ELECTRICAL MACHINES - II

IV Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB15	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil			Total Classes: 60			

OBJECTIVES:

The course should enable the students to:

I. Explain the concepts of rotating magnetic fields
II. Understand the operation of AC machines
III. Analyze performance characteristics of AC machines

COURSE OUTCOMES (COs)

CO1: Analyze constant, pulsating and revolving magnetic fields
CO2: Describe the operation and performance of three phase induction motors
CO3: Understand the operation and performance characteristics of synchronous generator
CO4: Demonstrate the construction and operation of synchronous motor
CO5: Understand the construction, starting methods and torque speed characteristics of various single phase induction motors

COURSE LEARNING OUTCOMES (CLOs)

At the end of the course, the student will have the ability to:

1. Understand the concept of constant magnetic fields
2. Analyze pulsating fields produced by spatially displaced windings
3. Describe revolving magnetic fields
4. Understand the principle of operation, constructional features different types of torques, various losses, efficiency and torque- slip characteristics of three phase induction motor
5. Describe no -load and blocked rotor test of three phase induction motor for calculating the equivalent circuit parameters and circle diagram
6. Understand the starting and speed control methods of three phase induction motor, induction generator and doubly-fed Induction machines
7. Understand the principle of operation and constructional features and different types of armature windings of synchronous alternator
8. Understand the phasor diagrams of alternator on no-load, load and analyze the harmonics and its suppression methods.
9. Describe the different methods for calculating the voltage regulation, parallel operation and slip test
10. Understand the principle of operation, constructional features and starting methods of synchronous motor
11. Describe the importance of power, excitation circles and effect of varying different parameters on synchronous motor performance
12. Understand the concept of constructing V, inverted V curves and synchronous condenser
13. Understand double revolving, cross field theory and the principle of operation and constructional features of single phase induction motor
14. Describe the starting methods of single phase induction motor

MODULE - I	THREE PHASE INDUCTION MOTORS	Classes: 09
Constant magnetic field, pulsating magnetic field, alternating current in windings with spatial displacement, Magnetic field produced by a single winding, fixed current and alternating current. Pulsating fields produced by spatially displaced windings, windings spatially shifted by 90 degrees. Addition of pulsating magnetic fields. Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field		
MODULE - II	**TESTING AND SPEED CONTROL OF INDUCTION MOTORS**	**Classes: 09**
Three phase induction motors: Introduction, construction, types of induction motors, slip and frequency of rotor currents, rotor MMF and production of torque, equivalent circuit, power across air gap, torque and power output, torque slip characteristics, generating and braking modes, maximum (breakdown) torque, starting torque, maximum power output, problems. Equivalent circuit model: No load test and blocked rotor test, circuit model, starting methods, speed control of induction motors, induction generator, principle of operation, isolated induction generator, Doubly-Fed Induction Machines, circle diagram, determination of induction motor parameters from circle diagram, problem		
MODULE - III	**ALTERNATORS**	**Classes: 09**
Synchronous generators: Introduction, principle of operation, constructional features, armature windings, integral slot and fractional slot windings, distributed and concentrated windings, winding factors, basic synchronous machine model, circuit model of a synchronous machine, phasor diagrams, determination of synchronous impedance, short circuit ratio, armature reaction, ampere turns and leakage reactance. Voltage regulation: Calculation of regulation by synchronous impedance method, MMF, ZPF and ASA methods, slip test, parallel operation of alternators, synchronization of alternators, problems.		
MODULE - IV	**SYNCHRONOUS MOTORS**	**Classes: 09**
Synchronous motors: Principle of operation, power developed, synchronous motor with different excitations, effect of increased load with constant excitation, effect of change in excitation with constant load, effect of excitation on armature current and power factor, construction of "V" and inverted "V" curves, power and excitation circles, starting methods, salient pole synchronous motor, phasor diagrams and analysis, synchronous condenser.		
MODULE - V	**SINGLE PHASE INDUCTION MOTOR**	**Classes: 09**
Single phase induction motor: Principle of operation, two reaction theory, equivalent circuit analysis, split phase motor, construction, principle of operation, capacitor start motor, shaded pole motor, torque speed characteristics.		

Text books

1. P S Bimbra, "Electrical Machines", Khanna Publishers, 2nd Edition, 2008.
2. Kothari, "Electrical Machines", TMH publication, 3rd Edition, 2010.
3. B. L Thereja, A.K Thereja Charles Kingsley JR., Stephen D U mans, "Electric Machinery", McGraw-Hill, 6th Edition, 1985.

References

1. M G Say, E O Taylor, "Direct Current Machines", Longman Higher Education, 1st Edition, 1985.
2. M V Deshpande, "Electrical Machines", PHI Learning Private Limited, 3rd Edition, 2011.
3. Ian McKenzie Smith, Edward Hughes, "Electrical Technology", Prentice Hall, 10th Edition, 2015.