POWER ELECTRONICS

Course Code	23EE3501	Year	III	Semester	I
Course Category	Professional Core	Branch	EEE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	BEEE, ECA, CS
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the concepts of Power semiconductor devices, principle of operation of different converters and different PWM techniques. (L2)
CO2	**Apply** basic knowledge to explain the two-transistor analogy and design appropriate snubber circuits. (L3)
CO3	**Apply** basic knowledge to analyze the operation of various AC-DC, DC-DC, AC-AC, and DC-AC converters. (L3)
CO4	**Analyze** the performance of single-phase and three-phase phase-controlled rectifiers, and various AC-AC, DC-DC, and DC-AC converters. (L4)
CO5	**Analyze** the control of DC-DC and DC-AC converters with different PWM techniques. (L4)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1				1	1		1	3	3
CO2	3	2	2	1				2	2		2	3	3
CO3	3	2	2	1				2	2		2	3	3
CO4	2	3	2	1				2	2		2	3	3
CO5	2	3	2	1				2	2		2	3	3

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Power Semi-Conductor Devices** Silicon controlled rectifier (SCR) – Two transistor analogy - Static and Dynamic characteristics – Turn on and Turn off Methods - Triggering Methods (R, RC and UJT) – Snubber circuit design- Numerical problems. Static and Dynamic Characteristics of Power MOSFET and Power IGBT.	**CO1, CO2**
II	**Single-phase AC-DC Converters** Single-phase half-wave controlled rectifiers - R and RL loads with and without freewheeling diode - Single-phase fully controlled mid-point and bridge converter with R load, RL Continuous and Discontinuous conduction - Effect of source inductance in Single-phase fully controlled bridge rectifier – Expression for output voltages – Single-phase Semi-Converter with R load-RL – Continuous	**CO1, CO3, CO4**

	and Discontinuous conduction - Dual converter and its mode of operation - Numerical Problems	
III	**Three-phase AC-DC Converters & AC – AC Converters** Three-phase half-wave Rectifier with R and RL load - Three-phase fully controlled rectifier with R and RL load - Three-phase semi converter with R and RL load - Expression for Output Voltage - Numerical Problems. Single-phase AC-AC power control by phase control with R and RL loads - Expression for rms output voltage - Numerical Problems– Single-phase step down and step up Cycloconverter with R and RL Loads – (principle of operation).	**CO1, CO3, CO4**
IV	**DC–DC Converters** Operation of Basic Chopper – Analysis of Buck, Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) - Output voltage equations using volt-sec balance in CCM & DCM – Expressions for output voltage ripple and inductor current ripple -Numerical Problems – control techniques – Introduction to PWM control.	**CO1, CO3, CO4, CO5**
V	**DC–AC Converters** Introduction - Single-phase half-bridge and full-bridge inverters with R and RL loads - Numerical Problems – Phase Displacement Control – PWM with bipolar voltage switching, PWM with unipolar voltage switching - Three-phase square wave inverters - 120^0 conduction and 180^0 conduction modes of operation - Sinusoidal Pulse Width Modulation - Current Source Inverter (CSI)	**CO1, CO3, CO4, CO5**

Learning Resources

Text Books:

1. Ned Mohan, Tore M Undeland, William P Robbins, "Power Electronics: Converters, Applications and Design" by John Wiley & Sons, 2002.
2. M. H. Rashid, "Power Electronics: Circuits, Devices and Applications", Prentice Hall of India, 2nd edition, 2017.
3. L. Umanand, "Power Electronics: Essentials & Applications", Wiley Pvt. Limited, India, 2009

Reference Books:

1. Philip T. Krein. "Elements of Power Electronics", Oxford University Press; Second edition, 2014.
2. P. S. Bhimbra, "Power Electronics", Khanna Publishers.
3. G. K. Dubey, S. R. Doradla, A. Joshi and R. M. Sinha, "Thyristorised Power Controllers", New Age International (P) Limited Publishers, 1996.
4. Daniel W. Hart, "Power Electronics", Mc Graw Hill, 2011.

E-Resources:

1. https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007
2. https://archive.nptel.ac.in/courses/108/101/108101126