MODELING AND DYNAMICS OF ELECTRICAL MACHINES

Hours Per Week :

L	T	P	C
3	1	-	4

Total Hours :

L	T	P

WA/RA	SA	SSH	S	BS

Course Description and Objectives:

This course deals with the basics of electromechanical energy conversion and enables them to be acquainted with the mathematical modeling of various types of machines and the dynamics related to speed control of these machines

Course Outcomes:

Upon successful completion of this course, the student should be able to:

a. Design induction machine for starting, accelerating and braking w.r.to rotor resistance.

b. Analyze different control theories.

c. Model and simulate AC machines for further studies.

d. Utilize BLDC and SRM motors.

SKILLS ACQUIRED:

- ✓ Able to understand the principle of coenergy.
- ✓ Able to understand the working of basic two pole machine.
- ✓ Able to transform a machine between reference frames.
- ✓ Able to analyze induction and synchronous machine.

ACTIVITIES:

1. Mathematical modeling of induction machine.
2. Mathematical modeling of synchronous machine.
3. Mathematical modeling of BLDC.
4. Mathematical modeling of SRM.

UNIT – I **L- 10**

Basic Principles of Electrical Machine Analysis

Operation and Steady State Behavior of Electrical Machines: Magnetically coupled circuits Electromechanical conversion – Principles of energy flow - Steady state equations of dc machines - rotating field theory – operation of Induction motor – operation of Synchronous motor – power angle characteristics.

UNIT – II **L- 10**

Theory of two pole machine

Elements of generalized theory Basic two pole machine, Transformer and speed voltages in the armature, Kron's primitive machine, Analysis of Electric Machines.

UNIT – III **L- 10**

Reference Frame theory

Linear transformation in machines-Invariance of power, transformation from a displayed brush axis, Reference theory Transformation from 3 phases–to-2 phase, (α-β and d-q transformation), Physical concept of Park‟s transformation. Transformation between reference frames.

UNIT – IV **L- 10**

Modeling & Analysis of Asynchronous machines

Poly phase Induction Machines- Mathematical Modeling of Induction Machines. Voltage and torque equations in machine variables, Induction machine dynamics during starting and braking –Induction machine dynamics during normal operation

UNIT – V **L- 10**

Modeling & Analysis of Synchronous machines

Synchronous motor – circuit model of a three –phase synchronous motor, flux linkages voltage equations–parks transformation to d,q,0 variables, Electromechanical equation –Motor operation – generator operation – small oscillations – general equations for small oscillations

TEXT BOOKS:

1. P. C. Krause, Oreg Wasynczuk, Scott D. Sudhoff, "Analysis of Electric Machinery and drive systems" , IEEE Press, 2002.
2. P. S. Bhimbra, "Generalized Theory of Electrical Machines", Khanna Publications.

REFERENCES:

1. Werner Leonhard, "Control of Electrical Drives", Springer; 3rd edition, 2001.
2. D. P. Sen Gupta and J. W. Lynn, "Electrical Machine Dynamics, The Macmillan Press, 1980.
3. T.J.E Miller, "Brushless permanent Magnet & Reluctance Motor Drives" clarendom press, Oxford 1989.
4. Kenjo T and Nagamoris "Permant Magnet & brushless Dc motor" Clarendon press, Oxford, 1989.