COURSE CONTENT

ELECTRICAL MACHINES-I								
I Semester: EEE								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
2530224	**Core**	3	0	0	3	40	60	100
Contact Classes:45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes:45**		
Prerequisites: Electrical Circuits -I & II.								

Course Overview:

This course introduces the basics of DC machines and transformers, including their construction, operation, characteristics, losses, testing, and applications, providing a foundation for electrical power and industrial systems.

Course Objectives:

1. To understand the construction, operation, and characteristics of D.C. generators, including windings, EMF equation, armature reaction, commutation, excitation methods, and applications.
2. To understand the principle, operation, characteristics, speed control, losses, efficiency, and testing methods of various D.C. motors.
3. To understand the construction, working principles, EMF equation, losses, phasor diagrams, and applications of single-phase transformers.
4. To understand the equivalent circuit, losses, efficiency, regulation, all-day efficiency, and testing methods of transformers.
5. To understand the parallel operation, auto-transformers, poly-phase connections, equivalent circuits, and applications of transformers.

Course Outcomes: After Completion of the Course, Students should be able to

1. Explain the operation and performance of shunt, series, and compound D.C. generators.
2. Apply their knowledge to speed control and efficiency of shunt, series, and compound D.C. motors.
3. Analyze the working and performance of single-phase transformers.
4. Evaluate the performance, efficiency, and regulation of transformers using various tests.
5. Examine operation, connections, and performance of parallel and poly-phase transformers.

UNIT - I: D.C. Generators: Principle of operation – Action of commutator – constructional features – armature windings – lap and wave windings – simplex and multiplex windings (elementary treatment only) – EMF Equation. Concept of Armature reaction and commutation – Cross magnetizing and de-magnetizing AT/pole. Methods of Excitation – separately excited and self-excited generators – build-up of EMF - critical field resistance and critical speed. Performance Characteristics of shunt, series and compound generators and applications.

UNIT - II: DC Motors: Principle of operation – Back EMF. - Torque equation – characteristics and application of shunt, series and compound motors. 3-point starter, Speed control of DC shunt and series motors - Armature voltage and field flux control methods. Losses – Constant & Variable losses – calculation of efficiency – condition for maximum efficiency. Testing of DC

Machines: Methods of Testing – Direct, Indirect, and Regenerative Testing – Brake Test – Swinburne's Test – Hopkinson's Test.

UNIT - III: Single Phase Transformers: Types - constructional details-minimization of hysteresis and eddy current losses- EMF equation - operation on no-load and on load - phasor diagrams and Applications.

UNIT - IV: Equivalent circuit - losses and efficiency – regulation - All day efficiency - effect of variations of frequency & supply voltage on iron losses. Testing of Transformers: Open Circuit and Short Circuit tests - Sumpner's Test - predetermination of efficiency and regulation-separation of losses test.

UNIT - V: Parallel operation with equal and unequal voltage ratios - auto transformers-equivalent circuit - comparison with two winding transformers. Poly-phase transformers – Poly-phase connections - Y/Y, Y/Δ, Δ/Y, Δ/Δ and open Δ, Scott connection and Applications.

TEXT BOOKS:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, Revised Edition, 2021.
2. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

REFERENCE BOOKS:

1. Prithwiraj Purkait, Indrayudh Bandyopadhyay, "Electrical Machines", Oxford, 2017.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
4. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

ELECTRONIC RESOURCES:

1. **https://www.electrical4u.com/dc-generator/**
2. **https://www.electrical4u.com/dc-motor/**
3. **https://www.electrical4u.com/single-phase-transformer/**
4. **https://www.electricaltechnology.org/2012/10/testing-of-transformers.html**
5. **https://www.electrical4u.com/auto-transformer/**
6. **https://archive.nptel.ac.in/courses/108/105/108105067/**

MATERIALS ON LINE:

1. Course template
2. Tutorial question bank
3. Tech talk and Concept Video topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper–I
8. Model question paper–II
9. Lecture notes
10. E-Learning Readiness Videos (ELRV)