

**III Year – I SEMESTER**

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**POWER ELECTRONICS****Preamble:**

The usage of power electronics in day to day life has increased in recent years. It is important for student to understand the fundamental principles behind all these converters. This course covers characteristics of semi conductor devices, ac/dc, dc/dc, ac/ac and dc/ac converters. The importance of using pulse width modulated techniques to obtain high quality power supply (dc/ac converter) is also discussed in detail in this course.

**Learning Objectives:**

- To study the characteristics of various power semiconductor derive and analyze the operation of diode bridge rectifier.
- To design firing circuits for SCR. Analyze the operation of AC voltage controller and half-wave phase controlled rectifiers.
- To understand the operation of single phase full-wave converters and analyze harmonics in the input current.
- To study the operation of three phase full-wave converters and dual converter.
- To analyze the operation of single phase cyclo converters and high frequency dc-dc converters.
- To understand the working of inverters and application of PWM techniques for voltage control and harmonic mitigation.

**UNIT-I:****Power Semi Conductor Devices**

Thyristors–Silicon controlled rectifiers (SCR’s) –Characteristics of power MOSFET and power IGBT– Basic theory of operation of SCR–Static characteristics– Turn on and turn off methods–Dynamic characteristics of SCR– Snubber circuit design–Numerical problems–Diode bridge rectifier with R-load and capacitive filter–Output voltage and input current waveforms.

**UNIT-II:****Phase Controlled Converters – Single Phase**

Firing circuits for SCR– Line commutation principle– Single phase AC voltage controller with R and RL load–Half wave converters with R, RL and RLE loads– Derivation of average load voltage and current–Effect of freewheeling diode for RL load.

**UNIT-III:****Single Phase Bridge Converter and Harmonic Analysis Fully controlled converters**

Operation with R, RL and RLE loads–Derivation of average voltage and current – Effect of source Inductance.

**Semi Converters (Half Controlled):**

Operation with R, RL and RLE loads – Harmonic analysis for input current waveform in a system with a large load inductance –Calculation of input power factor.

**UNIT-IV:****Three Phase AC–DC Bridge Converters**

Full converter with R and RL loads–Semi converter (Half Controlled) with R and RL loads– Derivation of load voltage–Line commutated Inverter operation–Dual converters with non–circulating and circulating currents.

**UNIT – V:****AC–AC and DC–DC Converters**

Single phase Bridge type cyclo converter with R and RL load (Principle of operation) –High frequency DC–DC converters: Buck Converter operation–Time ratio control and current limit control strategies–Voltage and current waveforms–Derivation of output voltage–Boost converter operation–Voltage and current waveforms–Derivation of output voltage – Buck-Boost converter operation –Voltage and current waveforms.

**UNIT – VI:****DC–AC Inverters****Inverters**

Single phase inverters–Unipolar and bipolar switching–Three phase Inverters ( $120^\circ$  and  $180^\circ$  modes of operation) –PWM techniques– Sine triangular PWM technique– amplitude and frequency modulation Indices –Harmonic analysis.

**Learning Outcomes:**

Student should be able to

- Explain the characteristics of various power semiconductor derive and analyze the operation of diode bridge rectifier.
- Design firing circuits for SCR. Analyze the operation of AC voltage controller and half-wave phase controlled rectifiers.
- Explain the operation of single phase full-wave converters and analyze harmonics in the input current.
- Explain the operation of three phase full-wave converters and dual converter.
- Analyze the operation of single phase cyclo converters and high frequency dc-dc converters.
- Explain the working of inverters and application of PWM techniques for voltage control and harmonic mitigation.

**Text Books:**

1. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998
2. Power Electronics: converters, applications & design -by Nedmohan, Tore M. Undeland, Robbins by Wiley India Pvt. Ltd.
3. Power Converter Circuits -by William Shepherd, Li zhang, CRC Taylor & Francis Group.

**Reference Books:**

1. Elements of Power Electronics–Philip T.Krein.oxford.
2. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers, 1996.
4. Power Electronics handbook by Muhammad H. Rashid, Elsevier.