20PE003 - MODELING AND ANALYSIS OF ELECTRICAL MACHINES

UNIT - I
Basic Concepts of Modeling: Basic two pole machine representation of commutator machines, 3-phase synchronous machine with and without damper bar and 3-phase induction machine, Kron's primitive machine-voltage, current and torque equations.
DC Machine Modeling: Mathematical model of separately excited DC motor-steady state and transient state analysis, sudden application of inertia load, transfer function of separately excited DC motor, mathematical model of dc series motor, shunt motor, linearization techniques for small perturbations.

UNIT - II
Reference Frame Theory: Real time model of a two phase induction machine, transformation to obtain constant matrices, three phase to two phase transformation, power equivalence. Dynamic Modeling of
Three Phase Induction Machine: Generalized model in arbitrary frame, electromagnetic torque, deviation of commonly used induction motor models-stator reference frames model, rotor reference frames model, synchronously rotating reference frames model, equations in flux linkages, per unit model, dynamic simulation.
Small Signal Equations of the Induction Machine: Derivation of small signal equations of induction machine, space phasor model, DQ flux linkages model derivation, control principle of the induction motor.

UNIT - III
Transformer Modeling: Introduction, single phase transformer model, three phase transformer connections, per phase analysis, normal systems, per unit normalization, per unit three phase quantities, change of base, per unit analysis of normal system, regulating transformers for voltage and phase angle control, auto transformers, transmission line and transformers.

UNIT - IV
Modeling of Synchronous Machines: Introduction, voltage equations and torque equation in machine variables, stator voltage equations in arbitrary and rotor reference frame variables, Park's equations, torque equations in substitute variables, rotor angle and angle between rotors, per unit system, analysis of steady state operation.

UNIT - V
Dynamic Analysis of Synchronous Machines: Dynamic performance during sudden change in input torque and during a 3-phase fault at the machine terminals, approximate transient torque versus rotor angle characteristics, comparison of actual and approximate transient torque-angle characteristics during a sudden change in input torque; first swing transient stability limit, comparison of actual and approximate transient torque-angle characteristics during a 3-phase fault at the machine terminals, critical clearing time, equal area criterion, computer simulation.

REFERENCE BOOKS:
1. P.S.Bimbra, "Generalized Theory of Electrical Machines", 5thEdition, Khanna Publications, 1995.
2. R. Krishnan, "Electric Motor Drives - Modeling, Analysis & Control", PHI Learning Private Ltd, 2009.
3. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive Systems", 2ndEdition, Wiley(India),2010.
4. Arthur R Bergen and Vijay Vittal, "Power System Analysis", 2nd Edition, Pearson, 2009.
5. PrabhaKundur, "Power System Stability and Control", TMH, 2010.
6. Chee-MunOng, "Dynamic Simulation of Electric Machinery using Matlab / Simulink",Prentice Hall, 1998.