Power Electronics(304193)

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Assessment:
Phase I : 30
End Semester Examination:
Phase II: 70

Course Objectives:

- To introduce students to different power devices to study their construction, characteristics and turning on circuits.
- To give an exposure to students of working & analysis of controlled rectifiers for different loads, inverters, DC choppers, AC voltage controllers and resonant converters.
- To study the different motor drives, various power electronics applications like UPS, SMPS, etc. and some protection circuits.

Course Outcomes:

After successfully completing the course students will be able to

- Design & implement a triggering / gate drive circuit for a power device
- Understand, perform & analyze different controlled converters.
- Evaluate battery backup time & design a battery charger.
- Design & implement over voltage / over current protection circuit.

Unit I : Power Devices 6L

Construction, Steady state characteristics & Switching characteristics of SCR, Construction, Steady state characteristics Power MOSFET & IGBT. SCR ratings: IL, IH, VBO, VBR, dv/dt, di/dt, surge current & rated current.Gate characteristics, Gate drive requirements, Synchronized UJT triggering for SCR, triggering of SCR using IC-785, gate drive circuits for Power MOSFET / IGBT.

Unit II : AC-DC Power Converters 6L

Concept of line & forced commutation, Single phase Semi & Full converters for R, R-L loads, Performance parameters, Effect of freewheeling diode, Three phase Semi & Full converters for R load.

Unit III : DC-AC Converters 6L

Single phase bridge inverter for R and R-L load using MOSFET / IGBT, performance parameters, single phase PWM inverters. Three phase voltage source inverter for balanced star R load.

Unit IV : DC-DC converters & AC Voltage Controller 6L

Working principle of step down chopper for R-L load (highly inductive), control strategies. Performance parameters, Step up chopper, 2-quadrant & 4-quadrant choppers, SMPS. Single-phase full wave AC voltage controller with R load.

Unit V :Power Electronics Applications 6L

ON-line and OFF line UPS with battery AH, back up time, battery charger rating. Electronic ballast: Characteristics of fluorescent lamps and advantages over conventional ballast. Single phase separately excited DC motor drive, stepper motor drive, BLDC motors. Variable voltage & variable frequency three phase induction motor drive.

Unit VI: Resonant Converters & Protection of Power Devices & Circuits 6L

Need for resonant converters, SLR half bridge DC/DC converter in low frequency, Concept of zero current switching (ZCS) and zero voltage switching (ZVS) resonant converters. Cooling & heat sinks, over voltage conditions, over voltage protection circuits, over current fault conditions, over current protection. Electromagnetic interference: Sources, minimizing techniques.

Text Books:

1. M. H. Rashid, “Power Electronics circuits devices and applications”, PHI 3rd edition, 2004 edition, New Delhi.
2. M. S. Jamil Asghar, "POWER ELECTRONICS", PHI, 2004, New Delhi

Reference Books:

1. Ned Mohan, T. Undeland & W. Robbins, “Power Electronics Converters applications and design” 2nd edition, John Willey & sons, Singapore
2. U. R. Moorthi, "POWER ELECTRONICS, DEVICES, CIRCUITS & INDUSTRIAL APPLICATIONS" , Oxford University Press, New Delhi, 2005
3. P.C. Sen, “Modern Power Electronics”, S Chand & Co New Delhi.
4. "GE SCR MANUAL" 6th edition, General Electric, New York, USA
5. Dr. P. S. Bimbhra, “Power Electronics”, Khanna Publishers, Delhi.
6. Nagrath Kothari, “Electrical Machines”, TMH.