Course Name Electrical Machine - I

Course Code EE401

Course Credit 4

Contact Hour 3L-1T

Prerequisite Basic Electrical Engineering (EE101), Field Theory

Course Objective

The objectives of this course are

1. To prepare students to analysis of any electromechanical system.
2. To teach principles of DC machine Induction Machine and Transformers and how they work.
3. To empower students to understand the working of electrical equipment used in everyday life.
4. To expose the students to the concepts of various types of electrical machines and applications of electrical machines.
5. To analyze power requirements, power capability, efficiency, operating characteristics, control requirements and electrical demands of these machines.

Course Outcome

On completion of the course students will be able to

1. Formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions.
2. Understand and explain the principle of operation and performance of d.c. machine, induction motor and transformer.
3. Analyze the response of d.c. machine, induction motor and transformer.
4. Troubleshoot the operation of d.c. machine, induction motor and transformer.
5. Analyze given require specification of electrical machine and select a suitable measuring instrument for a given application.
6. Calculate load of d.c. machine, induction motor and transformer for a given application and then select the suitable specification of electrical machine

CO Mapping with departmental POs

H: High, M: Medium, L: Low

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	H											
CO 2	H	M	L									
CO 3			M	H								
CO 4			M	H								
CO 5			H									
CO 6			M	H								

Course Content

Module I: Electromechanical Energy Conversion **6L**

Electromechanical Energy Conversion Principle, Singly Excited Magnetic System and Doubly Excited Magnetic system. Physical concept of torque production; Electromagnetic torque and Reluctance torque.

Concept of General terms pertaining to Rotating Machines: Electrical & Mechanical degree, Pole pitch, Coil, Generated EMF in full pitched coil, Generated EMF in a short pitched coil, EMF polygon.

Distribution factor, Pitch factor. MMF produced by Distributed Windings, MMF of a coil, MMF of single phase distributed Winding, MMF waveform of Commutator machines.

Module II: DC Machines **12L**

EMF generated in the armature. Methods of Excitation, Armature reaction & its effect in the performance, Methods of decreasing the effects of Armature reaction, Effect of Brush shift. Commutation process, Resistance commutation, Delayed commutation, Voltage commutation, Improvement of Commutation. Operating Characteristics of DC Generators: Separately Excited generators, Shunt Generators, Series Generators and Compound Generators.

Torque equation of D.C motor, Operating Characteristics of Shunt, Series &Compound motors. Losses and efficiency of DC machines, Hopkinson's and Swinburne's test. D.C Machine application: Generator application, Motor application.

Module III: 3 phase Induction Machine **9L**

Induction motor as a Transformer, Flux and MMF phasors in Induction motors. Equivalent circuit, Performance equations, Induction motor phasor diagram. Toque-slip characteristic, Power slip characteristic, Determination of equivalent circuit parameters. Methods of starting of squirrel Cage and Wound rotor Motors. Speed control of Induction motor. Polarity Test, Application of Polyphase Induction motor.

Module IV: 3 phase Transformer **10L**

Determination of polarity and connections (star/star, star/delta, delta/star, star/zigzag, delta/zigzag, open delta), Phasor groups. Effect of unbalanced loading, Production of Harmonics in Transformer and its suppression. 3 phase to 2 phase transformation, Scott connection, 3 phase to 6 phase connections, Double star and Double delta. 3 winding transformer: Parameter estimation, application. Parallel operation of Transformers, Introduction to Tap changing transformer and its function.

Special Transformers: Potential transformer, Current transformer, Pulse transformer, Audio frequency transformer, Grounding transformer, Pulse transformer.

Numerical Problems to be solved in the tutorial classes

Text Books

1. Electrical Machinery, P.S. Bhimra, 6th Edition, Khanna Publishers.
2. Electric Machines, D.P. Kothari & I.J Nagrath, 3rd Edition, TMGH Pub.
3. Electrical Machines, P.K. Mukherjee & S. Chakrabarty, Dhanpat Rai Publication.

Reference Books

1. Electric Machinery & Transformers, Bhag S. Guru and H.R. Hiziroglu, 3rd Edition, Oxford University press.
2. Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill Edition.
3. The performance and Design of Direct Current Machines, Clayton & Hancock, CBS Pub.
4. The performance and Design of Alternating Current Machines, M.G.Say, CBS Pub.
   Electric Machinery & transformer, Irving L Koskow, 2nd Edition, Prentice Hall India.