



# 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		
AEED06	Core	L	T	P	C	CIA	SEE	Total
		3	0	0	3	40	60	100
Contact Classes: 48		Tutorial Classes: Nil		Practical Classes: Nil			Total Classes: 48	
Prerequisite: Electrical Circuits, Engineering Physics								

### 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 its 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:

- CO1 Describe the load sharing capabilities and reliability of electrical machines using parallel operation under various loading conditions.
- CO2 Use the concepts of complex algebra, phasor operations, principles of electromagnetism and circuit theory. for analyzing the performance related issues in electrical machines.
- CO3 Demonstrate the working of linear machine as generator and motor by applying electromagnetic laws and its mathematical models under different loading conditions.
- CO4 Identify various control strategies for calculating the performance parameters and voltage regulation of electrical machines.
- CO5 Illustrate the equivalent circuits and connections of single and three phase transformers and auto transformers for power system analysis.

### IV. COURSE CONTENT:

#### 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 (09)

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 (09)**

Three phase transformers: 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, 1<sup>st</sup> edition, 2011.
2. I J Nagrath and D P Kothari, "Electric Machines", McGraw Hill Education, 1<sup>st</sup> edition, 2010.
3. J B Guptha "Theory and performance of Electrical machines", S.K.Kataria & Sons Publishers 14<sup>th</sup> edition, 2009.

### **VI. REFERENCE BOOKS:**

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

### **VII. ELECTRONIC RESOURCES:**

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

### **VIII. MATERIALS ONLINE:**

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open end 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)
11. Power point presentation