NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B.Tech. in Electrical Engineering**
Semester:	**VI**
Course Code:	**3EE105ME26**
Course Title:	**Modelling and Analysis of Electrical Machines**
Course Type:	**Department Elective-II**
Year of Introduction:	**2020– 21**

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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. evaluate the parameters of various electromechanical systems (BL5)
2. elucidate mathematical model for electrical machines. (BL3)
3. make use of reference frame theory in electrical machines (BL3)
4. analyse the performance of electrical machines (BL4)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Basics of Electric Machine Analysis** Magnetically coupled circuits, electromechanical energy conversion, machine windings, and air-gap mmf, winding inductances and voltage equations of synchronous machine and induction machine	**05**
Unit-II	**Modelling of DC Machines** Elementary direct current machine, voltage and torque equations, practice examples, dynamic characteristics of various dc machines, time-domain block diagrams, and state equations	**06**
Unit-III	**Reference Frame Theory** Basic concept of reference frame, equations of transformation: change of variables, stationary circuit variables transformed to the arbitrary reference frame, commonly used reference frames, transformation between reference frames	**06**
Unit-IV	**Modelling of Induction Machines** Voltage and torque equations in machine variables, equations of transformations for rotor circuits, commonly used reference frames, equivalent per unit model, voltage and torque equations in arbitrary reference frame variables, analysis of steady-state operation, free acceleration characteristic viewed from various reference frames, mathematical model/block diagram to predict dynamic response during sudden change in load torque, concepts of computer simulation in various reference frames	**12**

Unit-V **Modelling of Synchronous Machines** **10**

Voltage and torque equations in machine variables, Stator voltage equations in arbitrary reference frame variables, voltage equations in rotor reference frame variables: Park's equations, torque equations in substitute variables, rotor angle, dynamic performance during a sudden change in input torque, dynamic performance during a fault at the machine terminals.

Unit-VI **Modelling of Permanent Magnet Machines** **06**

Introduction, voltage and torque equations in machine variables and rotor reference frame variables, dynamic characteristics of permanent magnet machines

Self-Study: The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/ References:

- Paul C. Krause, *Analysis of Electric Machinery*, Tata McGraw Hill.
- Kimbark E W, *Power System Stability*, Wiley Interscience.
- Bernard Adkins, *The General Theory of Electrical Machines*, Chapman & Hall Ltd.
- R. Krishnan, *Electric Motor Drives: Modeling, Analysis, and Control*, Prentice Hall India.
- Ned Mohan, *Advanced Electric Drives: Analysis, Control, and Modeling Using MATLAB / Simulink*, Wiley.
- C.V. Jones, *Unified Theory of Electrical Machines*, Butterworth Publishers.
- P. Kopylov, *Mathematical Models of Electric Machines*, Mir Publisher, Moscow.
- C. M. Ong, *Dynamic Simulation of Electric Machines*, Prentice – Hall, NJ.
- Latest publications from referred journals.

Tutorial: Tutorial work will be based on above syllabus with minimum 08 tutorials.