POWER ELECTRONICS

V Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEE010	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

COURSE OBJECTIVES:

The course should enable the students to:

I. Integrate the revolutionary development in power transmission, distribution and utilization with the advent of semiconductor devices.
II. Demonstrate rectifiers, choppers and various schemes of pulse width modulated inverters.
III. Explain AC voltage converters and cycloconverters.
IV. Outline complete range of power supplies, including switched mode and uninterruptible power supplies.

COURSE OUTCOMES (COs):

CO 1: Describe the characteristics of basic elements, turn on and turn off methods of SCR, protection, ratings of SCRs and series parallel operations of SCRs.
CO 2: Discuss the operation of single phase, three phase rectifiers and single phase, three phase dual converters.
CO 3: Analyze the principle of operation of AC voltage controllers and cycloconverters
CO 4: Discuss the principle of operation of chopper, classification of choppers, AC chopper and switched mode regulators
CO 5: Describe the operation of series, parallel inverters, single phase inverters, three phase inverters, voltage source inverters and current source inverters

COURSE LEARNING OUTCOMES (CLOs):

1. Understand the characteristics of basic elements of power electronics
2. Discuss various turn on and turn off methods of Silicon controlled rectifier
3. Describe the protection and ratings of thyristors
4. Apply the series parallel operations of thyristors
5. Analyze the operation of single phase and three phase rectifiers with different loads
6. Describe the operation of single phase and three phase dual converter
7. Understand the principle of operation of AC voltage controller and modes of operation
8. Compute input power factor, total harmonic distortion of various input and output waveforms of AC voltage controllers
9. Describe the principle of operation and classification of cycloconverters
10. Understand the principle of operation and control strategies of chopper
11. Describe the classification of choppers
12. Analyze the importance of AC chopper and switched mode regulators
13. Discuss the principle of operation of series and parallel inverters
14. Understand the principle of operation of three phase inverters with different modes of operation
15. Analyze the principle of operation of voltage source inverters and current source inverters
16. Apply the concept of power electronics and converters to solve real time world applications
17. Explore the knowledge and skills of employability to succeed in national and international level competitive examinations

UNIT - I	POWER SEMICONDUCTOR DEVICES AND COMMUTATION CIRCUITS	Classes: 09
Power semiconductor devices and commutation circuits: Thyristors, principle of operation of silicon controlled rectifiers (SCR), bipolar junction transistor (BJT), power metal oxide semiconductor filed effect transistor (MOSFET), power insulated gate bipolar transistor (IGBT), gate turnoff thyristor (GTO) and characteristics, turn on and turnoff methods, dynamic characteristics of SCR, two transistor analogy, unijunction transistor firing circuit, series and parallel operation of SCR's, design of snubber circuit; Specifications and ratings: Ratings of SCR, BJT and IGBT, line commutation and forced commutation circuits, numerical problems.		
UNIT - II	**SINGLE PHASE AND THREE PHASE CONTROLLED RECTIFIERS**	**Classes: 10**
AC - DC converters: Phase control technique, single phase line commutated converters, midpoint and bridge connections, half controlled converters and semi converters with R, RL and RLE loads, derivation of average load voltage and current, active and reactive power inputs to the converters without and with freewheeling diode, numerical problems; Fully controlled converters: Midpoint and bridge connections with R, RL loads and RLE load, derivation of average load voltage and current, line commutated inverters, active and reactive power inputs to the converters without and with freewheeling diode, derivation of load voltage and current, numerical problems; Three phase converters: Three pulse and six pulse converters, midpoint and bridge connections, average load voltage with R and RL loads, effect of source inductance, operation of single phase and three phase dual converters, numerical problems.		
UNIT – III	**AC VOLTAGE CONTROLLERS AND CYCLOCONVERTERS**	**Classes: 08**
AC - AC controllers: Introduction, single phase 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, numerical problems; Cycloconverters: Principle of operation of single phase midpoint and bridge type cycloconverters with resistive and inductive loads, continuous and discontinuous mode of operation**.**		
UNIT - IV	**DC – DC CONVERTERS**	**Classes: 09**
DC - DC converters: Principle of operation of **c**hoppers, time ratio control and current limit control strategies, types of choppers, derivation of load voltage and currents with R, RL and RLE loads, AC chopper, problems; Switched mode regulators: Study of buck, boost and buck - boost regulators, Cuk regulators.		
UNIT - V	**INVERTERS**	**Classes: 09**
DC - AC converters: Single phase inverter, basic series inverter, parallel inverter, operation and waveforms, voltage source inverter (VSI), three phase inverters 180, 120 degrees conduction modes of operation, voltage control techniques for inverters, pulse width modulation techniques, reduction of harmonics, current source inverter (CSI) with ideal switches, capacitor commutated type CSI, numerical problems.		
Text Books:		
1. M D Singh, K B Kanchandhani, "Power Electronics", Tata Mc Graw Hill Publishing Company, 2nd Edition, 1998. 2. Dr. P S Bimbhra, "Power Electronics", Khanna Publishers, 5th Edition, 2012. 3. Ned Mohan, Tore M Undeland, William P Robbins, "Power Electronics: Converters, Applications, and Design", 3rd Edition, John Wiley and sons, 2002. 4. M H Rashid, "Power Electronics, Circuits, Devices and Applications", Pearson, 3rd Edition, 2001.		

Reference Books:

1. Vedam Subramanyam, “Power Electronics”, New Age International Limited, 2nd Edition, 2006.
2. P C Sen, “Power Electronics”, Tata McGraw-Hill Publishing, 1st Edition, 1987.
3. G K Dubey, S R Doradra, A Joshi, R M K Sinha, “Thyristorised Power Controllers”, New Age International Limited, 2nd Edition, 2008.
4. V R Moorthi, “Power Electronics Devices”, Oxford University Press, 4th Edition, 2005.

Web References:

1. https://www.nptel.iitm.ac.in
2. https://www.iare.ac.in
3. https://www.bookboon.com/en/introduction-to-power-electronics-ebook

E-Text Books:

1. https://www.freebookcentre.net
2. https://www.amazon.in/POWER-ELECTRONICS-HANDBOOK
3. https://www.circuitstoday.com