ELECTRICAL MACHINES-I

Course Code	19EE3401	**Year**	II	**Semester**	II
Course Category	Program Core	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisite**	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 basic concepts of magnetic circuits, construction, operation of D.C machines, single phase transformer, auto transformer and three phase transformer.
CO2	**Classify** the performance characteristics of D.C machines, single phase transformer, auto transformer and three phase transformer.
CO3	**Analyze** the speed control methods and testing techniques of D.C machines.
CO4	**Analyze** the testing techniques of single phase transformer and three phase transformer.
CO5	**Analyze** the different configurations of D.C machines, single phase transformer, auto transformer and three phase transformer.

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	2												2	
CO2	2	2				2		1			1	2	2	2
CO3	2	2				2		1			1	2	2	2
CO4	2	2				2		1			1	2	2	2
CO5	2	2				2		1			1	2	2	2

Syllabus		
Unit No.	Contents	Mapped CO
I	Magnetic circuits: Definition of magnetic quantities, analysis of magnetic circuits- series, parallel, leakage flux, comparison of magnetic and electric circuits. B-H curve of magnetic materials; flux- linkage vs current characteristic of magnetic circuits; Energy in Magnetic Systems-Field energy and mechanical force-singly and doubly	CO1

	excited magnetic field systems- forces and torques in systems with electromagnets.	
II	DC Generators: Principle of operation, armature winding - lap and wave windings, separately and self-excited generators, armature reaction-cross magnetization and demagnetization AT/pole, compensating winding, commutation process, methods of improving commutation, voltage build-up in a shunt generator, critical field resistance and critical speed, internal and external characteristics of shunt, series and compound generators, parallel operation.	CO1 CO2 CO5
III	DC Motors: Principle of operation, characteristics of shunt, series and compound motor, speed control methods, 4-point starter- design of starter elements, losses in DC machine, testing of DC machine – No load test, load test, Hopkinson's test , retardation test and field test.	CO1 CO2 CO3
IV	Single-Phase Transformers: Principle of operation, ideal transformer, transformer under no load and on load with Phasor diagrams, equivalent circuit, condition for maximum efficiency and voltage regulation, all day efficiency. Determination of equivalent circuit parameters, efficiency at different loadings and regulation using O.C and S.C test, polarity test, back-to-back test, separation of hysteresis and eddy current losses, Parallel operation of single-phase transformers.	CO1 CO2 CO4 CO5
V	Autotransformers - construction, principle of operation, applications and comparison with two winding transformer. Three-Phase Transformers: Types of connection and their comparative features, Scott connection, Tap-changing transformers - No- load and on-load tap-changing of transformers.	CO1 CO2 CO4 CO5

Learning Resources

Text Books

1. Dr.P. S Bimbhra, ― Electrical Machinery-7/e -Khanna Publishers,2018.
2. I.J. Nagarath and D.P. Kothari, ―Electric Machines‖, 4/e, McGraw Hill, 2010.
3. A.E. Fitzgerald, Charles Kingsley Jr. Stephen D. Umans, ― Electric Machinery, 7/e, McGraw,Hill.,2013.

Reference Books

1. J.B. Gupta , ―Theory and performance of Electrical Machines- Katson Publishers.
2. A.E. Clayton and N N Hancock,― Performance and Design of DC Machines‖,Oxford,1987
3. Abhijit Chakrabarti, Sudipta Debnath, ― Electrical Machines, 1/e, Mc Graw Hill,2015.
4. S.J. Chapman, ―Electric Machine Fundamentals, 5/e, McGraw Hill, 2011.

e- Resources & other digital material

1. https://nptel.ac.in/courses/108/105/108105155/