COURSE TITLE	**ELECTRICAL MACHINES-I**
COURSE CODE	**01EE1303**
COURSE CREDITS	**4**

Objective:

1 Student will be able to understand the construction and working principle of rotating and static electrical machines and utilization of them for appropriate applications based on their operating characteristics.

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

1 Describe the principles of electromechanical energy conversion of different electric machines.

2 Compute various parameters of electric machines under various operating conditions.

3 Obtain parameters and efficiency of electrical machines using standard tests.

4 Compare the characteristics of various electric machines to determine their suitability for different applications.

Pre-requisite of course: Basics of Electrical Engineering

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Concept of Magnetic circuit and Electromechanical Energy Conversion** Basics of Magnetic circuits, statistically & dynamically induced EMF, Electromagnetic induction, Force on a conductor in a magnetic field & between two current carrying conductors, Types of torque, Physical Concept of Force & Torque Production, Principles of energy conversion, Singly Excited & Doubly Excited Systems, Energy Stored in Magnetic Field.	6

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Contents : Unit	Topics	Contact Hours
2	**DC Machines** DC generator: Working principle and Construction of a DC generator, Terminology related to Armature Windings, EMF Equation, Types of DC Generators, Voltage Build-Up in a Shunt Generator, Critical field Resistance & Critical Speed, Losses in DC Machine, Power Stages & Efficiency,, Armature Reaction & its Effects, Inter Poles & Compensating Winding, Commutation & Methods to Improve Commutation, Characteristics of DC Generators, Applications., DC motor: Working Principle, Back EMF and its significance, Voltage & Power Equations, Types, Torque of a DC Motor, Power Stages, Efficiency, Performance Characteristics,, Necessity of Starter, Three & Four Point Starters, Speed Control of DC Motors, Applications., Efficiency and Testing of DC Machines: Methods of Testing, Efficiency and Testing of DC Machines: Methods of Testing	14
3	**Single phase Transformers** Working Principle, Construction, Types, EMF Equation, Ideal Transformer at no load and on load,, Practical Transformer at no load and on load, Phasor Diagrams, equivalent circuit,, Losses, Efficiency & Voltage Regulation, concept of power and distribution transformer, All Day Efficiency, Direct Load Test, O.C. & S.C. Tests, Sumpner's Test, Polarity, Test, Parallel Operation & Load Sharing, Auto Transformers, Applications of Auto Transformer.	10
4	**Three-phase transformer** Principle of operation, constructional features, types of connection and their comparisons, , Open Delta and Scott connection, Three Winding Transformer, Tertiary Winding, Polarity, Vector groups, Tap changing transformer, , Inrush current, Harmonics in Transformer, , Parallel Operation of 3-Phase Transformers, Cooling methods of transformers	8
5	**Instrument transformers and Special D.C. machines** Principle of operation of Current transformer and voltage transformer, Construction, working and application of PMDC motor, stepper motor and servo motor	4
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment No. 01** To study the cut section of D.C. Machine.	2
2	**Experiment No. 02** To Obtain the following Characteristics of DC Shunt generator. (1) O.C.C. (2) Internal Characteristics, (3) External Characteristics	2
3	**Experiment No. 03** To perform polarity test on 1- Ø transformer.	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
4	**Experiment No. 04** To Obtain torque and speed , speed and armature current , torque and armature current characteristics of DC shunt motor	2
5	**Experiment No. 05** To Perform speed control operation of DC Motor by (1) Armature Control Method, (2) Field Control Method.	2
6	**Experiment No. 06** Demonstration of 3-Point and 4-Point starter for DC Motor.	2
7	**Experiment No. 07** To Perform Swinburn's test of DC shunt motor for find out the constant loss and efficiencies at different loading condition.	2
8	**Experiment No. 08** To Draw an Equivalent circuit of Transformer using O.C and S.C Test.	2
9	**Experiment No. 09** To Perform Parallel operation of single-Phase Transformer.	2
10	**Experiment No. 10** To Perform Back-to-Back Test on single Phase Transformer	2
11	**Experiment No. 11** To perform Hopkinson's test on dc shunt machine.	2
12	**Experiment No. 12** To perform Field's test on DC series machines.	2
Total Hours		**24**

Textbook :

1 Electrical machinery, Bimbhra, P. S., Khanna Publishers, New Delhi, 2010

2 A textbook of electrical technology vol II, Theraja, B.L, S. Chand publishers, 2005

3 Electric Machines, Ashfaq Husain, Dhanpat Rai & Company, 2010

References:

1 Electric machines, Electric machines, Kothari, DwarkadasPralhaddas, and I. J. Nagrath, Tata McGraw-Hill Education, 2004

2 Electrical Machinery, Electrical Machinery, Fitzgerald A.E and Kingsley, Tata McGraw Hill, 2002

3 Theory & Performance Of Electrical Machines, Theory & Performance Of Electrical Machines, Gupta, J. B., SK Kataria and Sons, 2009

Suggested Theory Distribution:

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

Distribution of Theory for course delivery

Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
20.00	30.00	25.00	15.00	10.00	0.00

Instructional Method:

1. 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.
2. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and classroom
3. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory
4. Students will use supplementary resources such as online videos, NPTEL videos, ecourses, Virtual Laboratory.

Supplementary Resources:

1. https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/
2. https://studyelectrical.com/electrical-machines
3. https://archive.nptel.ac.in/courses/108/105/108105155/
4. http://people.ece.umn.edu/users/riaz/animations/listanimations.html

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