

III Year B.Tech. EEE – I Semester

23A02501T	POWER ELECTRONICS (Professional Core)	L	T	P	C
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Course Outcomes:

- CO1:** Understand the I-V Characteristics and Gate Drive Requirements of Power Devices Including Diodes, Thyristors, MOSFETs, and IGBTs. -L2
- CO2:** Design Single-Phase and Three-Phase Rectifiers with Different Load Conditions and Evaluate Power Factor and Source Inductance Effects. -L5
- CO3:** Apply Duty Ratio Control and Analyze Steady-State Waveforms of Buck, Boost, and Buck-Boost Converters. L3
- CO4:** Analyze the Operation of Inverters, AC Voltage Controllers, and Cyclo Converters with Various Load Conditions and Commutation Techniques. L4
- CO5:** Explore advanced power electronic devices like GaN and SiC, understanding their applications in modern power systems. L3

UNIT I

Power Switching Devices:

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET, IGBT and GTO. Introduction to Gallium Nitride and Silicon Carbide Devices.

UNIT II

Rectifiers:

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape, power factor and effect of source inductance; Analysis of rectifiers with filter capacitance, Dual Converter -Numerical problems.

UNIT III

DC-DC Converters:

Elementary chopper with an active switch and diode, concepts of duty ratio, control strategies and average output voltage: Power circuit, analysis and waveforms at steady state, duty ratio control and average output voltage of Buck, Boost and Buck- Boost Converters.

UNIT IV

Inverters:

Single phase Voltage Source inverters – operating principle - steady state analysis, Simple forced commutation circuits for bridge inverters – Voltage control techniques for inverters and Pulse width modulation techniques, single phase current source inverter with ideal switches, basic series inverter, single phase parallel inverter – basic principle of operation only, Three phase bridge inverters (VSI) – 180 degree mode – 120 degree mode of operation - Numerical problems.

UNIT V

AC Voltage Controllers & Cyclo Converters:

AC voltage controllers – Principle of phase control – Principle of integral cycle control - Single phase two SCRs in anti-parallel – With R and RL loads – modes of operation of Triac – Triac with R and RL loads – RMS load voltage, current and power factor - wave forms – Numerical problems. Cyclo converters - Midpoint and Bridge connections - Single phase to single phase step-up and step-down cyclo converters with Resistive and inductive load, Principle of operation, Waveforms, output voltage equation.

Text Books:

1. M. H. Rashid, “Power Electronics: Circuits, Devices and Applications”, 2nd edition, Prentice Hall of India, 1998.
2. P.S. Bimbhra, “Power Electronics”, 4th Edition, Khanna Publishers, 2010.
3. M. D. Singh & K. B. Kanchandhani, “Power Electronics”, Tata Mc Graw Hill Publishing Company, 1998.

Reference Books:

1. Ned Mohan, “Power Electronics”, Wiley, 2011.
2. Robert W. Erickson and Dragan Maksimovic, “Fundamentals of Power Electronics” 2nd Edition, Kluwer Academic Publishers, 2004.
3. Vedam Subramanyam, “Power Electronics”, New Age International (P) Limited, 1996.
4. V. R. Murthy, “Power Electronics”, 1st Edition, Oxford University Press, 2005.
5. P. C. Sen, “Power Electronics”, Tata Mc Graw-Hill Education, 1987.
6. J. M. D. Murphy “Power Electronic Control of Alternating Current Motors”.