EE 304: POWER ELECTRONICS (3-1-2: 5)-Revised

Introduction

Power Electronics Scope and Applications, Interdisciplinary Nature of Power Electronics, Types of power electronics circuits, Introduction to power electronic devices like Thyristor (SCR), Power BJT, Power MOSFET, GTO, IGBT, Thyristor Characteristics, Two transistor analogy, Gate Characteristics, Methods of triggering and commutation, Ratings and protection of devices, Series and parallel operation of thyristor, Protection of dv/dt & di/dt for semiconductor switches.

Phase Controlled Rectifiers / AC-DC Converter

Principle of phase control, half wave controlled rectifiers, half wave controlled rectifiers with R, R-L, R-L with Freewheeling Diode, R-L-E load, single phase full wave controlled converters, 2-pulse mid-point converters, 2-pulse half and fully controlled bridge converters with R, R-L, R-L-E load, Three phase converter system with diodes, 3 phase half and fully controlled bridge converters, triggering scheme, Effect of source impedance on the performance or the converters, Dual converters.

Choppers / DC-DC Converter

Basic principle of chopper operation, Different methods of classification, Control strategies – Duty Ratio Control and Frequency Control, Types of idealized chopper circuit, Steady state time domain analysis of Class - A choppers, Thyristor Chopper Circuits.

Inverters / DC-AC Converter

Voltage Source Inverter (VSI)- Single phase voltage source inverters, Half bridge inverters, full bridge inverters, Steady state analysis, Voltage control in single phase inverters, 3-phase bridge inverters; 180^{o} mode VSI, 120^{o} mode VSI, Pulse Width Modulated (PWM) inverters; single pulse, multiple pulse, sinusoidal pulse modulation, Current Source Inverter (CSI), Series and parallel inverter, Reduction of harmonics in output voltage, Control of output voltage.

Cyclo-converter / AC-AC Converter

Principle of AC Voltage Controllers – Integral Cycle Control and Phase Control, Types of AC voltage controllers, Analysis of 1-phase & 3-phase voltage controllers with R and R-L load.

Principle of operation of cyclo-converters, circulating and non circulating mode of operation, single phase to single phase step up and step down Cyclo-converters, three phase to single phase Cyclo-converters, three phase to three phase Cyclo-Converter .

Suggested list of Experiments:

1) Study of IGBT UJT, MOSFET, SCR, TRIAC, DIAC characteristics.
2) Study of different SCR Triggering Circuit – DC, R, R-C, UJT
3) Study of Synchronized Cosine control Triggering circuit.
4) Study of Single Phase Half & Fully controlled Bridge Converter with R and R-L Load.
5) Study of Ramp Comparator scheme of Regulating AC power using TRIAC and Opto- Isolator
6) Study of Single phase AC Voltage controller
7) Study of Series Resonant Inverter
8) Study of Three Phase Half and Fully controlled Bridge Converter with R and R-L load
9) Study of Single Phase Full Bridge Inverter Circuit.
10) Study of Chopper circuits
11) Study of different cyclo-converter circuits with R & R-L load.

12) Simulation of Power Electronics circuits in PSIM and MATLAB.

Text Books:

1. M. H Rashid, “Power Electronics Circuits, Devices, and Applications”, Prentice-Hall of India Pvt. Ltd.
2. L. Umanand, “Power Electronics Essential and Applications”, Willey India.

References:

1. P. S. Bimbhra, “Power Electronics”, Khanna Publishers.
2. M. D. Singh and K. B. Khanchandani, “Power Electronics”, Tata McGraw-Hill Publishing Co. Ltd.
3. M. Ned and T. M. Undeland, “Power Electronics Converters Applications and Design”, John Willey Inc.
4. J. P. Agrawal, “Power Electronic Systems: Theory and Design”, Addison Wesley Longman Pte. Ltd.
5. V. R. Moorthi, “Power Electronics Devices, Circuits and Applications”, Oxford University Press.