

COURSE TITLE	ELECTRICAL MACHINES- II
COURSE CODE	01EE1503
COURSE CREDITS	4

Objective:

- 1 Introduce learner to basic principles and performance analysis of various electrical machines used in industries, agriculture, irrigation, and power system for different applications.

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

- 1 Illustrate constructional features and operating principle of AC machines and special machines.
- 2 Derive equivalent circuit, phasor diagram and circle diagram for rotating machines.
- 3 Characterize the performance of AC machines under different operating conditions.
- 4 Compute the performance parameters of rotating machines by performing different test on it.

Pre-requisite of course:Electrical Machines-I

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	Three phase Induction Motor Construction, working principle and types of induction motor (squirrel cage and slip- ring), Concept of rotating magnetic field, synchronous speed and slip. Starting, Running and Maximum Torque. Torque Slip Characteristics, Equivalent circuit and Phasor Diagram. No-load & blocked rotor test, calculation of Equivalent circuit parameters, losses and efficiency, Circle diagram of induction motor, Methods of starting, braking and speed control for induction motors. Effect of harmonics, Cogging & Crawling, Working of doubly fed induction generator and its power factor control. various classes of energy efficient induction motor	12
2	Single phase Induction Motor Constructional details of single phase induction motor, Double field revolving theory and operation, Equivalent circuit and its parameters calculations, No load and blocked rotor test, Performance analysis, Starting methods of single-phase induction motors, Capacitor- start capacitor run Induction motor, Shaded pole induction motor	8

Contents : Unit	Topics	Contact Hours
3	Synchronous Generator Constructional details, Types of rotors, winding factors, emf equation, Synchronous reactance, Armature reaction, Phasor diagrams of non-salient pole synchronous generator connected to infinite bus, Synchronizing and parallel operation, Synchronizing torque, Change of excitation and mechanical input, Voltage regulation using different methods EMF, MMF, ZPF and A.S.A methods and their Comparisons, steady state power- angle characteristics, Two reaction theory, Slip test for measurement of X_d and X_q , Parallel operation of alternators and methods for synchronization	10
4	Synchronous motor Methods of starting of synchronous motors, Different torques in Synchronous motor, Synchronous motor with different excitation, Stability, Power developed by synchronous motor, Synchronous condenser, Synchronous phase modifiers, V-curves and Inverted V - curves of Synchronous motors, hunting of synchronous machines and its prevention	6
5	Special machines Construction, working principle and applications of linear induction motor, Stepper motor and Switched reluctance motor, Permanent magnet synchronous motor, Construction and Operation of Brushless DC Motor (BLDC)	6
Total Hours		42

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Experiment No. 01 To perform no load and blocked rotor test on three phase induction motor to obtain the parameters of equivalent circuit	2
2	Experiment No. 02 To perform no load and blocked rotor test on three phase induction motor to evaluate the performance parameters using circle diagram	2
3	Experiment No. 03 To obtain the performance parameters of three phase induction motor using direct load test	2
4	Experiment No. 04 To perform no load and blocked rotor test on single phase induction motor to obtain the parameters of equivalent circuit	2
5	Experiment No. 05 To perform open circuit, short circuit and resistance measurement tests on alternator to find out its voltage regulation using synchronous impedance method	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
6	Experiment No. 06 To perform open circuit, short circuit and resistance measurement tests on alternator to find out its voltage regulation using MMF method	2
7	Experiment No. 07 To perform open circuit, short circuit, zero power factor and resistance measurement tests on alternator to find out its voltage regulation using ZPF method	2
8	Experiment No. 08 To obtain direct axis and quadrature axis reactance of salient pole synchronous machine using slip test	2
9	Experiment No. 09 To perform synchronization of alternator using dark lamp method, two bright one dark lamp method and synchroscope	2
10	Experiment No. 10 To obtain the v-curves of a synchronous motor	2
Total Hours		20

Textbook :

- 1 Electric Machinery, E. Fitzgerald and C. Kingsley,, New York, McGraw Hill Education,, 2013
- 2 Electric Machines, I J Nagrath and D. P. Kothari,, McGraw Hill Education,, 2010
- 3 Theory and Performance of Electrical Machines, J B Gupta, Katson Publication, 2009
- 4 Electrical Technology – Part II, B L Theraja, S Chand Publications, 2011
- 5 Performance and design of AC machines, M. G. Say, CBS Publishers, 2002
- 6 Electrical Machinery, P. S. Bimbhra, Khanna Publishers, 2011
- 7 Electrical Machines – II, G C Garg, Khanna Publishers, 2021

References:

- 1 Principle of Electrical Machine Design with Computer Programs, Principle of Electrical Machine Design with Computer Programs, S K Sen, Oxford & IBH , 2006

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, case studies etc.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the class-room.
- 3 Practical examination will be conducted at the end of semester for evaluation of performance of students in classroom.
- 4 Students will use supplementary resources such as online videos

Supplementary Resources:

- 1 <http://www.scilab.org/>
- 2 <http://www.vlab.co.in>
- 3 <http://www.femm.info>