DC MACHINES AND TRANSFORMERS

III Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEC07	Core	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Prerequisite: Electrical Circuits (AEEC02). Engineering Physics (AHSCO3)

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. COURSE OBJECTIVES:

The students will try to learn:

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 DC machines.
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, phasor operations, principles ofelectromagnetism and circuit theory. for analyzing the performancerelated issues in electrical machines.	Apply
CO 2	**Demonstrate** the working of linear machine as generator, motor andtransformer 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 phasetransformers 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. COURSE SYLLABUS:

MODULE-I: DC GENERATORS (10)

DC generators: Principle of operation, construction, lap and wave windings, simplex and multiplex windings, commutator, EMF equation, types of DC generators, Armature reaction: Cross magnetization and demagnetization, ampere turns per pole, compensating winding; Commutation: Methods of improving commutation; Open circuit characteristics, voltage buildup, critical field resistance and critical speed, causes for failure to self-excite and remedial measures, load characteristics of shunt, series and compound generators; Conditions and necessity for parallel operation, load sharing, equalizer bars, cross connection of field windings, numerical problems.

MODULE-II: DC MOTORS (08)

DC motors: Principle of operation, back EMF, torque equation, types of DC motors, condition for maximum power developed, armature reaction and commutation, characteristics, types of starters, numerical problems.

MODULE-III: PERFORMANCE OF DC MACHINES (10)

Losses and efficiency: Types of losses, efficiency, condition for maximum efficiency

Speed Control Methods: Speed control of DC machines; Testing methods: Swinburne's test, brake test, retardation test, separation of stray losses, Hopkinson's test, and field's test, numerical problems

MODULE-IV: SINGLE PHASE TRANSFORMERS (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; Cooling methods; Testing of transformers: objectives, polarity test, measurement of resistance, OC and SC tests, back to back test, heat run test, parallel operation, numerical problems.

MODULE-V: POLY PHASE TRANSFORMERS (07)

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, numerical problems.

V. TEXT BOOKS:

1. P S Bimbhra, "Electrical Machinery", Khanna Publishers, 1st Edition, 2011.
2. I J Nagrath and D P Kothari, "Electric Machines", McGraw Hill Education, 1st Edition, 2010.
3. J B Guptha "Theory and performance of Electrical machines", S.K.Kataria & Sons Publishers 14th Edition, 2009.

VI. REFERENCE BOOKS:

1. M G Say, E O Taylor, "Direct Current Machines", Longman Higher Education, 1st Edition, 1985.
2. M G Say, "Performance and design of AC machines", CBS Publishers, 1st Edition, 2002.
3. A E Fitzgerald and C Kingsley, "Electric Machinery", New York, McGraw Hill Education, 1st Edition, 2013.
4. M V Deshpande, "Electrical Machines", PHI Learning Private Limited, 3rd Edition, 2011.

VII. WEB REFERENCES:

1. https://www.electrical4u.com
2. https://www.freevideolectures.com

VIII. E-TEXT BOOKS:

1. https://www.freeengineeringbooks.com
2. https://www.pdfdrive.com/textbook-of-electrical-technology-ac-and-dc-machines-d184089760.html