INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

DC MACHINES AND TRANSFORMERS								
III Semester: EEE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AEEE06	**Core**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
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 Describe the load sharing capabilities and reliability of electrical machines using parallel operation under various loading conditions

CO 2 Use the concepts of complex algebra, phasor operations, principles of electromagnetism and circuit theory. for analyzing the performance related issues in electrical machines.

CO 3 Demonstrate the working of linear machine as generator and motor by applying electromagnetic laws and its mathematical models under different loading conditions.

CO 4 Identify various control strategies for calculating the performance parameters and voltage regulation of electrical machines.

CO 5 Illustrate the equivalent circuits and connections of single and three phase transformers and auto transformers for power system analysis.

CO 6 Ability to analyze the performance of DC machines by calculating losses, efficiency, and applying testing methods.

IV. COURSE SYLLABUS:

MODULE-I: 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-II: POLY PHASE TRANSFORMERS (07)

Three phase transformers: Principle of operation, star to star, delta to delta, star to delta, delta to star, three phase to sixphase, 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.

MODULE-III: 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-IV: 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-V: 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, retardationtest, separation of stray losses, Hopkinson's test, and field's test, 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.

VIII. MATERIALS ONLINE

1. Course Outline Description
2. Lecture notes
3. PowerPoint presentation

4. Definitions and Terminology
5. Tutorial Question Bank
6. Case Studies
7. Real life Examples
8. Complex Engineering Problems
9. Tech Talk Topics
10. Concept Video Topics
11. Open-ended Exercises
12. Assignments
13. Model Question Paper – I
14. Model Question Paper – II
15. GATE Question Bank
16. Previous Question Papers and Solutions