GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: INSTALLATION, COMMISSIONING AND MAINTENANCE
(COURSE CODE: 3360902)

Diploma Programme in which this course is offered	Semester in which offered
ELECTRICAL ENGINEERING	SIXTH SEMESTER

1. RATIONALE

Due to establishment of medium and large scale industries, it requires highly skilled engineers/technicians basically expertise in the field of installation, commissioning and testing of electrical equipments/machines. The technician should be able to prepare foundation of various electrical machines/equipments. He / She should be able to installation of various meter, accessories and protective devices. He /She should be able to test various equipments before commissioning and after commissioning as per specification of machines / instruments as per I.S. He / She should also have expertise in maintenance of electrical equipments and machine. The course contents of this subject is designed such that it develop all the above skills in the students

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Test and maintain various electrical equipments**

(The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency)

3. Course Outcomes:

Student will be able to:

- Apply the procedure of unloading of electrical equipments/machines
- Commissioning test and analysis of test results of various electrical equipments/machines
- Maintain various electrical equipments/machines
- Trouble shoot various electrical equipments/machines
- Carryout and testing of earthing system
- Apply electrical accidents and safety rules during maintenance

4. Teaching and Examination Scheme

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
4	2	2	8	70	30	20	30	150

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit **ESE** - End Semester Examination; **PA** - Progressive Assessment**.**

5. COURSE DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I. INSTALLATION OF ELECTRICAL EQUIPMENTS	1a Describe the planning before unloading of heavy electrical equipments at site 1b Select appropriate tools for installation of electrical equipment 1c Explain the procedure for handling ,inspection, storage and installation of static and rotating electrical equipments	1.1 Introduction 1.2 Unloading of electrical equipment at site 1.3 Inspection 1.4 Storage 1.5 Foundation 1.6 Alignment of electrical machines 1.7 Tools/Instruments necessary for installation 1.8 Inspection, storage and handling of transformer, switchgear and induction motor 1.9 Preparation of technical report
Unit– II COMMISSIONING AND TESTING	2a Describe various commissioning test on electrical equipments/machines 2b Describe the specific test on electrical equipments/machines 2c Explain the various commissioning test on equipments/machines 2d Explain the standard tests to be performed on insulation oil 2e Determine the insulation resistance of electrical equipments/machines 2f Explain the procedure of drying the winding of electrical equipments/machines 2g Explain the various factor affecting the insulation resistance 2h Explain the loading procedure of electrical equipments	2.1 Tests before commissioning of electrical equipment : Electrical and Mechanical test 2.2 Specific tests on - transformer, induction motor, alternator, synchronous power and electrical power installation 2.3 Need of gradually loading of electrical equipment 2.4 Preparations before commissioning of power transformer 2.5 Commissioning- power transformer, three phase induction motor 2.6 Transformer insulation oil: Properties as per IS, sampling, testing and filtering/purifying, standard tests as per IS 2.7 Measurement of insulation resistance of different equipments/machines 2.8 Methods of Drying the winding of electrical equipments and its record 2.9 Classification and measurement of insulation resistance, Polarization Index 2.10 Appropriate insulation test for specific purpose 2.11 Factor affecting the insulation resistance of insulating materials

Unit	Major Learning Outcomes	Topics and Sub-topics
		2.12 Various Tests to be performed after commissioning and before starting the machine 2.13 Various instruments required for testing 2.14 Commissioning of switchgear 2.15 Test report on commissioning and test certificate
Unit– III MAINTENANCE OF ELECTRICAL EQUIPMENTS	3a Understand the concept of different types of maintenance 3b Explain the reason of failure of electrical equipment due to poor maintenance 3c Explain the maintenance schedule of different equipments 3d Describe the probable fault due to poor maintenance in various electrical equipments	3.1 General aspect of maintenance, Classification 3.2 Preventive maintenance-concept, classification, advantages, activities, functions of the Maintenance Department 3.3 Breakdown maintenance-concept, advantages, activities 3.4 Reasons of failure of electrical equipment due to poor maintenance 3.5 Factors for preparing maintenance schedule 3.6 Frequency of maintenance 3.7 Maintenance schedule of transformer below and above 1000kVA 3.8 Maintenance schedule - induction motor, circuit Breaker, overhead line, storage Battery 3.9 Probable faults due to poor maintenance in transformer, induction motor, circuit breaker, overhead lines and battery

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit–IV TROUBLE SHOOTING	4a List the various causes of fault in electrical machines 4b Describe the common troubles in electrical equipments 4c Understand the importance of trouble shooting chart for various electrical equipment 4d Prepare a trouble shooting chart for various electrical equipments	4.1 Causes of fault in electrical equipments- Internal and external 4.2 Instruments and tools for trouble shooting 4.3 Common troubles in electrical equipment – DC Machines, AC Machines, Transformers, Circuit-breaker, under-ground cable, electrical Installation 4.4 Need of trouble shooting chart, advantages 4.5 Trouble shooting chart – DC Motor, DC Generator, Transformer, Synchronous Motor, Induction Motor, Circuit-breaker 4.6 Trouble shooting chart for Domestic appliances- electrical iron, ceiling fan, Washing machine, Air cooler, Vacuum cleaner 4.7 Fluorescent tube light: Construction, working and troubleshooting chart
Unit–V EARTHING	5a Understand the necessity of earthing 5b Explain the different methods of earthing 5c Explain the various factors affecting the earth resistance 5d Describe the various methods of measuring the earth resistance 5e Compare equipment earthing and system grounding 5f Explain the earthing procedure in different types of electrical installations	5.1 Necessity of earthing 5.2 System earthing : advantage of neutral earthing of generator in power station 5.3 Equipment earthing: Objective 5.4 Types of earth electrodes 5.5 Methods of earthing : plate earthing ,pipe earthing and coil earthing 5.6 Earthing in extra high voltage and underground cable 5.7 Earthing resistance- factor affecting 5.8 Determination of maximum permissible resistance of the earthing system 5.9 Measurement of earth resistance: voltmeter-ammeter method, earth tester method, ohm meter method and earth loop tester method 5.10 Define: earthing , grounding and bonding 5.11 Comparison between equipment earthing and system grounding 5.12 Earthing procedure - Building installation, Domestic appliances, Industrial premises 5.13 Earthing in substation, generating station and overhead line

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit–VI ELECTRICAL ACCIDENTS AND SAFETY	6a Explain the various factor affecting the electrical shock 6b Apply safety measures according to types of electrical accident 6c Explain the procedure of shutdown for substation and power line 6d List the instruction for the safety while working on a job with a permit to work	6.1 Causes of electrical accidents 6.2 Factors affecting the severity of electrical shock 6.3 Actions to be taken when a person gets attached to live part 6.4 Safety regulations and safety measures 6.5 Indian electricity supply act 1948-1956 6.6 Factory act 1948 6.7 Procedure of shut down for sub-station and power lines 6.8 Permit to work : certificate of (i)requisition for shut down(ii) Permit to work and (iii)Line clear certificate 6.9 Instruction for the safety of persons working on a job with a permit to work 6.10 Fire extinguishers- For fixed installation and portable devices

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	INSTALLATION OF ELECTRICAL EQUIPMENTS	6	2	2	4	8
II	COMMISSIONING AND TESTING	14	4	6	6	16
III	MAINTENANCE OF ELECTRICAL EQUIPMENTS	12	4	5	5	14
IV	TROUBLE SHOOTING	9	4	5	3	12
V	EARTHING	9	2	5	5	12
VI	ELECTRICAL ACCIDENTSAND SAFETY	6	2	3	3	8
	Total	**56**	**18**	**26**	**26**	**70**

Legends: R = Remembrance; U = Understanding; A = Application and above levels (Revised Bloom's taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of cognitive and practical skills **(Outcomes in cognitive, psychomotor and affective domain)** so that students are able to acquire the competencies. Following is the list of practical exercises for guidance.

***Note**: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain*

S. No.	Unit No.	Practical Exercises (Outcomes' in Psychomotor Domain)	Hrs. required
1	I	Prepare complete layout of wiring for installation of given machine with specification	2
2	I	Prepare technical report on installation of electrical equipments/machines	2
3	II	Perform various test on insulating oil	4
4	II	Measure insulation resistance of a winding/cables/wiring installation	4
5	II	Prepare test report of an electrical machine after commissioning	2
6	III	Prepare maintenance schedule for power transformer	2
7	III	Prepare maintenance schedule for induction motor	2
8	IV	Dismantle and trouble shoot of ceiling fan	2
9	IV	Dismantle and trouble shoot of fluorescent tube light	2
10	IV	Measure earth resistance of installation of building/domestic wiring and appliances	2
11	V	Prepare plate/pipe earthing as per IS and measure the earth resistance	2
12	VI	Read and interpret IE rules pertaining to safety	2
13	VI	Prepare a report in case of an electrical accident	2
Total			**30**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

i. Prepare trouble shooting chart for various electrical equipments
ii. Prepare maintenance schedule for various electrical equipments
iii. Site visit for installation, commissioning and testing of electrical Equipments / machines
iv Refer Relevant IS Code for-Installation, maintenance and commissioning of electrical equipments/ machines different IS Codes

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

Demonstrate installation and maintenance of small electrical equipments/machines
Dismantle and troubles hoot ceiling fan
Demonstrate the wiring of fluorescent tube-light
Demonstrate use of fire extinguisher

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book	Author	Publication
1.	Testing Commissioning operation and maintenance of Electrical Equipments.	Rao S	Khanna Publication (Latest edition)
2.	Installation, commissioning & maintenance of Electrical equipments	Singh TARLOK	S.K.Kataria & Sons, New Delhi, Second edition-2012
3.	Electrical power system	Wadhwa C.L.	New Age international Publications
4.	Relevant IS Code for-Installation, maintenance and commissioning of electrical equipments/machines		Latest code

B) List of Major Equipment/ Instrument with Broad Specifications

i. Oil testing kit.	Mains Supply : 230V AC ±10%, 50Hz Single Phase Variac : 230V/ 0-270V High Voltage Source : 80kV, 20mA Voltmeter : 0 to 100kV
ii. Megger.	Insulation Testing:250V:500V:1000V: 1000 MΩ range,Auto-ranging, Auto discharge

C) List of Software/Learning Websites

www.lce.com/pdfs/The-PMPdM-Program-124.pdf
www.iapa.ca/pdf/prevent.pdf
http://cercind.gov.in/ElectSupplyAct1948.pdf
www.pfeiffereng.com/Principals%20of%20Electrical%20Grounding.pdf

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- Prof. R D PANCHAL, RC TECHNICAL INSTITUTE, AHMEDABAD
- Prof. C.T.PATEL, RC TECHNICAL INSTITUTE, AHMEDABAD

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. (Mrs.) Susan S. Mathew**
- **Dr. Joshua Earnest**,