Electrical Machines - II

Course Code	19EE3502	Year	III	Semester	I
Course Category	Program Core	Branch	EEE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Electrical Machines-I (19EE3401) Basic Electrical and Electronics Engineering (19ES1101)
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the construction, working principle and characteristics of different types of three phase induction motors and solve the problems for various parameters. (L2, L3)
CO2	Understand starting methods, speed control and testing of three phase induction motor.(L2,L3)
CO3	Understand the constructional details of synchronous machines, their load characteristics, solve the problems on regulation and parallel operation of alternator (L2, L3)
CO4	Understand the working principle ,methods of starting and applications of synchronous motor (L2,L3)
CO5	Understand double field theory, construction of single- phase induction motor, special electrical machines and their characteristics and industrial applications. (L2,L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			1		2		1				2	3	2
CO2	2			1		1		1				2	3	2
CO3	3			1		2		1				2	3	
CO4	3			1		2		1				2	3	2
CO5	3			1		1		1				2	3	

Syllabus		
Unit No.	Contents	Mapped CO
I	**Three phase Induction motors:** Concept of rotating magnetic field. Principle of operation, Constructional details of squirrel-cage &slip-ring rotor machines. Slip, torque-slip characteristics covering motoring, generating and braking regions of operation, maximum torque. Phasor diagram of induction motor on no-load and on load. Equivalent circuit.	CO1
II	**Testing of three-phase Induction Motor:** Losses in three phase induction motor efficiency, no-load and blocked rotor tests. Circle diagram and performance evaluation of motor. cogging and crawling. Direct on line (DOL), star-delta and autotransformer starting, rotor resistance starting. **Speed Control of Three-phase Induction Motors:** Speed control-voltage, frequency, and rotor resistance, pole changing and cascading of motors, introduction to solid state controllers.	CO2

III	**Synchronous Generator** Constructional Features of wound rotor and salient pole machines, distributed and concentrated windings – distribution, pitch and winding factors – E.M.F Equation - harmonics in generated e.m.f. – suppression of harmonics, phasor diagrams. Regulation of alternators on load, experimental determination of synchronous impedance - regulation by synchronous impedance method, M.M.F. method and Z.P.F. method. Experimental determination of X_d and X_q (Slip test),two reaction theory, regulation of salient pole alternators. **Parallel operation of alternators:** Synchronizing of alternators with infinite bus bars current practices– synchronizing power torque – parallel operation and load sharing.	CO3
IV	**Synchronous Motors – Principle of Operation** Theory of operation – phasor diagram – variation of current and power factor with excitation – synchronous condenser – mathematical analysis for power developed - excitation and power circles – hunting and its suppression – methods of starting. **Special Electrical Machines** **Principle of Operation –** Stepper Motor – BLDC Motor – Reluctance Motor – Linear Induction Motor – Hysteresis Motor. **(Theoretical Analysis Only)**	CO4
V	**Single Phase Induction Motor** Classification of single phase induction motors – double revolving field theory – working principle of single winding single phase induction motor – cross field theory – equivalent circuit – power developed – construction, working principle – speed torque characteristics - spilt phase capacitor start motor, capacitor start capacitor run motor - shaded pole motor, ratings and their applications –equivalent circuit – testing of motors – efficiency – no load and blocked rotor tests.	CO5

Learning Resources
Text Books
1. Electrical Machines by PS Bhimbra, Khanna publishers. 2. Electrical Machines by I.J.Nagrath & D.P.Kothari, Tata Mc Graw-Hill Publishers, 7th Edition 2005. 3. Electrical Machinery by A.E. Fitzgerald, C. Kingsley and S. Umans, Tata Mc Graw Hill Companies, 5th edition 1990. 4. Electrical Machines by J.B.Gupta, Kataria publications.
Reference Books
1. The Performance and Design of A.C.Machines by M.G.Say, ELBS and Pitman & Sons. 2. Theory of Alternating Current Machinery by Langsdorf, Tata Mc Graw Hill, 2nd edition. 3. Electromachanics-III (Synchronous and single phase machines) by S.Kamakashiah, Right Publishers.
e- Resources & other digital material
1. https://nptel.ac.in/courses/108/105/108105131s