II Year I Semester		L	Т	Р	С
17EE302		3	1	0	3
	ELECTRICAL MACHINES – I				

Preamble

This is a basic course on rotating electrical machines. This course covers the topics related to principles, performance, applications and design considerations of transformers and dc machines.

Learning objectives

- To predetermine the performance of single phase transformers with equivalent circuit models.
- Understand the methods of testing of single-phase transformer.
- Analyse the three phase transformers and achieve three phase to two phase conversion
- Understand the unifying principles of electromagnetic energy conversion
- Understand the construction, principle of operation and performance of DC machines.
- Learn the characteristics, performance, methods of speed control and testing methods of DC motors.

Unit - 1

Single-Phase Transformers:

Principle of operation, emf equation, Generalised Construction, Core and Shell Type Transformers – Transformer on no-load and Load conditions and phasor diagrams Concept of Equivalent Circuit – Types of Losses, Effect of variations of frequency & supply voltage on iron losses, Efficiency and Percentage Per unit Voltage Regulation, Auto transformer, comparison with two winding transformers.

Unit - 2

Testing of Transformers & Parallel Operation:

Open and Short Circuit Tests – Sumpner's test – Separation of Core Losses – parallel operation with equal voltage ratios – auto transformer - equivalent circuit –savings in copper material, comparison with two winding transformers.

Unit – 3

3-Phase Transformers:

Poly-phase connections - Y/Y, Y/ Δ , Δ /Y, Δ / Δ and open Δ -- Third harmonics in phase voltages - three winding transformers: determination of Zp, Zs and Zt -- transients in switching - off load and on load tap changers - Scott connection.

Unit - 4

Electromechanical Energy Conversion and introduction to DC machines

Principles of electromechanical energy conversion – singly excited and multi excited system Basic Principle of operation of DC Generator, Constructional details, EMF Equation for Generator – Classification of DC machines based on excitation, Applications of DC Generators– characteristics of DC Generators. OCC of DC shunt generator.

Unit - 5

Performance of D.C. Motors

Principle of operation of DC motor, Torque and Back-Emf equations of dc motors– Armature reaction and commutation –characteristics of separately-excited, shunt, series and compound motors - losses and efficiency- applications of dc motors.

Unit-6

Starting, Speed Control and Testing of D.C. Machines

Necessity of starter – Starting by 3 point and 4 point starters – Speed control by armature voltage and field control – testing of DC machines - brake test, Swinburne's method – principle of regenerative or Hopkinson's method - retardation test – field test and separation of losses.

Learning outcomes:

- Able to assimilate the concepts of electromechanical energy conversion.
- Able to mitigate the ill-effects of armature reaction and improve commutation in dc machines.
- Able to understand the torque production mechanism and control the speed of dc motors.
- Able to analyse the performance of single phase transformers.
- Able to predetermine regulation, losses and efficiency of single phase transformers.
- Able to parallel transformers, control voltages with tap changing methods and achieve threephase to two-phase transformation.

Text Books:

- 1. Electrical Machines P.S. Bhimbra, Khanna Publishers
- 2. Electric Machinery by A.E.Fitzgerald, Charleskingsley, StephenD.Umans, TMH

Reference Books:

- 1. Electrical Machines by D. P.Kothari, I .J .Nagarth, McGrawHill Publications, 4th edition
- 2. Electrical Machines by R.K.Rajput, Lakshmi publications,5th edition.
- 3. Electrical Machinery by AbijithChakrabarthi and Sudhipta Debnath,McGraw Hill education 2015.
- 4. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2010
- 5. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria& Sons