

3/4 B.Tech. FIRST SEMESTER

EE5T4
Lecture: 4 periods/week
Tutorial: 1 period /week

POWER ELECTRONICS

Credits: 4
Internal assessment: 30 marks
Semester end examination: 70 marks

Objective:

The usage of power electronics has increased in the recent years. The fundamental principles behind power electronic converters semiconductor devices ac / dc, dc /dc, ac/ac, dc/ac converters, using of PWM techniques to obtain high quality power supply are discussed in detail in this course

Learning outcomes:

1. Upon completing this course, students should be able to understand the principle of operation and characteristics of different power semiconductor devices, SCR protection schemes, different configurations of 1- Φ & 3 – Φ controlled rectifiers with R, RL and RLE loads with and without freewheeling diodes, effect of source inductance and basic operation of dual converters.
2. Students should be able to derive the RMS load voltage, current and power factors and know the basic principle of operations for 1- Φ AC voltage controllers and cyclo converters with R and RL loads.
3. Students should be able to know the basic operation and characteristics of step up and step down choppers with R, RL and RLE loads. Buck, Boost, Buck-Boost, MORGAN'S choppers, JONES choppers, Oscillation choppers, AC choppers. Basic operation principles of Inverters and SMPS.

UNIT I Power Semiconductor Devices

Power Diode, Power BJT, Power MOSFET, IGBT, GTO, DIAC, TRIAC Principle of Operation and Characteristics.

UNIT II Introduction to SCR'S

Principle of operations of SCR, Static, dynamic and gate Characteristics of SCR, two-transistor analogy, Triggering methods of SCR- R, RC and UJT firing circuits, Commutation techniques.

UNIT III

Snubber Circuits details, Series and parallel connections of SCRs – Static and Dynamic Equalizing networks, Specifications and Ratings of SCRs – Numerical Problems

UNIT IV Single Phase Controlled Rectifiers

Phase angle control, Single Phase half wave controlled rectifiers with R and RL load, Single phase full wave controlled rectifiers – midpoint connections and bridge connections – fully controlled bridge rectifier, half controlled bridge rectifier with R, RL and RLE loads - Derivation of average load voltage and current Line commutated inverters without and with Freewheeling Diode, Effect of source inductance – Derivation of load voltage and current.

UNIT V Three Phase Line Commutated Converters

Three phase converters – Three pulse and six pulse converters – Mid-point and bridge connections -average load voltage with R and RL loads – Effect of Source inductance–Dual converters (both single phase and three phase).

UNIT VI AC Voltage Controllers & Cyclo Converters

Single phase AC voltage controllers –two SCR's in anti parallel – With R and RL loads – modes of operation of Triac – Triac with R and RL loads – Derivation of RMS load voltage, current and power factor wave forms – Firing circuits -Numerical problems. Cyclo converters – Single phase mid-point cyclo converters with Resistive and inductive load (Principle of operation only) – Bridge configuration of single phase cyclo converter (Principle of operation only).

UNIT VII DC-DC Converters

Choppers – Time ratio control and Current limit control strategies – Step down choppers, Derivation of load voltage and currents with R, RL and RLE loads- Step up Chopper – load voltage expression, High Frequency DC-DC Converter – Buck, Boost, Buck-Boost (Principle of operation only).

Morgan's chopper – Jones chopper and Oscillation chopper (Principle of operation only)
Waveforms — AC Chopper – Problems.

UNIT VIII Inverters

Single Phase Inverters –Basic series inverter, Parallel Inverter, Bridge Inverters, PWM Techniques, Sine, Triangular PWM Inverter. Introduction to switch mode power supplies (SMPS).

Learning Resources

Text Books:

1. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998
3. Power Electronics: converters, applications & design by Nedmohan, Tore M. Undeland, Riobbins by Wiley India Pvt. Ltd.

Reference Books:

1. Power Electronics – by Vedam Subramanyam, New Age International (P) Limited, Publishers
2. Power Electronics - by V.R.Murthy , 1st edition -2005, OXFORD University Press
3. Power Electronics-by P.C.Sen,Tata Mc Graw-Hill Publishing.
4. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradra, A. Joshi and R. M. K. Sinha, New Age International (P) Limited Publishers, 1996.