



Semester – III

Subject Name: Electrical DC Machines and Transformer

Subject Code: 09EE1301

Diploma Branches in which this subject is offered: Electrical Engineering

Objective: This is one of the most important electrical engineering core subject. After studying this students should be able to understand the basic concept of electrical machine for highly effective working as a skilled electrical engineer in modern industry. This subject teach to students apply the basic principle for working of electrical machines; solve the machines related problems of electrical industry and electric network. Basically electrical engineering divided in power generation, transmission, distribution and utilization in form of A.C. so every electrical engineer should know basic concept, construction and testing of electrical machines used in above system. To solve the given problem by using the knowledge of fundamental concept of electrical machine. This course will develop the skill of student with knowledge of construction of machines, testing of machines, performance & various testing of machines, various connections of machines and cooling system for machines.

Credits Earned: 5 Credits

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

1. To understand basic concept of electrical machine.
2. To apply the various principle for operation of DC machines and transformer.
3. To understand construction, types, EMF generation, various characteristics, losses & efficiency, parallel operation, commutation and application of DC generator.
4. To analyse and understand working, back EMF, torque generation, types, speed control, requirement of starter, braking and application of DC motor.
5. To understand and analyse construction, classification, EMF generation, loading, equivalent circuit, losses, efficiency, load sharing, cooling methods, and application of single and three phase transformer.
6. To understand different types of transformer used in power system.
7. To analyse and carryout various test for DC machines and transformers.

Pre-requisite of course: Basic knowledge of D.C. Circuits and A.C. Circuits.

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	Principle of Electromechanical Energy Conversion <ul style="list-style-type: none">• Introduction• Law of energy balance• Role of electrical energy• Uses of electrical energy• Law of electromagnetism• Faraday's law of electromagnetic induction• Energy flow in electromagnetic device• Electromagnetic conversion principal• Unified theory of electrical machine• Type of magnetic field system• Comparisons of magnetic field system• Advantage of field energy method	05	9
2	Basic Concepts of Rotating Machines <ul style="list-style-type: none">• Introduction• Common features of rotating electrical machines• Types of rotating electrical machines• EMF generation in rotating electrical machines• Electromagnetic torque, Concept of torque production• Rotating magnetic fields• Electrical and mechanical degrees• Insulating materials• Rating of machines• Types of enclosures• Frame size	04	7
3	DC Generators <ul style="list-style-type: none">• Introduction• Type of DC machines• Principle of DC generator, single turn alternator• Construction of DC machines, action and role of commutator• Material used in different part of DC Generator with their function• Armature windings, it's terminology• Types of armature winding• Single layer and double layer windings• Dummy coils, Equalizing ring or connection• Comparison between simplex lap winding and wave winding• EMF equation of DC generator	15	27



	<ul style="list-style-type: none">• Types of DC generators• Symbolic representation of DC generators• Characteristics of DC generators• Voltage built up in DC shunt generator• Critical resistance and critical speed• Losses in DC generator• Power stage and efficiency of DC generator• Condition for maximum efficiency• Armature reaction in DC machine• Compensating winding• Demagnetizing and Cross-magnetizing conductors• Calculation of Demagnetizing ampere-turns per pole• Calculation of Cross-magnetizing ampere-turns per pole• Commutation• Methods of improving commutation• Interpoles or Commutators poles• What is different between compensating winding and interpoles• Parallel operations of DC generators• Application of various type of DC generators• Rating of DC generators		
4	DC Motors <ul style="list-style-type: none">• Introduction• Working principle of DC motor• Voltage equation of motor• Back EMF• Direction of rotation of motor• Power equation of motor• Torque of DC motor, armature torque, shaft torque• Types of DC motors• Equivalent circuit of DC motor• Speed and speed regulation• Torque and speed of DC motors• Performance characteristics of DC motors• Starter and it's types, automatic starter• Speed control of DC motors• Electronics speed control, Reversal of rotation• Losses, Power stage and efficiency of DC motor• Condition for maximum power and maximum efficiency• Electric braking of motors• Application and rating of DC motors	10	18



5	Transformers <ul style="list-style-type: none">• Introduction• Principle of transformer• Classification of transformer• Construction and parts of transformer• EMF equation of a transformer• Transformation ratio• Ideal transformer• Transformer on No load• Transformer on load• Actual transformer• Resistance and leakage reactance of windings• Equivalent resistance and reactance• Vector diagram of transformer• Equivalent circuit of transformer• Voltage regulation of transformer• Losses in a transformer• Efficiency of transformer and all day efficiency• Parallel operation of transformer• Autotransformer• Welding transformer• Instruments transformer(CT, PT)• Bank of three single phase transformer and single three phase transformer• Construction of three phase transformer• Accessories of transformer• Basic principle of three phase transformer• Tap changing transformer• Losses in three phase transformer• Three phase transformer connections• Cooling methods of transformers• Parallel operation of three phase transformer• What is difference between distribution and power transformer• Application of transformer• Specification, Name plate data and rating of transformer	15	27
6	Testing of DC Machine and Transformer <ul style="list-style-type: none">• Introduction• Direct and indirect methods of testing• Necessity of testing Testing of DC machines <ul style="list-style-type: none">• Brake load test• Swinburne's test• Field test	07	12



	<p>Testing of Transformer</p> <ul style="list-style-type: none"> • Need of testing on transformer • Equivalent circuit of transformer • Direct loading test • Open circuit and short circuit test • Sumpner test • Polarity test 		
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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 List of Experiments:

Sr. No.	Unit No.	Name of Topics	Contact Hours
1	3	To study construction of DC machine and it's various part	2
2	3	To maintain constant voltage of DC generator at different load conditions	2
3	3	To check the performance of DC shunt generator	2
4	3	Obtained external and internal characteristics of DC compound generator	2
5	4	Control the speed of DC shunt motor using armature control and field control method	2
6	4	Control the speed of DC series motor	2
7	6	To perform Swinburne's test of DC machine	2
8	5	To study construction of 1 phase and three phase transformer and it's various part	2
9	6	To perform open circuit and short circuit test of single phase transformer	2
10	6	Perform load test on single phase transformer	2



11	6	To perform polarity test of single phase transformer and operate two single phase transformer in parallel having equal impedance and difference impedance	2
12	6	Perform sumpner's test on single phase transformer	2
13	5	To study various methods of cooling of transformer	2

Instructional Method:

- 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, role play, Quiz, brainstorming, MOOCs etc.
- The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

References:

- B. L. Theraja and A. K. Theraja, "A Text Book of Electrical Technology Vol-II", S. Chand & Co. Ltd., 2015
- V.K. Mehta and Rohit Mehta, "Principal of Electrical Machine", S. Chand & Co. Ltd., 2010
- D.P. Kothari and I.J. Nagrath, "Electrical Machines", Tata-McGraw-Hill, 2011.
- Ashfaq Husain and Haroon Ashfaq, "Electrical Machines", Dhanpat Rai & Co. LTD., 2017
- J. B. Gupta, "Theory and Performance of Electrical Machine", S. K. Kataria & Sons, 2016
- U. A. Bakshi & M. V. Bakshi, "Electrical Machine-II", Technical Publication Pune, 2012
- Smarajit Ghosh, "Electrical Machines", Pearson, 2012

Supplementary Resources:

- <http://nptel.ac.in/courses/108105017/>
- https://onlinecourses.nptel.ac.in/noc17_ec10/course/
- <http://iitg.vlab.co.in/?sub=61&brch=168>
- <http://vlab.amrita.edu/index.php>



Marwadi
University

Syllabus for Diploma Engineering

Electrical Engineering