

Branch Name:	Electrical Engineering
Program Code:	ET109
Course Name:	Testing and Commissioning of Electrical Equipment
Course Code:	1ET1090703
Pre-requisite Course:	Fundamentals of Electrical Machines, Electrical Measurements

Course Objectives:

1. The students will acquire the knowledge regarding the fundamentals of Testing and Commissioning of Electrical Equipments.
2. To explore the knowledge of different safety measures to be taken before any electrical Installation.
3. This course will enable the students to understand the concepts, principles and acquire basic skills of installation, commissioning and maintenance of electrical equipment required in industry.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)								
Lecture	Tutorial	Practical	Credit	Theory				Practical				Total
				University Assessment		Continuous Assessment		University Assessment		Continuous Assessment		
				Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	-	2	4	28	70	12	30	12	30	08	20	150

Course Contents:

Sr. No.	Topic	Total Hours	Weightage (%)
1	Safety Management: Objectives, Safety Management during Operation and Maintenance, Clearance and Creepages, Electric Shock, need of Earthing, different methods of Earthing, factors affecting the Earth Resistance, methods of measuring the Earth Resistance, Equipment Earthing and System Grounding, Earthing Procedure - Building installation, Domestic appliances, Industrial premises, Earthing of substation, generating station and overhead line.	05	12
2	Installation of Electrical Equipment: Inspection of Electrical Equipment at site, Storage Electrical Equipment at site, Foundation of Electrical Equipment at site, Alignment of Electrical Machines, Tools/Instruments necessary for installation, Technical report, Inspection, storage and handling of transformer, switchgear and motors.	04	10
3	Testing of Transformer, Plant and Equipment: General Requirements for Type, Routine and Special Tests, Measurement of winding resistance; Measurement of voltage ratio and check of voltage vector relationship; Measurement of impedance voltage/short-circuit impedance and load loss; Measurement of no-load loss and current; Measurement of insulation resistance; Dielectric tests; Temperature-rise,	13	28

	insulation and HV test, dielectric absorption, switching impulse test. Testing of Current Transformer and Voltage Transformer, power transformer, distribution transformer, CVT and special transformer with reference to Indian Standard (IS). Drying out procedure for transformer. PI index, Commissioning steps for transformer, troubleshooting & maintenance of transformer.		
4	Installation and Commissioning of Rotating Electrical Machines: Degree of protection, cooling system, degree of cooling with IP- IC code (brief discussion), enclosures, rating of industrial rotating electric machine, installation, commissioning and protection of induction motor and rotating electric machine, drying out of electric rotating machine, insulation resistance measurement, site testing and checking, care, services and maintenance of motors, commissioning of synchronous generator, protection and automation of synchronous generator, synchronous motor, D.C. generator and motor with reference to Indian Standard (IS).	12	26
5	Substation Equipments: Bus bar: Temperature Rise test, rated short time current test, HV test, Power frequency voltage withstand test, Impulse / surge testing, Vibration. Earthing: Earthing resistance measurement, Substation grid Earthing, Soil resistivity measurement. Isolator Testing: Temp. Resistance test, Short circuit test, charging current making & breaking test, Inductive current making & breaking test.	04	12
6	Switch Gear & Protective Devices: Standards, Classification, specification, rating and duties of CB, installation, commissioning tests, maintenance schedule, type & routine tests. Operation of s/s (steps) for line Circuit breaker maintenance.	04	12

Reference Books:

1. Testing, commissioning, operation and maintenance of electrical equipment - S Rao, Khanna Publishers, 1998.
2. Electrical power equipment maintenance and testing - Paul Gill, CRC Press, 2012.
3. Installation, commissioning and maintenance of Electrical equipment - Tarlok Singh, S.K. Kataria and Sons, 2006.
4. Relevant Indian Standards (IS Code) and IEEE Standards for-Installation, maintenance and commissioning of electrical equipment/machines.

List of Experiments:

1. Interpret IE rules pertaining to safety, show the action to be taken when a person comes in contact with a live wire, undertake drill operation for using fire extinguisher for safety against fire.
2. Measure insulation resistance of a winding/cables/wiring installation.
3. Types of earthing & Measurement of earth resistance of installation of building and appliances by different methods.
4. Study of Power Quality and Harmonics due to various type of load using Power Analyzer.
5. To study of drying out process of Transformer and procedure of drying out of electrical equipment.
6. To Perform various tests on insulating oil.

7. To study various Test of Induction Motor and their significance.
8. To carry out routine tests on a given contractor used in the 3-phase supply.
9. To find out Phase shift in a transformer.
10. To find out reflection of fault current on opposite side of the transformer.

List of Open Source Software/learning website:

- http://www.ieee.org/publications_standards/publications_standards_index.html
- <http://www.nema.org/Standards/About-Standards/pages/default.aspx>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	To know unloading of the electrical equipment based on scientific procedure with its storage, inspection & foundation. Use of instruments for installation.	1 Remembering
CLO2	To interpret various commissioning test on electrical equipment & test preparations, Instruments required for testing, measurement of insulation resistance.	2 Understanding
CLO3	Preparation of maintenance schedule of different equipment and machines.	3 Applying
CLO4	To indicate the trouble shooting chart for various electrical equipment, machines and domestic appliances.	2 Understanding
CLO5	Categorize different types of earthing for different types of electrical installations.	4 Analyze
CLO6	Familiar about electrical safety regulations and rules during maintenance.	1 Remembering

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1			L			M					M			M		
CLO2	M			L			H		M	L		L	H			M
CLO3		L			L						L	M			L	
CLO4	L			M	H	L		M	L					L		M
CLO5		H	L				M	H							H	
CLO6				M	L					M	M		L			

H: High, M: Medium, L: Low