MODELING AND SIMULATION OF POWER ELECTRONIC SYSTEMS

Course Code: 15EE2213

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

CO1: Derive a mathematical model of Power Electronic Devices and computer simulation techniques widely used for Power electronic Converters.

CO2: Derive a mathematical model and Simulate AC-DC Converters.

CO3: Derive a mathematical model and Simulate DC-DC Converters.

CO4: Differentiate and describe the various simulation methods of analysis of power electronic systems.

CO5: Design & implementation of different types of algorithms for power electronic systems.

UNIT-I (10-Lectures)

INTRODUCTION AND REVIEW OF MODELING OF POWER ELECTRONIC DEVICES:

Overview and modeling of Power Electronic (PE) devices: Diodes, Thyristors, IGBTs, MOSFET; Comparison of switching characteristics of various devices, Transient and Steady state behaviour of PE devices.

COMPUTER SIMULATION OF PE CONVERTERS:

Challenges in Computer Simulation; Solution techniques for time domain simulation; widely used circuits and / or system oriented simulators. Choice of simulator(s).

UNIT-II (10-Lectures)

SIMULATION OF AC/ DC CONVERTERS:

Modeling of controlled and uncontrolled ac/ dc converters; single-phase & 3- phase ac/dc converters; other topologies for ripple current minimization and power factor improvement.

UNIT-III (10-Lectures)

SWITCH-MODE DC / DC POWER SUPPLIES:

Modeling & Simulation of dc/dc converters such as Buck, Boost, Buck-Boost, Cuk and Full bridge dc/dc Converters.

UNIT-IV (10-Lectures)

SEQUENTIAL METHOD OF SIMULATION OF POWER ELECTRONIC SYSTEMS:

Decoupled and Coupled Power Electronic Systems; Analysis of Decoupled Systems: Analysis of chopper fed DC motor, Analysis of Inverter fed Induction Machine; Analysis of coupled systems: Synchronous Machine fed from a naturally commutated inverter, Induction machine fed from a forced commutated current source inverter; computer aided analysis of machine-converter group.

UNIT-V (10-Lectures)

ADVANCED TECHNIQUES: EFFICIENT COMPUTATION OF STEADY STATE PERIODIC SOLUTIONS:

Definition of steady state computation problem – Newton-Raphson Method, Gradient Method, E-Algorithm for computation of steady-state solution; Computation of Steady-state solution in power electronic systems – Computation of steady-state of an AC Regulator, Computation of steady-state solution of HVDC Systems, Implementation of Steady-state computation algorithms.

TEXT BOOKS:

1. M. B. Patil, V. Ramanarayanan, V. T. Ranganathan, M. C. Chandorkar, "*Simulation of Power Converters"*, 1st edition, Narosa Publishers, 2010.
2. V. Rajagopalan, "*Modeling & Simulation of PE systems"*, Marcel Dekkar Inc.

REFERENCES:

1. Ned Mohan, T. M. Undeland and William P. Robbins: "*Power* Electronics: Converters Applications", 3rd edition, John Wiley & Sons, 2009.