POWER ELECTRONICS

V Semester: EEE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AEEC16	**Core**	3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		
Prerequisites: Network Analysis, Digital Electronics								

I. COURSE OVERVIEW:

The course focuses on presenting concepts for conversion, control and monitoring of electrical energyusing power semiconductor devices. Methods for analyzing power electronic converters suitable for DC/AC, DC/DC, AC/AC and AC/DC electrical energy conversions including regulators are presented. Additionally, principles for designing power electronic converters, including their power semiconductors and passive elements are established. The applications of power electronics in the fields of sustainable energy technologies, switched mode power supplies and uninterruptible power supplies as well as application of power electronic converters for transmission, distribution and control in the power systems is described.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The concepts on power semiconductor devices related to its characteristics, ratings, and protection to select these devices for various applications.
II. The fundamental principles and control techniques of power electronic converters for analyzing AC/DC, DC/DC, AC/AC and DC/AC power conversion circuits.
III. The application of power electronic converters in the fields of battery management system, industrial drive applications and enhancement of power quality.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Explain** the static and dynamic characteristics of power semiconductor devices used for power conversion in converter circuits.	Understand
CO 2	**Summarize** the various firing circuits and commutation techniques useful for accurate switching function of the SCR.	Understand
CO 3	**Analyze** the performance parameters of ac-dc converters under various loading conditions.	Analyze
CO 4	**Identify** the switching techniques and control strategies in switched mode regulators and perform steady state analysis in the chopper circuit.	Apply
CO 5	**Demonstrate** single phase ac voltage controllers and cyclo converter used for converting fixed ac supply into variable ac output	Understand
CO 6	**Apply** modulation and switching topologies in inverters for outputvoltage control.	Apply

IV. COURSE SYLLABUS

MODULE-I: POWER SWITCHING DEVICES (09)

Thyristor, MOSFET, IGBT: I-V Characteristics; R, RC and UJT firing circuit for thyristor; Gate drive circuits for MOSFET and IGBT. Series and parallel operation of thyristors, ratings, protection against dv/dt and di/dt, design of Snubber circuit, forced commutation circuits, other devices in thyristor family: TRIAC, GTO and their characteristics, numerical problems.

MODULE –II: PHASE CONTROLLED RECTIFIERS (09)

Single phase half wave and single phase full wave (Mid-Point and Bridge configurations) thyristor rectifier with R- load and highly inductive load; derivation of average load voltage and current, effect of freewheeling diode, effect of source inductance

MODULE-III: CHOPPERS (09)

Basic chopper operation, control strategies, step up chopper, derivation of load voltage and load currents with R and RL loads, chopper configurations.

Power circuit of a buck, boost and buck-boost converters: Analysis and waveforms at steady state.

MODULE –IV: AC VOLTAGE CONTROLLER AND CYCLO CONVERTERS (09)

Single phase AC voltage controllers - two SCRs in anti-parallel with R and RL loads, derivation of rms load voltage and load current, numerical problems, Cyclo converters - single phase midpoint and bridge type (step-up and step-down operations) with R and RL loads.

MODULE –V: INVERTERS (09)

Single phase inverters: Basic operation, voltage source inverters, basic series and parallel inverters, current source inverter, modified Mc Murray and Mc Murray-Bedford half bridge inverters (operation and waveforms), voltage control by pulse width modulation techniques (single pulse, multiple pulse and sinusoidal), numerical problems. Three phase bridge Inverters - 180^o and 120^o conduction modes of operation.

V. TEXT BOOKS:

1. Dr. P S Bimbhra, "Power Electronics", Khanna Publishers, Delhi, 4th Edition, 2008.
2. M H Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 3rd Edition, 2009.

VI. REFERENCE BOOKS:

1. L Umanand, "Power Electronics: Essentials and Applications", Wiley India, 3rd Edition, 2009.
2. N Mohan and T M Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2nd Edition, 2007.
3. R. W. Erickson and D Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2nd Edition, 2007.

VII. WEB REFERENCES:

1. https://www.coursera.org/learn/power-electronics
2. https://nptel.ac.in/courses/108/102/108102145/
3. https://www.electronicsforu.com/videos-slideshows/power-electronic-devices
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-334-power-electronics-
5. spring-2007/lecture-notes/