DC MACHINES AND TRANSFORMERS

III Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AEE004	**Core**	3	1	-	4	30	70	100

Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil	Total Classes: 60

I. COURSE OVERVIEW:

This course deals with the basic theory, construction, operation, performance characteristics and application of electromechanical energy conversion devices such as DC generators and motors. It also gives an in-depth knowledge on the operation of single phase and three phase transformers and it's testing. It also focus on the auto transformers, on-load, off-load tap changers which are widely used in real time applications.

II. OBJECTIVES:

The course should enable the students to:

I	The principles of single excited and multiple excited systems leading to the energy balance equations.
II	The construction, working and operation of self and separately excited DCmachines
III	The performance characteristics of different DC machines when they are under no load and load conditions.
IV	The energy transformation using single and poly phase transformers under no load and load conditions.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	Use the concepts of complex algebra, pharos operations, and principles of electromagnetism and circuit theory. For analyzing the performance related issues in electrical machines.	Apply
CO 2	Demonstrate the working of linear machine as generator, motor and transformer by applying electromagnetic laws and its mathematical models under different loading conditions.	Understand
CO 3	Identify various control strategies for calculating the performance parameters and voltage regulation of electrical machines.	Apply
CO 4	Illustrate the equivalent circuits and connections of three phase transformers and auto transformers for power system analysis.	Understand
CO 5	**Describe** the load sharing capabilities and reliability of electrical machines using parallel operation under various loading conditions.	Understand

IV. SYLLABUS:

UNIT - I	ELECTROMECHANICAL ENERGY CONVERSION	Classes: 05

Electromechanical energy conversion: Forces and torque in magnetic systems, energy balance, energy and force in a singly excited and multi excited magnetic field systems, determination of magnetic force, co energy.

UNIT - II	DC GENERATORS	Classes: 12

DC generators: Principle of operation, construction, armature windings, lap and wave windings, simplex and multiplex windings, use of laminated armature, commutator, emf equation, types of DC generators, voltage buildup, critical field resistance and critical speed, causes for failure to self excite and remedial measures; Armature reaction: Cross magnetization and demagnetization, ampere turns per pole, compensating winding, commutation, reactance voltage, methods of improving commutation; Characteristics: Principle of parallel operation load sharing, use of equalizer bars and cross connection of field windings problems.

UNIT - III	DC MOTORS AND TESTING	Classes: 10

DC motors: Principle of operation, back EMF, torque equation, condition for maximum power developed, types of DC motors, armature reaction and commutation, characteristics, methods of speed control, types of starters, numerical problems; Losses and efficiency: Types of losses, calculation of efficiency, condition for maximum efficiency.

Testing of DC machines: Swinburne's test, brake test, regenerative testing, Hopkinson's test, field's test, retardation test and separation of stray losses, problems.

UNIT - IV	SINGLE PHASE TRANSFORMERS	Classes: 10

Single phase transformers: Principle of operation, construction, types of transformers, emf equation, concept of leakage flux and leakage reactance, operation of transformer under no load and on load, phasor diagrams, equivalent circuit, efficiency, regulation and all day efficiency; Testing of transformers: objective of testing, polarity test, measurement of resistance, OC and SC tests, back to back test, heat run test, parallel operation, problems.

UNIT - V	POLY PHASE TRANSFORMERS	Classes: 08

Three phase transformer: Principle of operation, star to star, delta to delta, star to delta, delta to star, three phase to six phase, open delta connection, scott connection; Auto transformers: Principles of operation, equivalent circuit, merits and demerits, no load and on load tap changers, harmonic reduction in phase voltages, problems.

Text Books:

1. I J Nagrath, D P Kothari, "Electrical Machines", Tata McGraw-Hill publication, 3rd Edition, 2010.
2. P S Bimbra, "Electrical Machines", Khanna Publishers, 2nd Edition, 2008.
3. J B Gupta, "Theory and Performance of Electrical Machines", S K Kataria & Sons Publication,   14th Edition, 2010.
4. A E Fitzgerald, Charles Kingsley, JR., Stephen D Umans, "Electric Machinery", McGraw- Hill, 6th Edition, 1985.

Reference Books:

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.

Web References:

1. https://www.electrical4u.com/working-or-operating-principle-of-dc-motor
2. https://www.freevideolectures.com
3. https://www.ustudy.in › Electrical Machines
4. https://www.freeengineeringbooks.com

E-Text Books:

1. https://www.textbooksonline.tn.nic.in
2. https://www.freeengineeringbooks.com
3. https://www.eleccompengineering.files.wordpress.com
4. https://www.books.google.co.in

Course Home Page: