DYNAMICS OF ELECTRICAL MACHINES
(ELECTIVE-I)

Course Code: 15EE2205

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Pre requisites: Electrical Machines.

Course Outcomes: At the end of the course, a student will be able to

CO1: Derive Kron's Primitive machine as an unified electrical machine model.

CO2: Derive the mathematical model of a separately excited DC motor & DC Series Motor.

CO3: Analyze a three phase synchronous/ PM machine under transient conditions.

CO4: Derive the mathematical model and control a 3- phase Induction motor under transient /steady state conditions.

CO5: Analyze asymmetrical 2-phase / 1-phase induction motor under transient /steady state conditions.

UNIT-I (10-Lectures)

MODELING CONCEPTS

Basic Two-pole machine representation of commutator machines, 3-phase synchronous machine without damper bars and 3-phase induction machine, Kron's primitive machine-voltage, current and torque equations. Real time model of a two phase induction machine-transformation to obtain constant matrices-three phase to two phase transformation- power invariance.

UNIT-II (10-Lectures)

REFERENCE FRAME THEORY & PM AC MACHINE

Introduction–Background–Equations of Transformation–Stationary Circuit variables transformed to the Arbitrary Reference Frame–Commonly Used Reference Frames–Balanced Steady -State Phasor Relationships– Balanced Steady-State Voltage Equations.

PM AC Machine: Voltage & Torque equations in Machine Variables and Rotor Reference Frame Variables

UNIT-III (10-Lectures)

DC MACHINE MODELLING

Mathematical model of a separately excited DC motor- Steady state and transient analyses - Transfer function of a separately excited DC machine – Mathematical model of a DC series motor, shunt motor-linearization techniques for small perturbations

UNIT-IV (10-Lectures)

DYNAMIC ANALYSIS OF SYNCHRONOUS MACHINE

Synchronous machine inductances – voltage equations in the rotor's dq0 reference frame- electromagnetic torque-current in terms of linkages. Dynamic performance of synchronous machine, three-phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria– simulation of three phase synchronous machine – Dynamic performance during a sudden change in input torque– Torque vs. rotor angle characteristics.

UNIT-V (10-Lectures)

MODELING OF THREE PHASE SYMMETRICAL INDUCTION MACHINE

Generalized model in an arbitrary reference frame- Electromagnetic torque– Derivation of commonly used induction machine models– Stator reference frame model- Rotor reference frame model- Synchronously rotating frame model– Equations in flux linkages - per unit model- Dynamic Simulation- Small signal equations of induction machine – derivation of dq flux linkage model – Control principles of Induction machine, Analysis under steady state operation.

TEXT BOOKS:

1. Dr. P. S. Bimbhra, "*Generalized Theory of Electrical Machines*" – Fifth edition, Khanna publishers (for UNIT- I: Chapters 1 & 2))

2. P.C.Krause, Oleg Wasynczuk, Scott D. Sudhoff "*Analysis ofElectrical Machinery and Drive systems*", 3rd Edition, IEEE Press (for UNIT – II, III, IV & V: Chapters 3,4,5 ,6, 9, part of 10)

REFERENCES:

1. Chee Mun Ong "*Dynamic simulation of Electric machinery usingMatlab / Simulink*" –Prentice Hall
2. C.V. Jones: "*The Unified Theory of Electrical Machines*" Butterworth, London.