ELECTRICAL MACHINES – I

III Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB11	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

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.

COURSE OUTCOMES

Upon the successful completion of this course, the students will be able to:

CO 1 **Use** the concepts of complex algebra, phasor operations, principles of electromagnetism and circuit theory for analysing the performance related issues in electrical machines.
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.
CO 3 **Explain** the magnetic force, co-energy in a single and multi-excited system by using the electromechanical energy conversion principles.
CO 4 **Classify** the DC machines and perform power flow calculations using electrical equivalent circuits.
CO 5 **Demonstrate** the necessity of starters for safe starting of DC motors.
CO 6 **Explain** the significance of voltage build-up in DC shunt generator using different excitation methods
CO 7 **Explain** the significance of voltage build-up in DC shunt generator using different excitation methods**.**
CO 8 **Explain** the fundamental control practices like starting, reversing and speed control strategies associated with electrical machines by understanding the performance characterizes and the concepts of EMF, torque developed.
CO 9 **List** the effects of armature reaction and commutation on the performance of DC machines.
CO 10 **Evaluate** the performance of electrical machine by calculating losses, regulation and efficiency by conducting different tests.
CO 11 **Analyse** the load sharing capabilities and reliability of electrical machines using parallel operation under various loading conditions.
CO 12 **Demonstrate** the working principle, usage and the correlation between primary and secondary quantities in terms of turns ratio, power and efficiency of an auto transformer.
CO 13 **llustrate** the equivalent circuits and connections of three phase transformers and auto transformers for power system analysis
CO 14 **Work** in the field of operation, control and maintenance in a group as well as individual for addressing the real time problems in the field of electrical machines

MODULE-I	MAGNETIC FIELDS AND MAGNETIC CIRCUITS	Classes: 09
Review of magnetic circuits: MMF, flux, reluctance, inductance; Visualization of magnetic fields produced by a bar magnet and a current carrying coil through air and through a combination of iron and air, influence of highly permeable materials on the magnetic flux lines; 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.		
MODULE -II	**DC GENERATORS**	**Classes: 09**
DC generators: Principle of operation, construction, armature windings, lap and wave windings, simplex and multiplex windings, problems, 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: Open circuit characteristics, critical field resistance and critical speed. Load characteristics of shunt, series and compound generators; Parallel operation: Principle of parallel operation, load sharing, and use of equalizer bars, cross connection of field windings, problems.		
MODULE -III	**DC MOTORS AND TESTING**	**Classes: 09**
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, Hopkinson's test, field's test, retardation test and separation of stray losses, problems.		
MODULE -IV	**SINGLE PHASE TRANSFORMERS**	**Classes: 09**
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.		
MODULE -V	**POLY PHASE TRANSFORMERS**	**Classes: 09**
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, cooling methods of transformers problems.		

Text Books:

1. A E Fitzgerald and C Kingsley, "Electric Machinery", New York, McGraw Hill Education, 1st Edition, 2013.
2. A E Clayton and N N Hancock, "Performance and design of DC machines", CBS Publishers, 1st Edition, 2004.
3. M G Say, "Performance and design of AC machines", CBS Publishers, 1st Edition, 2002.
4. P S Bimbhra, "Electrical Machinery", Khanna Publishers, 1st Edition, 2011.
5. I J Nagrath and D P Kothari, "Electric Machines", McGraw Hill Education, 1st Edition, 2010.

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://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/