

25UECT412	POWER ELECTRONICS	Category	L	T	P	R	Credit	Year of Introduction
		PEC	3	0	0	0	3	2025

Preamble: The course covers the operation and characteristics of power devices and the analysis of rectifiers, DC–DC converters, AC–AC controllers, and inverters. It helps students develop the ability to design and analyze power conversion circuits used in industrial and renewable energy applications.

Prerequisite: IEE104 Introduction to Electrical and Electronics Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Describe the operation of power semiconductor devices and its characteristics.	K2 Understand
CO2	Apply various rectifier circuits for power devices.	K3 Apply
CO3	Apply the concept of power converter circuits for various electrical and electronic applications.	K3 Apply
CO4	Describe different types of inverter circuits and their operations.	K2 Understand

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	2	2	-
CO2	3	3	3	-	-	-	-	-	-	-	1	2	1
CO3	3	3	2	1	-	-	-	-	-	-	1	3	2
CO4	3	2	2	-	-	2	-	-	-	-	2	3	2
Avg	3	2.5	2	1	-	2	-	-	-	-	1.5	2.5	1.6

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*			*	
CO2	*	*	*	*	*			*	
CO3	*	*	*	*	*			*	
CO4	*	*	*	*	*		*	*	

Wks Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*		*	*	

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance	: 5 marks
Continuous Assessment Test	: 20 marks
Continuous Assessment Assignment	: 15 marks

SYLLABUS**Module 1 (10 hrs.)**

Introduction: Scope and applications of Power Electronics, Properties of ideal switch. Structure and static characteristics: Power diodes, SCR, Power BJT, MOSFET & IGBT – comparison. Series and parallel operation of SCR.

Module 2 (11 hrs.)

Rectifiers: Operation and analysis of, Single phase half controlled rectifier with R, RL load. Single phase fully controlled bridge rectifier (continuous conduction) – output voltage equation. Principle of three phase half wave controlled rectifier– (average output voltage equation for continuous load current)

Module 3 (11 hrs.)

Study of Buck, Boost, and Buck–Boost converters. Analysis of operating waveforms and derivation of expressions for output voltage, voltage ripple, and current ripple under Continuous Conduction Mode (CCM).

AC-AC voltage converters: Operation and analysis of single phase integral cycle and phase controlled converters.

Module 4 (10 hrs.)

DC-AC Inverters: Single phase and three phase bridge inverters- VSI and CSI-voltage control- PWM and square wave operation- Harmonics and their reduction techniques.

Text Books:

1. Bimbhra, P. S. (2004). *Power electronics* (3rd ed., 13th reprint). Khanna Publishers.
2. Rashid, M. H. (n.d.). *Power electronics: Circuits, devices, and applications* (3rd ed.). Pearson India.
3. Umanand, L. (2014). *Power electronics: Essentials & applications* (Reprint ed.). Wiley India.

Reference Books:

1. Mohan, N., Undeland, T. M., & Robbins, W. P. (2003). *Power electronics: Converters, applications, and design* (3rd ed.). Wiley India.

2. Vithayathil, J. (2010). *Power electronics: Principles and applications* (2nd reprint). Tata McGraw-Hill.
3. Hart, D. W. (2011). *Power electronics*. McGraw-Hill.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

Course Code	25UECT412
Course Name	POWER ELECTRONICS
Max. Marks: 60	Duration: 2.5 Hours

Part A <i>(Answer all questions. Each question carries 3 marks)</i>				
Qn No .	Question	Marks	CO	BL
1	Describe the construction and static V-I characteristics of SCR	3	CO 1	L2
2	Explain the characteristics of an ideal switch and describe its importance in power electronic circuits	3	CO 1	L2
3	Describe the construction and operation of a single-phase half-controlled rectifier with a resistive load using a suitable circuit diagram	3	CO 2	L2
4	Explain the average output voltage equation of a three-phase half-wave-controlled rectifier operating under continuous load current conditions.	3	CO 2	L2
5	Explain the operating characteristics of Buck, Boost, and Buck–Boost converters with respect to their output voltage polarity and voltage conversion capability.	3	CO 3	L2
6	Explain the principle of operation of a single-phase integral cycle AC voltage controller with suitable waveforms	3	CO 3	L2
7	Describe the operating characteristics of Voltage Source Inverters (VSI) and Current Source Inverters (CSI)	3	CO 4	L2
8	Describe the principle of Pulse Width Modulation (PWM) and explain its benefits in inverter circuits	3	CO 4	L2
Part B <i>(Answer any one full question from each Module. Each carries 9 marks)</i>				
Qn No .	Question	Marks	CO	BL

Module I				
9.	Describe why SCRs are connected in series and parallel, and explain the techniques used for voltage and current sharing with neat diagrams.	9	CO 1	L2
OR				
10.	Describe the construction, characteristics, operating principles, and applications of Power Diode, SCR, and Power BJT, and explain their suitability for various power electronic circuits	9	CO 1	L2
Module II				
11.	A factory uses a single-phase half-controlled rectifier to supply power to an electromagnet represented by an RL load. Apply your knowledge of rectifier operation to explain the current conduction process, draw the circuit and waveforms, and determine how the inductive load affects the output voltage and current characteristics.	9	CO 2	L3
OR				
12.	Apply the operating principles of a three-phase half-wave-controlled rectifier to derive the expression for average output voltage under continuous load current conditions and illustrate the associated waveforms	9	CO 2	L3
Module III				
13.	Apply the concept of phase control to explain the operation of a single-phase AC voltage converter and sketch the relevant voltage waveforms.	9	CO 3	L3
OR				
14.	A regulated DC power supply requires a Buck–Boost Converter operating in Continuous Conduction Mode. Apply the concepts of converter operation to determine the voltage conversion ratio and ripple quantities. Support your analysis with derivations and appropriate waveforms.	9	CO 3	L3
Module IV				
15	Describe the working principle of a single-phase bridge inverter and explain its operation in square-wave and PWM modes with suitable diagrams and waveforms.	9	CO 4	L2
OR				
16	Describe the construction and working of a three-phase bridge inverter. Explain the generation of three-phase output voltages and illustrate the corresponding waveforms.	9	CO 4	L2

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