2
4	CO7	PO2	L2	Identify the tools, accessories and instrument required for the installation of underground cables.	L2
4	CO8	PO1	L2	Knowledge on different types of test conducted on Underground cables is required to ensure the performance of the cables.	L2
4	CO8	PO2	L2	Describe the corrective and preventive maintenance of underground cables.	L2
5	CO8	PO4	L4	Investigate the location of faults using megger and preventive maintenance of underground cables.	L4
5	CO9	PO1	L2	Knowledge on isolators, circuit breakers, insulators and switch gears is required to analyse the operation of an electrical equipments.	L2
5	CO10	PO1	L4	Analyse the operation of an electrical equipments for the fault detection.	L4
5	CO10	PO2	L4	Investigation and testing on different types of electrical equipment such as isolators, circuit breakers, insulators and switch gears is done.	L4
5	CO10	PO4	L2	Knowledge on domestic equipment is required for electrical installation in a building.	L2

4. Articulation Matrix

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

-	-	Course Outcomes	Program Outcomes															-		
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3		Level	
1	15EE752.1	Understand the process to plan, control and implement commissioning of electrical equipments.	2.4	2.4																L2
1	15EE752.2	Demonstrate the routine test for transformers to ensure smooth functioning and continuity in the power supply as per national and international standards.	2.4	2.4	2.4															L3
2	15EE752.3	Understand the installation, foundation details of synchronous machine according to specification as per BIS standards.	2.4	2.4																L2
2	15EE752.4	Demonstrate the routine test for synchronous machines to ensure the required performance under practical conditions.	2.4	2.4	2.4															L3
3	15EE752.5	Understand the selection of an induction motor for specific application is decided by considering the rating of induction motor.	2.4	2.4																L2

3	15EE752.6	Demonstrate the routine test for induction motor to ensure proper manufacturing and smooth operation under practical conditions.	2.4	2.4	2.4														L2
4	15EE752.7	Analyze the tools and equipments used for installation of Underground cables knowing its mechanical considerations.	2.4	2.4															L4
4	15EE752.8	Identify the tools and equipments used for installation and maintenance of electrical equipments.	2.4	2.4	2.4														L3
5	15EE752.9	Analyze the operation of an electrical equipments such as isolators, circuit breakers, insulators and switch gears for fault detection.	2.4	2.4	2.4														L4
5	15EE752.10	Demonstrate the testing of electrical installation of a building considering IE rules for domestic installation.	2.4	2.4	2.4														L5
-	15EE752	Average attainment (1, 2, or 3)																	-
-	PO, PSO	1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design																	

5. Curricular Gap and Content

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

Mod ules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					
3					

6. Content Beyond Syllabus

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

Mod ules	Gap Topic	Area	Actions Planned	Schedule Planned	Resources Person	PO Mapping

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.

Mod ules	Title	Teach. Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Electrical Tools, accessories Transformers	10	2	-	-	1	1	2	CO1, CO2	L2, L3
2	Synchronous Machines	12	2	-	-	1	1	2	CO3, CO4	L2, L3
3	Induction Motor	12	-	2	-	1	1	2	CO5, CO6	L2, L5

4	Laying of Underground Cables	12	-	2	-	1	1	2	CO7, CO8	L4, L3
5	Switchgear and Protective Devices Domestic Installation	10	-	-	4	1	1	2	CO9, CO10	L4, L5
-	Total	56	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.

Mod ules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam - 1	30	CO1, CO2, CO3, CO4	L2, L3, L2, L3
3, 4	CIA Exam - 2	30	CO5, CO6, CO7, CO8	L2, L5, L4, L3
5	CIA Exam - 3	30	CO9, CO10	L4, L5
1, 2	Assignment - 1	05	CO1, CO2, CO3, CO4	L2, L3, L2, L3
3, 4	Assignment - 2	05	CO5, CO6, CO7, CO8	L2, L5, L4, L3
5	Assignment - 3	05	CO9, CO10	L4, L5
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	-		
	Final CIA Marks	40	-	

D1. TEACHING PLAN - 1

Module - 1

Title:	Introduction to power systems, Overhead transmission lines and insulators	Appr Time:	12 Hrs
a	Course Outcomes	CO	Blooms Level
-	At the end of the topic the student should be able to . . .	-	
1	Understand the process to plan, control and implement commissioning of electrical equipments.	CO1	L2
2	Demonstrate the routine test for transformers to ensure smooth functioning and continuity in the power supply as per national and international standards	CO2	L3
b	Course Schedule	-	-
Class No	Portion covered per hour	-	-
1	Electrical Tools, accessories: Tools, Accessories and Instruments required for Installation	CO1	L2
2	Maintenance and Repair Work	CO1	L2
3	India Electricity Rules, Safety Codes Causes and Prevention of Accidents	CO1	L2
4	Artificial Respiration, Workmen's Safety Devices	CO1	L2
5	Transformers: Installation, Location Site Selection, Foundation Details,	CO2	L2
6	Code of Practice for Terminal Plates, Polarity and Phase Sequence, Oil Tanks, Drying of Winding sand General Inspection	CO2	L3
7	Commissioning Tests As Per National and International Standards - Volts Ratio Earth Resistance, Oil Strength, Insulation Tests	CO2	L3
8	Impulse Tests Polarizing Index, Load Temperature Rise Tests.	CO2	L3
9	Specific Tests for Determination of Performance Curves like Efficiencies, Regulation Etc.	CO2	L3

10	Determination Mechanical Stress Under Normal and Abnormal Conditions.	CO2	L3
c	Application Areas	-	-
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	The main application of Transformer is to Step up (Increase) or Step down (Decrease) the level of Voltage in substations, Industries, domestic applications	CO1	L2
2	Transformers can isolate two circuits electrically	CO2	L2
d	Review Questions	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Explain Tools, Accessories and Instruments required for Installation	CO1	L2
2.	Enumerate India Electricity Rules.	CO1	L2
3.	Explain the Safely Codes Causes and Prevention of Accidents?	CO1	L2
4.	Explain Artificial Respiration?	CO1	L2
5	Explain different Workmen's Safety Devices?	CO1	L2
6	Explain the various types of cooling of power transformers.	CO1	L3
7	What are the standard specifications of a power transformer?	CO	L3
8	Mention and explain the typical test carried out on transformer before commissioning	CO2	L3
9	Explain in detail impulse testing of power insulating oil.	CO2	L3
10	What are the qualities of good insulating oil?	CO2	L2
11	Explain the procedure for drying of windings of transformer with and without oil.	CO2	L3
12	Write a brief note on testing of transformer oil.	CO2	L3
13	Explain the working of a Buchholtz relay with the help of a diagram	CO2	L3
14	Explain mechanical tests for alignment and air gap symmetry	CO2	L3
15	What is the function of tap changer? Explain the principle of off-circuit tap changer and on- load tap changer?	CO2	L3
16	Explain the civil work associated with transformer foundation	CO2	L3
17	Explain about efficiency and regulation of transformer?	CO2	L2
18	Enumerate the protective devices and accessories fitted on the power transformer.	CO2	L2
19	Explain how insulation resistance is measured and give the significance of Polarization index.	CO2	L2
20	Explain installation, inspection upon arrival at site and storage facility at site.	CO2	L3
21	Explain phasor diagram and phasor groups of a transformer.	CO2	L2
22	Describe testing of transformer oil.	CO2	L3
23	Explain the different drying techniques used in transformers	CO2	L2
24	What are the precautions to be taken while drying in a transformer ?	CO2	L2
25	Explain the various testing techniques used in transformers.	CO2	L3
26	What are the steps used in commissioning of transformers.	CO1	
27	Explain electrical and chemical properties of transformer oil.	CO2	L3
28	Explain about temperature rise test.	CO2	L3
29	Explain about O.C and S.C test.	CO2	L3
30	Explain about mechanical stress test.	CO2	L3
31	Explain about maintenance of transformers	CO2	L3
e	Experiences	-	-
1		CO1	L2
2			

Module – 2

Title:	Line Parameters	Appr Time:	7 Hrs
a	Course Outcomes	CO	Blooms Level
-	At the end of the topic the student should be able to . . .	-	
1	Understand the installation, foundation details of synchronous machine according to specification as per BIS standards.	CO3	L2
2	Demonstrate the routine test for synchronous machines to ensure the required performance under practical conditions.	CO4	L3
b	Course Schedule	-	-
Class No	Portion covered per hour	-	-
17	Calculation of inductance of single phase line. Flux linkages of one conductor in a group	CO3	L3
18	Calculation of inductance of 3phase lines with equilateral spacing, unsymmetrical spacing.	CO3	L3
19	Inductance of three phase line with unsymmetrical spacing but transposed and double circuit	CO3	L3
20	Inductance of composite conductor lines.	CO3	L3
21	Problems on Inductance with equilateral spacing, unsymmetrical spacing, Double circuit, transposed and composite conductors	CO3	L3
22	Capacitor, Capacitance- of single-phase line	CO3	L3
23	3phase lines with equilateral, unsymmetrical spacing	CO3	L3
24	Double circuit and transposed lines.	CO3	L3
25	Capacitance of composite conductor lines. Effect of earth on capacitance of transmission line	CO4	L3
26	Capacitance of composite conductor lines. Effect of earth on capacitance of transmission line	CO4	L3
27	Advantages of single circuit and double circuit lines.	CO4	L3
c	Application Areas	-	-
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Transmission line parameters provide the link between the supply and receiving end voltages and currents, considering the circuit elements to be linear in nature.	CO3	L3
2	Transmission line parameters provide the link between the supply and receiving end voltages and currents, considering the circuit elements to be linear in nature.	CO4	L3
d	Review Questions	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Explain the various specifications and ratings of synchronous machine	CO3	L2
2	What are the various steps in installation of an alternator?	CO3	L3
3	Explain why cooling is required and explain various types of cooling.	CO3	L2
4	Explain different testing methods of synchronous machines used	CO4	L3
5	Explain various tests being conducted on alternators.	CO4	L3
6	State and explain briefly the types of cooling employed for synchronous generator.	CO3	L2
7	Explain the protection scheme of rotating electric machines.	CO3	L2
8	Describe the negative phase sequence test on synchronous machine.	CO3	L3
9	Explain the different methods of starting of synchronous motors.	CO3	L2
10	Write short note on specification of synchronous motor.	CO3	L2
11	Mention the specification of synchronous generator.	CO3	L2
12	Explain the significance of balancing of rotor. How the balancing is achieved?	CO3	L2
13	Explain the function and principle of brushless excitation system.	CO3	L3
14	Explain the procedure of low slip test and method of calculation of Xq from the same.	CO3	L3

15	Explain the sudden 3- ϕ S.C. test on a 3- ϕ generator. How to calculate X_d' and X_d'' and X_d or X_s from the sudden 3- ϕ S.C. test.	CO4	L3
16	Enumerate the various steps of installation of a synchronous machine.	CO3	L3
17	Give the details of excitation system used in synchronous machine	CO4	L3
18	Explain the method of determining the insulation resistance of an alternator.	CO3	L2
19	State and explain the various abnormal conditions in synchronous generator and their effects.	CO4	L3
20	Explain the method of reduction of noise of the running generator.	CO4	L3
21	Explain the type tests and routine tests of synchronous machines.	CO4	L3

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	15EE752	Sem:	VII	Marks:	30	Time:	75 minutes	
Course:	Testing and Commissioning of Power System Apparatus							
-	-	Note: Answer all questions, each carry equal marks. Module : 1, 2				Marks	CO	Level
1	a	What are the standard specification of Power Transformer.				20	CO1	L1
	b	Explain the points to be considered in the selection of site and location of power transformer.					CO2	L2
	What	What are the specifications of the Synchronous machine.					CO3	L2
		OR						
1	a	Explain the method of measurement of insulation resistance and polarization index in case of transformer.				20	CO2	L2
	b	What are the qualities of good insulating oil?					CO1	L3
	c	State and explain briefly the types of cooling employed for synchronous generator.					CO4	L3
2	a	Explain the protection scheme of rotating electric machines.				20	CO4	L3
	b	Name and explain various accessories and fitments fitted on a power transformer.					CO2	L2
	c	Enumerate the various steps of installation of a synchronous machine.					CO4	L3
		OR						
2	a	Explain the type tests and routine tests of synchronous machines.				20	CO4	L3
	b	What are the different methods of drying out transformer? Explain also draw the drying out curve of a transformer					CO2	L2
	c	Describe the test set up for impulse testing of power transformer					CO2	L3
	d	State the steps, prior of the commissioning of a power transformer					CO2	L3

b. Assignment -1

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

Model Assignment Questions								
Crs Code:	15EE752	Sem:	VII	Marks:	5 / 10	Time:	90 – 120 minutes	
Course:	Testing and Commissioning of Power System Apparatus							
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.								
SNo	USN	Assignment Description				Marks	CO	Level
1	1KT15EE007	What are the qualities of good insulating oil?				5	CO2	L2
2	1KT15EE009	Explain the procedure for drying of windings of transformer with and without oil.				5	CO2	L3
3	1KT15EE012	Write a brief note on testing of transformer oil.				5	CO2	L3
4	1KT15EE014	Explain the working of a Buchholtz relay with the help of a diagram				5	CO2	L3
5	1KT15EE016	Explain mechanical tests for alignment and air gap symmetry				5	CO2	L3
6	1KT15EE020	What is the function of tap changer? Explain the principle of off-circuit tap changer and on- load tap changer?				5	CO2	L3
7	1KT15EE021	Explain the civil work associated with transformer foundation				5	CO2	L3
8	1KT14EE022	Explain about efficiency and regulation of transformer?				5	CO2	L2

9	1KT14EE024	Explain how insulation resistance is measured and give the significance of Polarization index.	5	CO2	L2
10	1KT14EE033	Explain installation, inspection upon arrival at site and storage facility at site.	5	CO2	L3
11	1KT16EE408	Explain phasor diagram and phasor groups of a transformer.	5	CO2	L2
12	1KT16EE406	Describe testing of transformer oil.	5	CO2	L3
13	1KT16EE409	Explain the different drying techniques used in transformers	5	CO2	L2
14	1KT15EE007	What are the precautions to be taken while drying in a transformer ?	5	CO2	L2
15	1KT15EE009	Explain the various testing techniques used in transformers.	5	CO2	L3
16	1KT15EE012	What are the steps used in commissioning of transformers.	5	CO1	L3
17	1KT15EE014	Explain electrical and chemical properties of transformer oil.	5	CO2	L3
18	1KT15EE016	Explain about temperature rise test.	5	CO2	L3
19	1KT15EE020	Explain about O.C and S.C test.	5	CO2	L3
20	1KT15EE021	Explain about mechanical stress test.	5	CO2	L3
21	1KT14EE022	Explain about maintenance of transformers	5	CO2	L3
22	1KT14EE024	Explain Tools, Accessories and Instruments required for Installation	5	CO1	L2
23	1KT14EE033	Enumerate India Electricity Rules.	5	CO1	L2
24	1KT16EE408	Explain the Safely Codes Causes and Prevention of Accidents?	5	CO1	L2
25	1KT16EE406	Explain Artificial Respiration?	5	CO1	L2
26	1KT16EE409	Explain different Workmen's Safety Devices?	5	CO1	L2
27	1KT15EE007	Explain the various types of cooling of power transformers.	5	CO1	L3
28	1KT15EE009	What are the standard specifications of a power transformer?	5	CO1	L3
29	1KT15EE012	Mention and explain the typical test carried out on transformer before commissioning	5	CO2	L3
30	1KT15EE014	Explain in detail impulse testing of power insulating oil.	5	CO2	L3
31	1KT15EE016	What are the qualities of good insulating oil?	5	CO2	L2
32	1KT15EE020	Explain Tools, Accessories and Instruments required for Installation	5	CO1	L2
33	1KT15EE021	Explain the various specifications and ratings of synchronous machine	5	CO3	L2
34	1KT14EE022	What are the various steps in installation of an alternator?	5	CO3	L3
35	1KT14EE024	Explain why cooling is required and explain various types of cooling.	5	CO3	L2
36	1KT14EE033	Explain different testing methods of synchronous machines used	5	CO4	L3
37	1KT16EE408	Explain various tests being conducted on alternators.	5	CO4	L3
38	1KT16EE406	State and explain briefly the types of cooling employed for synchronous generator.	5	CO3	L2
39	1KT16EE409	Explain the protection scheme of rotating electric machines.	5	CO3	L2
40	1KT15EE007	Describe the negative phase sequence test on synchronous machine.	5	CO3	L3
41	1KT15EE007	Explain the different methods of starting of synchronous motors.	5	CO3	L2
42	1KT15EE009	Write short note on specification of synchronous motor.	5	CO3	L2
43	1KT15EE012	Mention the specification of synchronous generator.	5	CO3	L2
44	1KT15EE014	Explain the significance of balancing of rotor. How the balancing is achieved?	5	CO3	L2
45	1KT15EE016	Explain the function and principle of brushless excitation system.	5	CO3	L3
46	1KT15EE020	Explain the procedure of low slip test and method of calculation of X_q from the same.	5	CO3	L3
47	1KT15EE021	Explain the sudden 3- ϕ S.C. test on a 3- ϕ generator. How to calculate X_d' and X_d'' and X_d or X_s from the sudden 3- ϕ S.C. test.	5	CO4	L3
48	1KT14EE022	Enumerate the various steps of installation of a synchronous machine.	5	CO3	L3

49	1KT14EE024	Give the details of excitation system used in synchronous machine	5	CO4	L3
50	1KT14EE033	Explain the method of determining the insulation resistance of an alternator.	5	CO3	L2
51	1KT16EE408	State and explain the various abnormal conditions in synchronous generator and their effects.	5	CO4	L3
52	1KT16EE406	Explain the method of reduction of noise of the running generator.	5	CO4	L3
53	1KT16EE409	Explain the type tests and routine tests of synchronous machines.	5	CO4	L3

D2. TEACHING PLAN - 2

Module - 3

Title:	Performance of transmission lines	Appr Time:	12 Hrs
a	Course Outcomes	CO	Blooms Level
-	At the end of the topic the student should be able to . . .	-	Level
1	Understand the selection of an induction motor for specific application is decided by considering the rating of induction motor.	CO5	L2
2	Demonstrate the routine test for induction motor to ensure proper manufacturing and smooth operation under practical conditions.	CO6	L5
b	Course Schedule		
Class No	Portion covered per hour	-	-
1	Induction Motor: Specifications. Installation- Location of Motors and its Control Apparatus	CO5	L2
2	Shaft Alignment for Various Coupling	CO5	L2
3	Fitting of Pulleys and Coupling	CO5	L2
4	Drying of Windings	CO5	L5
5	Commissioning Tests -Mechanical Tests For Alignment	CO6	L5
6	Air Gap Symmetry, Tests for Bearings	CO6	L5
7	Vibrations and Balancing	CO6	L2
8	Specific Tests -Performance test	CO6	L5
9	Specific Tests - Temperature Raise Tests	CO6	L5
10	Stray Load Losses, Shaft Alignment	CO6	L2
11	Re-Writing and Special Duty Capability	CO6	L2
12	Site Test	CO6	L5
c	Application Areas	-	-
-	Students should be able employ / apply the Module learning to . . .	-	-
1	Induction motor used in Electric Train engine, cooling fans used to cool large machines like alternators etc.	CO5	L3
2	Induction motor used in chimneys at power plants,printing machines, Rolling mills.	CO6	L2
d	Review Questions	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Explain the procurement and rating of a induction motor.	CO5	L2
2	Describe the techniques used in drying of windings in induction motors.	CO5	L2
3	Explain various testing methods of induction motors	CO7	L5
4	Explain load test in an induction motor.	CO7	L5
5	Explain the various methods of starting induction motors.	CO5	L3
6	Explain the methods of measuring slip of an induction motor.	CO5	L5
7	Explain the procedure of inspection of an induction motor prior to its installation at site.	CO5	L2
8	Explain the procedure of erection of induction motor.	CO5	L2

9	Explain the procedure of transport of induction motor.	CO5	L2
10	Explain various mechanical test carried out in induction motor.	CO7	L5
11	State and explain the various ratings of induction motor.	CO5	L2
12	State different types of electrical tests done on induction motor. Explain any one test in detail	CO7	L3
13	Explain the methods of drying out of induction motors.	CO5	L3
14	Explain how to obtain the performance of an induction motor	CO5	L3
15	Explain (i) speed (ii) power factor (iii) efficiency (iv) slip (v) current	CO5	L3
16	State the various types of tests performed on high voltage induction motor.	CO7	L5
17	Write explanatory notes on maintenance of circuit breakers.	CO5	L5
18	State the various steps in installation of a large rotating machine.	CO5	L2
19	Why are induction machines received in dismantled condition?	CO5	L3
20	Explain the significance of balancing rotor.	CO5	L2
21	How is the balancing achieved by static and dynamic balancing?	CO5	L2
22	Explain the no load test and locked – rotor test on 3- ϕ induction motor. What data does such a load test provide?	CO7	L3
23	State the causes of vibration in motors and generators.	CO5	L2
24	Explain the harmful effects of vibrations. How are vibrations measured ?	CO7	L5
25	Explain the h.v. Test on rotating machine.	CO7	L5
26	State the various types of enclosures for rotating electrical machines and the type of cooling adopted in them.	CO5	L2

Module – 4

Title:	Corona and underground cable	Appr Time:	13 Hrs
a	Course Outcomes	CO	Blooms Level
-	At the end of the topic the student should be able to . . .	-	
1	Analyze the tools and equipments used for installation of Underground cables knowing its mechanical considerations.	CO7	L4
2	Identify the tools and equipments used for installation and maintenance of electrical equipments.	CO8	L3
b	Course Schedule		
Class No	Portion covered per hour	-	-
1	Laying of Underground Cables: Inspection	CO7	L4
2	Storage, Transportation and Handling of Cables	CO7	L4
3	Cable Handling Equipment, Cable Laying Depths and Clearances from other Services such as Water Sewerage,	CO7	L4
4	Gas, Heating and other Mains, Series of Power and Telecommunication Cables and Coordination with these Services	CO7	L4
5	Excavation of Trenches	CO8	L3
6	Cable Jointing and Terminations Testing and Commissioning	CO8	L3
7	Location of Faults using Megger	CO8	L3
8	Effect of Open or Loose Neutral Connections	CO8	L3
9	Provision of Proper Fuses on Service Lines and Their Effect on System	CO8	L3
10	Causes and Dim	CO8	L3
11	Flickering Lights	CO8	L3
12	Applications	CO8	L3
c	Application Areas	-	-
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Underground cables are widely used in densely populated urban areas, in factories, and even to supply power from the overhead posts to the consumer premises.	CO7	L5
2	Underground cables are used in cross country cables, Submarine cables etc	CO8	L2

d	Review Questions	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Explain the various steps in Inspection of Underground Cables	CO7	L3
2	Explain the procedure of handling of cables	CO7	L4
3	State the various steps in Excavation of Trenches	CO8	L3
4	Explain the Effect of Open or Loose Neutral Connections	CO7	L4
5	State the various applications of flickering lights	CO8	L3
6	State different types of electrical tests done on cables. Explain any one test in detail	CO8	L4
7	Explain the procedure for location of Faults using Megger	CO8	L3
8	Explain the Cable Jointing and Terminations Testing.	CO8	L4
9	Explain various commissioning test done on underground cables.	CO8	L3
10	What are the effects of Open or Loose Neutral Connections	CO7	L4
11	Explain the procedure for laying of underground cables	CO7	L4
e	Experiences	-	-
1		CO7	L2
2			
3			

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	15EE752	Sem:	VII	Marks:	30	Time:	75 minutes	
Course:	Testing and Commissioning of Power System Apparatus							
-	-	Note: Answer all questions, each carry equal marks. Module : 3, 4				Marks	CO	Level
1	a	Write briefly on 'shimming work and shaft alignment during installation of IM				20	CO5	L3
	b	Explain high voltage test of an electrical machine					CO5	L2
	c	Explain the various steps in Inspection of Underground Cables					CO7	L3
		OR						
1	a	Write the terminal plate details of a induction motor				20	CO5	L2
	b	Explain load test, short circuit test, no load test of IM					CO5	L4
	c	State the various steps in Installation & Commissioning of Induction motor					CO5	L3
	d	Briefly Explain the high voltage test on rotating machine with neat sketch					CO6	L2
2	a	Explain various methods used to measure slip of Induction motor				20	CO5	L1
	b	State the various abnormal condition in induction motor					CO6	L2
	c	Explain the procedure for location of Faults using Megger					CO6	L1
		OR						
2	a	Explain various commissioning test done on underground cables.				20	CO8	L2
	b	What are the standard specifications of induction motor					CO5	L2
	c	Write short note on balancing of induction motor					CO6	L1
	d	Explain the Cable Jointing and Terminations Testing.					CO8	L3

b. Assignment – 2

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

Model Assignment Questions								
Crs Code:	15EE752	Sem:	VII	Marks:	5 / 10	Time:	90 – 120 minutes	
Course:	Testing and Commissioning of Power System Apparatus							
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.								
SNo	USN	Assignment Description				Marks	CO	Level
1	1KT15EE007	Explain the procurement and rating of a induction motor.				5	CO5	L2
2	1KT15EE009	Describe the techniques used in drying of windings in induction motors.				5	CO5	L2
3	1KT15EE012	Explain various testing methods of induction motors				5	CO7	L5

4	1KT15EE014	Explain load test in an induction motor.	5	CO7	L5
5	1KT15EE016	Explain the various methods of starting induction motors.	5	CO5	L3
6	1KT15EE020	Explain the methods of measuring slip of an induction motor.	5	CO5	L5
7	1KT15EE021	Explain the procedure of inspection of an induction motor prior to its installation at site.	5	CO5	L2
8	1KT14EE022	Explain the procedure of erection of induction motor.	5	CO5	L2
9	1KT14EE024	Explain the procedure of transport of induction motor.	5	CO5	L2
10	1KT14EE033	Explain various mechanical test carried out in induction motor.	5	CO7	L5
11	1KT16EE408	State and explain the various ratings of induction motor.	5	CO5	L2
12	1KT16EE406	State different types of electrical tests done on induction motor. Explain any one test in detail	5	CO7	L3
13	1KT16EE409	Explain the methods of drying out of induction motors.	5	CO5	L3
14	1KT15EE007	Explain how to obtain the performance of an induction motor	5	CO5	L3
15	1KT15EE009	Explain (i)speed (ii)power factor (iii)efficiency (iv)slip (v)current	5	CO5	L3
16	1KT15EE012	State the various types of tests performed on high voltage induction motor.	5	CO7	L5
17	1KT15EE014	Write explanatory notes on maintenance of circuit breakers.	5	CO5	L5
18	1KT15EE016	State the various steps in installation of a large rotating machine.	5	CO5	L2
19	1KT15EE020	Why are induction machines received in dismantled condition?	5	CO5	L3
20	1KT15EE021	Explain the significance of balancing rotor.	5	CO5	L2
21	1KT14EE022	How is the balancing achieved by static and dynamic balancing?	5	CO5	L2
22	1KT14EE024	Explain the no load test and locked – rotor test on 3- ϕ induction motor. What data does such a load test provide?	5	CO7	L3
23	1KT14EE033	State the causes of vibration in motors and generators.	5	CO5	L2
24	1KT16EE408	Explain the harmful effects of vibrations. How are vibrations measured ?	5	CO7	L5
25	1KT16EE406	Explain the h.v. Test on rotating machine.	5	CO7	L5
26	1KT16EE409	State the various types of enclosures for rotating electrical machines and the type of cooling adopted in them.	5	CO5	L2
27	1KT15EE007	Explain the various steps in Inspection of Underground Cables	5	CO7	L3
28	1KT15EE009	Explain the procedure of handling of cables	5	CO7	L4
29	1KT15EE012	State the various steps in Excavation of Trenches	5	CO8	L3
30	1KT15EE014	Explain the Effect of Open or Loose Neutral Connections	5	CO7	L4
31	1KT15EE016	State the various applications of flickering lights	5	CO8	L3
32	1KT15EE020	State different types of electrical tests done on cables. Explain any one test in detail	5	CO8	L4
33	1KT15EE021	Explain the procedure for location of Faults using Megger	5	CO8	L3
34	1KT14EE022	Explain the Cable Jointing and Terminations Testing.	5	CO8	L4
35	1KT14EE024	Explain various commissioning test done on underground cables.	5	CO8	L3
36	1KT14EE033	What are the effects of Open or Loose Neutral Connections	5	CO7	L4
37	1KT16EE408	Explain the procedure for laying of underground cables	5	CO7	L4

D3. TEACHING PLAN - 3

Module – 5

Title:	Distribution and Reliability and Quality of distribution system	Appr Time:	10 Hrs
a	Course Outcomes	CO	Blooms Level
-	At the end of the topic the student should be able to . . .	-	Level
1	Analyze the operation of an electrical equipments such as isolators, circuit breakers, insulators and switch gears for fault detection.	CO9	L4

2	Demonstrate the testing of electrical installation of a building considering IE rules for domestic installation.	CO10	L5
b Course Schedule			
Class No	Portion covered per hour	-	-
1	Switchgear and Protective Devices: Standards,	CO9	L4
2	Types, Specification, Installation	CO9	L4
3	Commissioning Tests, Maintenance Schedule	CO9	L4
4	Type and Routine Tests.	CO9	L4
5	Domestic Installation: Introduction	CO10	L5
6	Testing of Electrical Installation of a Building	CO10	L5
7	Testing of Insulation Resistance to Earth	CO10	L5
8	Testing of Insulation and Resistance between Conductors Continuity or Open Circuit Test, Short Circuit Test	CO10	L5
9	Testing of Earthing Continuity, Location of Faults	CO10	L5
10	IE Rules for Domestic Installation	CO10	L5
c Application Areas			
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Switchgear are used to isolate electric circuits from the power supply to enable a safe execution of maintenance activities or to clear faults. Used in Metering Equipment, panel board etc.	CO9	L3
2	Electrical Installation refers to any electrical wiring, fitting or apparatus used for the conveyance and control of electricity in any premises.	CO10	L2
d Review Questions			
-	The attainment of the module learning assessed through following questions	-	-
1	What are the factors to be considered while selecting circuit breakers?	CO10	L3
2	Write explanatory notes on maintenance of circuit breakers.	CO10	L3
3	Explain the procedure of transport, erection and commissioning of SF6 insulated metal clad switchgear.	CO10	L3
4	State and explain the various ratings of High Voltage circuit breakers.	CO10	L3
5	Explain the various steps in maintenance of circuit breakers.	CO10	L2
6	Explain the procedure of installation of circuit breakers and metal clad switchgear.	CO10	L4
7	Explain the terms: a. Relay b. Fuse c. Circuit breaker	CO10	L2
8	Write a note on circuit breaker and its types.	CO10	L3
9	Explain the various tests on circuit breakers.	CO10	L4
10	Explain the terms : isolator, load break switch	CO10	L2
11	Explain the functions of circuit breakers.	CO10	L3
12	Explain the different methods of testing of Electrical Installation of a Building.	CO9	L4
13	Briefly explain testing of Insulation Resistance to Earth.	CO9	L4
14	Explain IE rules for Domestic Installation.	CO9	L2
15	Write a short notes on Testing of Earthing Continuity.	CO9	L4
16	Write a short notes on Location of Faults.	CO9	L4
e Experiences			
1		CO10	L2
2		CO9	
3			

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code:	15EE752	Sem:	VII	Marks:	30	Time:	75 minutes	
Course:	Testing and Commissioning of Power System Apparatus							
-	-	Note: Answer all questions, each carry equal marks. Module : 5				Marks	CO	Level

1	a	What are the factors to be considered while selecting circuit breakers?	20	CO9	L1
	b	Explain the procedure of transport, erection and commissioning of SF6 insulated metal clad switchgear.		CO10	L2
	c	State and explain the various ratings of High Voltage circuit breakers.		CO9	L3
OR					
1	a	Explain the various steps in maintenance of circuit breakers.	20	CO10	L2
	b	Explain the procedure of installation of circuit breakers and metal clad switchgear.		CO9	L4
	c	Write a short notes on Location of Faults.		CO9	L3
2	a	Explain the various tests on circuit breakers.	20	CO10	L1
	b	Explain the terms : isolator, load break switch		CO10	L2
	c	What are the factors to be considered while selecting a circuit breaker. Explain.		CO9	L1
OR					
2	a	Briefly explain testing of Insulation Resistance to Earth.	20	CO10	L2
	b	Explain IE rules for Domestic Installation.		CO9	L2
	c	Explain various protective device and their functions used in electrical system.		CO9	L1

b. Assignment – 3

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

Model Assignment Questions							
Crs Code:	15EE752	Sem:	VII	Marks:	5 / 10	Time:	90 – 120 minutes
Course:	Testing and Commissioning of Power System Apparatus						

Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT15EE007	What are the factors to be considered while selecting circuit breakers?	5	CO10	L3
2	1KT15EE009	Write explanatory notes on maintenance of circuit breakers.	5	CO10	L3
3	1KT15EE012	Explain the procedure of transport, erection and commissioning of SF6 insulated metal clad switchgear.	5	CO10	L3
4	1KT15EE014	State and explain the various ratings of High Voltage circuit breakers.	5	CO10	L3
5	1KT15EE016	Explain the various steps in maintenance of circuit breakers.	5	CO10	L2
6	1KT15EE020	Explain the procedure of installation of circuit breakers and metal clad switchgear.	5	CO10	L4
7	1KT15EE021	Explain the terms: a. Relay b. Fuse c. Circuit breaker	5	CO10	L2
8	1KT14EE022	Write a note on circuit breaker and its types.	5	CO10	L3
9	1KT14EE024	Explain the various tests on circuit breakers.	5	CO10	L4
10	1KT14EE033	Explain the terms : isolator, load break switch	5	CO10	L2
11	1KT16EE408	Explain the functions of circuit breakers.	5	CO10	L3
12	1KT16EE406	Explain the different methods of testing of Electrical Installation of a Building.	5	CO9	L4
13	1KT16EE409	Briefly explain testing of Insulation Resistance to Earth.	5	CO9	L4
14	1KT15EE007	Explain IE rules for Domestic Installation.	5	CO9	L2
15	1KT15EE009	Write a short notes on Testing of Earthing Continuity.	5	CO9	L4
16	1KT15EE012	Write a short notes on Location of Faults.	5	CO9	L4

F. EXAM PREPARATION

1. University Model Question Paper

Course:	Testing and Commissioning of Power System Apparatus			Month / Year	May /2018
Crs Code:	15EE752	Sem:	VII	Marks:	80
				Time:	180 minutes
Mod ule	Note Answer all FIVE full questions. All questions carry equal marks.			Marks	CO
					Level

1	a	What are the standard specification of Power Transformer.	16 / 20	CO1	L2
	b	Explain the points to be considered in the selection of site and location of power transformer.		CO2	L2
	c	Name and explain various accessories and fitments fitted on a power transformer.		CO2	L2
		OR			
1	a	What are the different methods of drying out transformer? Explain also draw the drying out curve of a transformer	16 / 20	CO2	L3
	b	Explain the Safely Codes Causes and Prevention of Accidents?		CO2	L2
	c	Explain the method of measurement of insulation resistance and polarization index in case of transformer.		CO2	L2
2	What	What are the specifications of the Synchronous machine.	16 / 20	C03	L2
	b	State and explain briefly the types of cooling employed for synchronous generator.		CO4	L4
	c	Explain the protection scheme of rotating electric machines.		CO4	L2
		OR			
2	a	Explain the protection scheme of rotating electric machines.	16 / 20	CO3	L2
	b	Explain the type tests and routine tests of synchronous machines.		CO4	L3
	c	Enumerate the various steps of installation of a synchronous machine.		CO4	L3
3	a	Write briefly on 'shimming work and shaft alignment during installation of IM	16 / 20	CO5	L3
	b	Explain high voltage test of an electrical machine		CO5	L2
	c	Explain various methods used to measure slip of Induction motor		CO6	L3
		OR			
3	a	State the various abnormal condition in induction motor	16 / 20	CO6	L2
	b	Write the terminal plate details of a induction motor		CO5	L2
	c	Explain load test, short circuit test, no load test of IM		CO6	L4
	d	State the various steps in Installation & Commissioning of Induction motor		CO5	L2
4	a	Explain the Effect of Open or Loose Neutral Connections	16 / 20	CO7	L2
	b	Explain various commissioning test done on underground cables.		CO7	L3
	c	Explain the Cable Jointing and Terminations Testing.		C08	L2
		OR			
4	a	State different types of electrical tests done on cables. Explain any one test in detail	16 / 20	CO7	L3
	b	State the various steps in Excavation of Trenches		CO8	L3
	c	Explain the procedure for laying of underground cables		CO7	L2
5	a	List the different test conducted on circuit breaker	16 / 20	CO9	L2
	b	Explain the various steps in maintenance of circuit breaker		CO10	L3
	What	What are the steps taken for installation and commissioning of outdoor Circucircuit Breaker.		CO9	L2
5		OR			
	a	What are the specification of circuit breaker.	16 / 20	CO9	L2
	b	Briefly explain testing of Insulation Resistance to Earth and Explain IE rules for Domestic Installation		CO9	L2
	c	Write a short notes on Testing of Earthing Continuity.		C09	L2

2. SEE Important Questions

Course:	Testing and Commissioning of Power System Apparatus			Month / Year	May / 2018		
Crs Code:	15EE752	Sem:	7	Marks:	80	Time:	180 minutes
	Note	Answer all FIVE full questions. All questions carry equal marks.				-	-
Module	Qno.	Important Question	Marks	CO	Year		
1	1	What are the different methods of drying out transformer? Explain also draw the drying out curve of a transformer	16 / 20	CO2	2012		
	2	Explain the Safety Codes Causes and Prevention of Accidents?		CO2	2014		
	3	Explain the method of measurement of insulation resistance and polarization index in case of transformer.		CO2	2012		
	4	What are the qualities of good insulating oil?		CO1	2017		
	5	What are the standard specification of Power Transformer.		CO1	2012		
2	1	Explain the protection scheme of rotating electric machines.	16 / 20	CO3	2015		
	2	Explain the type tests and routine tests of synchronous machines.		CO4	2015		
	3	Enumerate the various steps of installation of a synchronous machine.		CO4	2011		
	4	Explain the type tests and routine tests of synchronous machines.		CO4	2012		
	5	Enumerate the various steps of installation of a synchronous machine.		CO4	2012		
3	1	Write the terminal plate details of a induction motor.	16 / 20	CO5	2016		
	2	Explain load test, short circuit test, no load test of IM		CO6	2016		
	3	State the various steps in Installation & Commissioning of Induction motor		CO6	2017		
	4	briefly Explain the high voltage test on rotating machine with neat sketch		CO6	2014		
	5	Explain various methods used to measure slip of Induction motor		CO5	2014		
			10				
4	1	State different types of electrical tests done on cables. Explain any one test in detail	16 / 20	CO7	2017		
	2	State the various steps in Excavation of Trenches		CO8	2017		
	3	Explain the Effect of Open or Loose Neutral Connections		CO8	2017		
	4	Explain various commissioning test done on underground cables.		CO8	2017		
	5	Explain the Cable Jointing and Terminations Testing.		CO7	2014		
5	1	What are the specification of circuit breaker.	16 / 20	CO10	2009		
	2	List the different test conducted on circuit breaker		CO10	2007		
	3	Explain the various steps in maintenance of circuit breaker		CO10	2017		
	4	What are the steps taken for installation and commissioning of outdoor circuit breaker.		CO10	2014		
	5	Briefly explain testing of Insulation Resistance to Earth and Explain IE rules for Domestic Installation		CO9	2016		

G. Content to Course Outcomes

1. TLPA Parameters

Table 1: TLPA – Example Course

Module #	Course Content or Syllabus (Split module content into 2 parts which have similar concepts)	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Levels	Identified Action Verbs for Learning	Instruction on Methods for Learning	Assessment Methods to Measure Learning
A	B	C	D	E	F	G	H

1	Electrical Tools, accessories: Tools, Accessories and Instruments required for Installation, Maintenance and Repair Work, India Electricity Rules, Safely Codes Causes and Prevention of Accidents, Artificial Respiration, Workmen's Safety Devices. Introduction to power system: Structure of electric power system: generation, transmission and Distribution. Advantages of higher voltage transmission: HVAC, EHVAC, UHVAC and HVDC. Interconnection. Feeders, distributors and service mains.	3	- L2 - L3	L2	- Remem bering - Explain ing	- Lecture	-Unit Test - Assignment
1	Transformers: Installation, Location Site Selection, Foundation Details, Code of Practice for Terminal Plates, Polarity and Phase Sequence, Oil Tanks, Drying of Winding sand General Inspection. Commissioning Tests As Per National and International Standards - Volts Ratio Earth Resistance, Oil Strength, Insulation Tests, Impulse Tests Polarizing Index, Load Temperature Rise Tests. Specific Tests for Determination of Performance Curves like Efficiencies, Regulation Etc., Determination Mechanical Stress Under Normal and Abnormal Conditions.	11	- L2 - L3	L3	- Remem bering - Explain ing	- Lecture/ PPT	-Unit Test - Assignment
2	Synchronous Machines: Specifications as per BIS Standards. Installation - Physical Inspection, Foundation Details, Alignments, Excitation Systems, Cooling and Control Gear, Drying Out. Commissioning Tests - Insulation, Resistance Measurement of Armature and Field Windings, Wave Form and Telephone Interference Tests, Line Charging Capacitance	6	- L4 - L5	L2	- Understa nding - Calculate	- Lecture	-Unit Test - Assignment
2	Performance Tests -Various Tests to Estimate the Performance of Generator Operations, Slip Test, Maximum Lagging Current, Maximum Reluctance Power Tests, Sudden Short Circuit Tests, Transient Sub Transient Parameters, Measurement of Sequence Impedances, Capacitive Reactance, and Separation Of Losses, Temperature Rise Test, and Retardation Tests. Factory Tests -Gap Length, Magnetic Eccentricity, Balancing Vibrations, Bearing Performance.	5	- L2 - L3	L3	- Understa nding - Calculate	- Lecture/ PPT	-Unit Test - Assignment
3	Induction Motor: Specifications. Installation- Location of Motors and its Control Apparatus, Shaft Alignment for Various Coupling, Fitting of Pulleys and Coupling, Drying of Windings. Commissioning Tests -Mechanical Tests For Alignment, Air Gap Symmetry, Tests for Bearings,	8	- L2 - L4	L2	- Understa nding - Explain ing & analyzing	- Lecture	-Unit Test - Assignment
3	Vibrations and Balancing. Specific Tests -Performance and Temperature Raise Tests, Stray Load Losses, Shaft Alignment, Re-Writing and Special Duty Capability, Site Test	4	- L2 - L5	L5	- Understa nding - Explain ing & analyzing	- Lecture/ PPT	-Unit Test - Assignment

4	Laying of Underground Cables: Inspection, Storage, Transportation and Handling of Cables, Cable Handling Equipment, Cable Laying Depths and Clearances from other Services such as Water Sewerage, Gas, Heating and other Mains, Series of Power and Telecommunication Cables and Coordination with these Services, Excavation of Trenches, Cable Jointing and Terminations	4	- L1 - L4	L4	- Remembering - Explaining	- Lecture	-Unit Test - Assignment
4	Testing and Commissioning. Location of Faults using Megger, Effect of Open or Loose Neutral Connections, of Proper Fuses on Service Lines and Their Effect on System, Causes and Dim, and Flickering Lights	8	- L2 - L3	L3	- Understanding - Explaining	- Lecture	-Unit Test - Assignment
5	Switchgear and Protective Devices: Standards, Types, Specification, Installation, Commissioning Tests, Maintenance Schedule, Type and Routine Tests.	6	- L2 - L4	L4	- Understanding - Explaining	- Lecture	-Unit Test - Assignment
5	Domestic Installation: Introduction, Testing of Electrical Installation of a Building, Testing of Insulation Resistance to Earth, Testing of Insulation and Resistance between Conductors Continuity or Open Circuit Test, Short Circuit Test, Testing of Earthing Continuity, Location of Faults, IE Rules for Domestic Installation.	04	- L2 - L5	L5	- Remembering - Explaining	- Lecture	-Unit Test - Assignment

2. Concepts and Outcomes:

Table 2: Concept to Outcome – Example Course

Module #	Learning or Outcome from study of the Content or Syllabus	Identified Concepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome Student Should be able to ...
A	I	J	K	L	M	N
1	- Study of Power System - Study of importance of high voltage transmission	- Power System - high voltage transmission	Electric Power System	Structure of Power system Importance of HVAC, EHVAC, UHVAC and HVDC transmission.	-Explaining Power system Importance of HVAC, EHVAC, UHVAC and HVDC transmission.	Explaining about the structure of the power system & the importance of HVAC, EHVAC, UHVAC and HVDC transmission.
1	-Study of Overhead transmission lines	- Overhead transmission lines	Overhead transmission lines & Insulators	Overhead transmission lines, supporting structures and	-Explaining Overhead transmission lines, Insulators	Explain about the types of structures used for supporting overhead lines &

	-Study of Insulators	- Insulators		conductors used for overhead transmission & distribution and importance of sag and Insulators, Methods of increasing string efficiency	-Types of supporting structures and conductors used for overhead transmission & distribution, importance of sag and Methods of increasing string efficiency	types of conductors used for overhead transmission & distribution. Explaining about the importance of sag and derive an expression for sag of a transmission line when supports at same and different level and analyze the performance of transmission line when effected by atmospheric conditions Understanding about the different types of insulators and to design insulators for a given voltage level.
2	-Study of Transmission Line parameters -Study of calculation of line parameters for different configuration	- Transmission Line parameters	Line parameters	Line parameters, Calculate the parameters of the transmission line.	-Calculate Line parameters -Calculate the parameters of the transmission line.	Calculate the parameters of the transmission line for different configurations.
2	-Study of Transmission Line parameters -Study of calculation of line parameters for different configuration	- Transmission Line parameters	Line parameters	Line parameters, Calculate the parameters of the transmission line.	-Calculate Line parameters -Calculate the parameters of the transmission line.	Calculate the parameters of the transmission line for different configurations.
3	-Study of Overhead transmission line classification -Study of performance of line for different configurations	-	Performance of Transmission lines	Overhead transmission line, classification Performance of line	-Explaining & analyzing Overhead transmission line -classification Performance of line	Explaining about the classification of overhead transmission line and analyze the performance of line for different configurations
3	-Study of Overhead transmission line classification -Study of	- Transmission lines	Performance of Transmission lines	Performance of line	-Explaining & analyzing Overhead transmission line -classification	Analyze the performance of line for different configurations

	performance of line for different configurations				Performance of line	
4	-Study of corona -Study of Parameters related to corona	-Corona -	Corona	Basic principle of corona, Parameters related to corona	-Explaining -Basic principle of corona -Parameters related to corona	Explaining about the basic principle of corona and discussing about the parameters related to corona
4	-Study of Underground cable -Study of insulating materials used for cable.	- Undergroud cable -	Underground cable	Underground cables, selection of cables, classification of underground cable, insulating materials used for cable.	-Explaining -underground cables -selection of cables, classification of underground cable, -insulating materials used for cable.	Compare underground cables and overhead lines and Explain about the requirements for selection of cables, classification of underground cable, insulating materials used for cable.
5	Study of Distribution System -Study of Types of distribution systems	- Distribution System -	Distribution System	Distribution system, Types of distribution systems	-Understanding -Distribution system -Types of distribution systems	Understanding about the requirements of a good distribution system and explaining about the types of distribution systems.
5	Study of Distribution System -Study of Reliability and Quality of Distribution system	- Distribution System - Reliability and Quality of Distribution system	Reliability and Quality of Distribution system	Distribution system Reliability and Quality	-Understanding -Distribution system -Reliability and Quality	Understanding about the Reliability and Quality of Distribution system