Syllabus for Diploma Engineering

Electrical Engineering

Semester – III

Subject Name: Electrical DC Machines and Transformer

Subject Code: 09EE2301

Diploma Branches in which this subject is offered: Electrical Engineering

Objective: This is one of the essential electrical engineering core subject. The students should understand the basic concept of electrical machines for highly effective working as a skilled electrical engineer in modern industry. This subject covers basic principles for working of different electrical machines and solving the electrical industry's machines-related problems. Electrical engineering is divided into power generation, transmission, distribution and utilisation in the form of AC. So, every electrical engineer should know the basic concept, construction and testing of electrical machines used in the above system. To solve the given problem by using the knowledge of the fundamental concept of the electrical machine. This course will develop the skill of students with knowledge of the construction of machines, testing of machines, performance & various testing of machines, various connections of machines and cooling systems for machines.

Credits Earned: 4 Credits

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

1. To understand the basic concept of the electrical machine.
2. To apply various principle for operation of dc mchines 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 the working, back EMF, torque generation, types, speed control, starter requirement, braking, testing and applications of DC motor.
5. To understand and analyse construction, classification, EMF generation, loading, equivalent circuit, losses, efficiency, load sharing, cooling methods, testing and applications of single and three-phase transformers.

Pre-requisite of course: Basic knowledge of DC Circuits and AC 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	
3	0	2	4	50	30	20	25	25	150

Contents:

Unit	Topics	Contact hours	Weightage (%)
1	**Principle of Electromechanical Energy Conversion** • 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	**04**	**9**
2	**DC Generator** • Introduction • Type of DC machines • Principle of DC generator, single turn alternator • Construction of DC machines, action and role of commutator • Material used in a 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, Equalising ring or connection • Comparison between simplex lap winding and wave winding • EMF equation of DC generator • Types of DC generators • Symbolic representation of DC generator • 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 • Demagnetising and Cross-magnetising conductors • Calculation of Demagnetising ampere-turns per pole	**14**	**33**

	• 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		
3	**DC Motor** • 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 • Nessesity of testing • Direct and indirect test of DC motor	**12**	**29**
4	**Transformer** • 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	**12**	**29**

	• 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 • Bank of three single-phase transformers and a single three-phase transformer • Construction of three-phase transformer • Accessories of transformer • Basic principle of three-phase transformer • Tap changing transformer • Losses in a three-phase transformer • Three-phase transformer connections • Cooling methods of transformers • Parallel operation of three-phase transformer • What is the difference between distribution and power transformer • Application of transformer • Specification, Nameplate data and rating of the transformer • Direct loading test • Open circuit and short circuit test • Sumpner test • Polarity test		

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
40%	40%	10%	10%	0%	0%

Suggested List of Experiments:

Sr. No.	Unit No.	Name of Topics	Contact Hours
1	2	To dismantle DC machine and identify various parts	2

		of DC machine	
2	2	To maintain constant voltage of DC generator at different load conditions	2
3	2	To obtain open circuit characteristics of DC generator	2
4	2	Obtained external and internal characteristics of DC generator	2
5	3	Control the speed of DC shunt motor using armature control method	2
6	3	Control the speed of DC shunt motor using field control method	2
7	3	To perform Swinburne's test of the DC machine	2
8	3	To reverse the direction of rotaion of DC motor	2
9	4	To identify different parts of transformer and it's function in transformer	2
10	4	To perform open circuit and short circuit test of single phase transformer	2
11	4	To perform a load test on single phase transformer	2
12	4	To perform polarity test of single phase transformer	2
13	4	To perform the parallel operation of two transformers to determine the load current sharing.	2
14	4	To identify various methods of cooling of transformer	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, role play, 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

References:

1. B. L. Theraja and A. K. Theraja, "*A Text Book of Electrical Technology Vol-II*", S. Chand & Co. Ltd., 2015
2. V.K. Mehta and Rohit Mehta, "*Principal of Electrical Machine*", S. Chand & Co. Ltd., 2010

3. D.P. Kothari and I.J. Nagrath, "*Electrical Machines*", Tata-McGraw-Hill, 2011.
4. Ashfaq Husain and Haroon Ashfaq, "*Electrical Machines*", Dhanpat Rai & Co. LTD., 2017
5. J. B. Gupta, "*Theory and Performance of Electrical Machine*", S. K. Kataria & Sons, 2016
6. U. A. Bakshi & M. V. Bakshi, "*Electrical Machine-II*", Technical Publication Pune, 2012
7. Smarajit Ghosh, "*Electrical Machines"*, Pearson, 2012

Supplementary Resources:

1. http://nptel.ac.in/courses/108105017/
2. https://onlinecourses.nptel.ac.in/noc17_ec10/course/
3. http://iitg.vlab.co.in/?sub=61&brch=168
4. http://vlab.amrita.edu/index.php