Marwadi University
Marwadi Chandarana Group

Syllabus for Diploma Engineering

Electrical Engineering

Semester – V

Subject Name: Testing and Maintenance of Electrical Machines

Subject Code: 09EE2502

Diploma Branches in which this subject is offered: Electrical Engineering

Objective: Electrical power system network and modern industry consists of number of electrical machines and equipments, which machines require installation, testing and routine maintenance to prevent before fault. Diploma electrical engineer do job as a supervisor and work carryout installation, testing and maintenance of various electrical machinery in power transmission and distribution network, power plants and modern industry. This course give basic idea to diploma holder regarding understand basic concept, principles and necessary skill related to power transmission and distribution network, power plants and modern industry. After study this subject student's gain knowledge to inspect, test, install and maintenance electrical equipment as per standard.

Credits Earned: 5 Credits

Course Outcomes: After completion of this course, student will be able

1. To understand Indian electricity act, safety rules, safety of machines and humans, prevention of accidents, safety measures and state safety precautions.
2. To perform loading, unloading, and inspection of various electrical equipment as per standard procedure.
3. To understand procedure of testing of various electrical equipments as per IS.
4. To prepare maintenance schedule and troubleshooting chart for different electrical equipment.
5. To understand procedure of different type of earthing as per requirement in electrical installations.

Pre-requisite of course: Basic knowledge of electrical Circuits, Electrical Machines, Electrical Measurement and Instrumentations and Electrical power system.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE	IA	CSE	Viva	Term work	
4	0	2	5	50	30	20	25	25	150

Contents:

Unit	Topics	Contact hours	Weightage (%)
1	**Safety & Prevention of Accidents** • Introduction • Definition of terminology used in safety; safety, hazard, accident, major accident, responsibility, authority, accountability, monitoring • I.E. Act & statutory regulations for safety of persons & equipments working with electrical installation • Dos & don'ts for substation operators as listed in IS • Meaning & causes of electrical accidents factors on which severity of shock depends • Procedure for rescuing the person who has received an electric shock, methods of providing artificial respiration • Precautions to be taken to avoid fire due to electrical reasons, operation of fire extinguishers. • Necessity of earthing, Need and purpose of earthing • Earth electrodes and its type, Methods of earthing, Earth resistance, Factors for affecting the earth resistance, various methods of measurement of earth resistance • Equipment earthing and system grounding, earthing, grounding and bonding • Earthing procedure for different types of installation	5	9
2	**General Introduction** • Introduction • Objectives of testing significance of I.S.S. concept of tolerance, routine tests, type tests, special tests. • Methods of testing a. Direct, b. Indirect, c. Regenerative. • Functions of the maintenance department; Reasons of failure of electrical equipment • Concept of routine, preventive & breakdown maintenance • Advantages of preventive maintenance, procedure for developing preventive maintenance schedule • Factors affecting preventive maintenance schedule. • Introduction to total productive maintenance.	8	14
3	**Testing & maintenance of rotating machines** • Type tests, routine tests & special tests of single & three phase Induction motors • Routine, preventive, & breakdown maintenance of	7	13

	single & three phase Induction motors as per IS 9001:1992 • Parallel operation of alternators, maintenance schedule of alternators & synchronous machines as per IS 4884-1968 • Brake test on DC series motor.		
4	• **Testing & maintenance of Transformers** • Listing type test, routine test & special test as per I.S. 2026-1981 • Procedure for conducting following tests: Measurement of winding resistance, no load losses, & no load current, Impedance voltage, load losses, Insulation resistance, Induced over voltage withstand test, separate source voltage withstand test, Impulse voltage withstand test, Temperature rise test of oil & winding, • Different methods of determining temp rise - back to back test, short circuit test, open delta (delta - delta) test. • Preventive maintenance & routine maintenance of distribution transformer as per I.S. 10028(part III): 1981, • Periodic checks for replacement of oil, silica gel • Parallel operation of single & three phase transformer, load sharing calculations (numerical)	**12**	**21**
5	**Testing & maintenance of Insulation** • Classification of insulating materials as per I.S. 8504(part III)1994, • Factors affecting life of insulating materials, measurement of insulation resistance & interpretation of condition of insulation. • Methods of measuring temperature of internal parts of windings/machines & applying the correction factor when the machine is hot. • Properties of good transformer oil, list the agents which contaminates the insulating oil • Understand the procedure of following tests on oil as per I.S. 1692-1978 - a. acidity test, b. sludge test, c. crackle test, e flash point test. • Filtration of insulating oil protection of electrical equipments (insulation) during the period of inactivity. • Methods of cleaning the insulation covered with loose, dry dust, sticky dirt, & oily viscous films, • Procedure for cleaning washing & drying of insulation & revarnishing • Methods of internal heating & vacuum impregnation.	**9**	**16**

6	**Trouble shooting of Electrical Machines & Switch gear** • Significance of trouble shooting of various electrical machines and describes the procedure for the same. • Internal and external causes of failure of equipment. • Various types of faults (mechanical, electrical & magnetic) in electrical machines, reason for their occurrence. • Use of following tools: Bearing puller, Filler gauge, dial indicator, spirit level, megger, earth tester, growler, and multimeter. • Trouble shooting charts for single and three phase induction motor, single and three phase transformer. • List the common troubles in electrical installation & cables Maintenance. • Trouble shooting of LV switchgear like MCCB, ELCB, contactors & batteries.	**9**	**16**
7	**Installation** • Factors involved in designing the machine foundation. • Requirement of different dimension of foundation for static & rotating machines. • Procedure for levelling & alignment of two shafts of directly & indirectly coupled drives, effects of misalignment. • Installation of rotating machines as per I.S. 900-1992. • Use of various devices & tools in loading & unloading, lifting, carrying heavy equipment.	**6**	**11**

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyse	Evaluate	Create
35%	35%	15%	15%	0%	0%

Suggested Laboratory Work / Activity:

Following are the activities which can be undertaken to accelerate the attainment of the various outcomes in this course

Sr. No.	Unit No.	Name of Topics	Contact Hours
1	1	To prepare plate/pipe earthing as per IS and measure the earth resistance.	2
2	3,6	To study installation procedure of induction motor, Draw circuit diagram select appropriate meters, carry out/perform various routine test on single phase/three phase induction motor, calculate the different parameters, prepare test report of testing of induction motor, prepare maintenance schedule of three phase induction motor and prepare trouble shooting chart of induction motor.	6
3	3,6	To study installation procedure of synchronous machines and DC machines, carry out/perform various routine test on synchronous motor, synchronous generator, DC motor, DC generator, prepare test report of testing, prepare maintenance schedule of synchronous motor, synchronous generator, DC motor, DC generator and prepare trouble shooting chart of synchronous motor, synchronous generator, DC motor, DC generator. Perform parallel operation of alternator as per I.S.	8
4	4,6	To study installation procedure of transformer, carry out/perform various routine test on single phase/three phase transformer, prepare test report of testing of transformer, prepare maintenance schedule of three phase transformer and prepare trouble shooting chart of transformer. Perform parallel operation of transformer as per I.S.	6
5	5	To perform measurement of insulation resistance test of machine winding/cable/wiring installation and check PI	2
6	5	To perform various tests on insulating oil (transformer oil)	2
7	7	Draw/prepare layouts of wiring for installation of any electrical machine with all specification	2

Instructional Method:

a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, Quiz, brainstorming, MOOCs etc.
b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory and animation of demonstrates installation of various electrical equipments.
e. Arrange an industrial visit to nearby industry observe installation and trouble shooting of various electrical machines/equipments.

References:

1. S. Rao, "*Testing Commissioning Operation & Maintenance of Electrical Equipment* ", Khanna Publishers, 2016.
2. Tarlok Singh, "*Installation Commissioning & Maintenance of Electrical Equipments*", S. K. Kataria & Sons, 2017.
3. Madhvi Gupta, "*Installation, Maintenance and Repair of Electrical Machines and Equipments*", S. K. Kataria & Sons, 2017.
4. R. P. Singh, "*Electrical Workshop*", I.K. International, 2012
5. C. J. Hubert, "*Operating, Testing, and Preventive Maintenance of Electrical Power Apparatus*", Pearson, 2002
6. Paul Gill, "*Electrical Power Equipment Maintenance and Testing*", CRC Press, 2008

Supplementary Resources:

1. https://npti.gov.in/electrical-safety-and-inspection-electrical-installations- under-ie-rules
2. https://electrical-engineering-portal.com/resources/electric-testing-maintenance
3. https://bis.gov.in/
4. https://www.nema.org/pages/default.aspx
5. https://www.osha.gov/SLTC/electrical/standards.html