Power Electronics and Applications(304212)

Teaching Scheme:
Lectures: 4 Hrs/ Week

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

Course Objectives:

- To study working & analysis of controlled rectifiers for different loads
- To study working & analysis of single phase bridge inverter.
- To study the working of PWM inverter & 3-¢ inverter.
- To study working & analysis of different DC choppers.
- To understand the working of SMPS
- To study working & analysis of AC voltage controller using SCRs and Triacs
- To study different resonant converters.
- To study power quality issues.
- To study working of different power electronics applications like UPS, electronic ballast, HVDC transmission etc.
- To study use of power electronics for renewable energy sources like solar and wind.

Course Outcomes:

After successfully completing the course students will be able to

- Design & implement a triggering / gate drive circuit for a power converters
- Design and analyze different line commutated converter circuits
- Design and analyze different inverter circuits
- Design a step down chopper
- Design a single phase AC voltage controller i.e. light dimmer / fan regulator
- Evaluate battery backup time & design a battery charger
- Understand various power quality issues and their remedies
- Understand various applications of power electronics like HVDC transmission, UPS, Electronic Ballasts etc.
- Understand renewable energy systems like photovoltaic and wind.

Unit I : AC-DC power converters 7L

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 and RL load. Simple triggering circuits for single phase converters, triggering circuit requirement for three phase converters

Unit II : DC-AC Converters 7L

Single phase bridge inverter for R & R-L load using MOSFET / IGBT, performance parameters, single phase PWM inverters. Three phase voltage source inverter for balanced star R load. Control circuits for single phase bridge inverters, control circuit requirement for three phase inverters

Unit III : DC-DC converters & AC Voltage Controller 7L

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. Typical control circuits for single quadrant and two quadrant choppers. Single-phase full wave AC voltage controller with R load.

Unit IV: 7L

a) Resonant converters: Need for resonant converters, Classification, Resonant Switch: ZC resonant switch and ZV resonant switch, Quasi Resonant Converters: ZCS and ZVS, their comparison, Load resonant converters: SLR half bridge DC/DC converter in low frequency.

b) Power Quality: Power Quality considerations, Reactive Power and Harmonic Compensation, Active filters for power conditioning.

Unit V: Power Electronics Applications 7L

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. Power Electronics in Capacitor Charging Applications. HVDC transmission: Main components of HVDC Converter station, Types of HVDC systems. Universal motor speed control.

Unit VI : Power Electronics for Renewable Energy Sources 7L

Power Electronics for Photovoltaic Power Systems: Basics, Types, Stand-alone PV systems, Grid connected PV systems. Power Electronics for wind power systems: Basics, Types, Stand-alone wind energy systems, Grid connected wind energy systems, Control of wind turbines.

Text Books

1. M. H. Rashid, “Power Electronics Handbook”, Academic Press, 2001.
2. M. S. Jamil Asgar, "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. "GE SCR MANUAL" 6th edition, General Electric, New York, USA
4. Timothy Skvarenina, “The Power Electronics Handbook”, CRC Press, 2002