

Branch Name:	Electrical Engineering
Program Code	ET403
Course Name:	MAINTENANCE OF TRANSFORMER AND CIRCUIT BREAKER
Course Code:	2ET4030505
Pre-requisite Course:	

COURSE OBJECTIVE:

The course content should be taught and implemented with an aim to develop different skills

1. Undertake /apply preventive maintenance
2. Maintain power and distribution transformers.
3. Commission different types of transformers
4. Maintain different types of circuit breakers

TEACHING AND EVALUATION SCHEME:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
4	-	2	5	60	40	20	30	150

DETAILS OF COURSE CONTENTS:

Sr No	Topics and Sub-topics	Total Hours	% Weightage
1	Preventive Maintenance 1.1 Maintenance and its types Preventive and Breakdown 1.2 Advantages of preventive maintenance 1.3 Scope of preventive maintenance 1.4 Economics of preventive maintenance	06	10

2	Maintenance of Transformers 2.1 Significance of transformer maintenance 2.2 Parts of transformer- Tank, Core, winding, conservator, radiators, bushings, terminals, temperature measurement system, safety valves, tap changers and accessories/ fittings etc. 2.3 Factors affecting the life of transformer- Moisture, water oxygen, solid impurities, varnish, slackness of windings and dust. 2.4 Inspection- Sensory, records and electrical test. 2.5 General/Typical maintenance schedule of power transformers-up to 1000 kVA and above 1000 kVA 2.6 Testing of transformer oil- Characteristic, interpretation of tests, procedure of testing BDV, filtering plant. 2.7 Causes of failures of power transformers and preventive actions. 2.8 Protective Devices :- Buchholz relay, Pressure relief device, Differential relay, Dial thermometer alarm contact, Over current relay, ground fault relay, voltmeter, ammeter, Human senses 2.9 Check list of maintenance of power transformers 2.10 Causes and methods to reduce Audible Noise (AN) from transformer 2.11 Maintenance of distribution transformer i. Reasons for failure of Distribution Transformers and the remedial measures thereof	20	35
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	ii. Inspection & Maintenance Schedule for Distribution Transformers: iii. Inspection & Maintenance of transformer and accessories within the sub-station and its proximity. 2.12 Procedure of measuring the insulation resistance of transformer windings.		
3	Commissioning and Recharging of Transformers 3.1 Concept of commissioning and recharging of transformer. 3.2 General checks 3.3 Insulation resistance test 3.4 Measurement of oil characteristics 3.5 Off circuit tap switch 3.6 Continuity test 3.7 Measurement of winding resistance 3.8 Voltage ratio tests 3.9 Magnetizing current 3.10 Charging of the transformer 3.11 Do's and Don'ts for transformer 3.12 Various commissioning tests on a power transformer 3.13 Procedure of loading the transformers. 3.14 Transformer grounding.	12	25
4	Maintenance of Circuit Breaker 4.1 Steps in maintenance of CB 4.2 Maintenance of molded case circuit breakers -Frequency and routine maintenance tests 4.3 Maintenance of low-voltage circuit breakers -Frequency and maintenance procedures 4.4 Maintenance of medium voltage circuit breakers – Air, Oil and Vacuum circuit breakers - Frequency of maintenance, safety practices and maintenance procedures for each of the above 4.5 Maintenance of high-voltage circuit breakers - frequency of inspections, External and internal inspection guidelines, typical internal breaker problems, Influence of duty imposed, Types of tests performed. 4.6 OIL CB, Post fault maintenance, Steps in maintenance of MOCB 4.7 Maintenance for AIR CB and Frequency of maintenance.	18	30

	4.8 Maintenance of AIR BLAST CB 4.9 Maintenance of SF6 gas circuit breakers • Properties of SF6 (Sulphur hexafluoride) gas • Handling non faulted SF6 • Handling faulted SF6 • Procedure of filling SF6 gas in single pressure puffer type SF6 CB • Gas monitoring system and gas handling system for SF6 filled equipment • Types and function of SF6 gas handling units. • Maintenance of SF6 CB 4.10 Maintenance of VACCUM CB 4.11 Life of arcing contacts in various CB in case of normal current switching and short circuit operation 4.12 Causes of failure of CB, trouble shooting and procedure of failure analysis. 4.13 Typical Record card for maintenance work of CB 4.14 Commissioning tests on HV A.C. CB 4.15 Operating mechanism used in HV A.C. CB 4.16 Safety precautions to be taken in maintenance of CB		
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LIST OF REFERENCES:

1. Testing Commissioning operation and maintenance of Electrical Equipments.
Rao S Khanna Publication
2. Relevant IS Code for-Maintenance of Transformer, circuit breaker, switchgears, insulating oil
3. www.nptel.iitm.ac.in
4. www.youtube
5. www.howstuffworks.com
6. <http://electrical-engineering-portal.com/>

LIST OF PRACTICAL:

SR NO	PRACTICALS/EXPERIMENTS
1	Prepare a technical report on the preventive maintenance of Transformer.
2	Prepare a technical report on various accessories and fitments on a power transformer in a sub- station.
3	Prepare a technical report on various causes of troubles and failure of power transformer

4	Prepare a maintenance schedule for transformer having capacity below 1000 KVA.
5	Prepare a maintenance schedule for transformer having capacity above 1000 KVA.
6	Prepare a technical report on filtering process and filtering plant for transformer oil filtration.
7	Prepare a technical report on various type of tests performed on high voltage circuit breakers.
8	Prepare a technical report on maintenance of air blast circuit breakers.
9	Prepare a technical report on maintenance of SF6 circuit breakers.
10	Prepare a technical report on maintenance of vacuum circuit breakers.

COURSE OUTCOME:

The course content should be taught and implemented with an aim to develop different skills leading to the achievement of the following competencies and course learning outcomes:

- Discuss the preventive maintenance.
- List and identify maintenance of power transformers.
- List and identify maintenance of distribution transformers
- Discuss and Explain Commission of different types of transformers.
- Discuss maintenance of different types of circuit breaker and illustrate it.
- Outline different commissioning test and use and identify the test result.

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

CLO	Description	Bloom's Taxonomy Level
CLO1	Discuss the preventive maintenance.	2 Understanding
CLO2	List and identify maintenance of power transformers.	1 Remembering 4 Analyzing
CLO3	List and identify maintenance of distribution transformers	1 Remembering 4 Analyzing
CLO4	Discuss and Explain Commission of different types of transformers.	2 Understanding 4 Analyzing
CLO5	Discuss maintenance of different types of circuit breaker and illustrate it.	2 Understanding 3 Applying
CLO6	Outline different commissioning test and use and identify the test result.	2 Understanding 3 Applying

		4 Analyzing
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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
CLO1	H				M			L		L			H	L	L
CLO2	L				M								H	M	L
CLO3	L											L	L		M
CLO4				L	L		L	L					M		M
CLO5					L						M		M		
CLO6		M		M				L					L	L	

H: High, M: Medium, L: Low