GANPAT UNIVERSITY

FACULTY OF DIPLOMA ENGINEERING

Programme	Diploma in Electronics and Communication Engineering		
Semester	IV	Version	1.0.0.0
Effective from Academic Year	2026-27	Effective for the batch Admitted in	JULY 2025
Course code	1EC41PE01	Course Name	Power Electronics and Applications

I.TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Type	Course Code	Learning Scheme						Assessment Scheme										
		Actual Contact Hrs./Week			SLH	NLH	Credits	Theory				Practical				Based on SL		Total Marks
		CL	TL	LL				FA-TH	SA-TH	TOTAL		FA-PR	SA-PR	TOTAL		SLA		
								MAX	MAX	MAX	MIN	MAX	MAX	MAX	MIN	MAX	MIN	
VEC	1EC41PE01	3	-	2	3	6	3	40	60	100	40	30	20	50	20	20	8	170

Abbreviation:			
	CL- Classroom Learning	**TL -** Tutorial Learning	**LL -** Laboratory Learning
	SLH - Self Learning Hours	**NLH -** Notional Learning Hours	**SLA -** Self Learning Assessment
	FA - Formative Assessment (Term work +Mid Sem Exam +Attendance)		**SA -** Summative Assessment

II. PRE-REQUISITES

Basic knowledge of Semiconductor physics, Analog electronics, Electronic devices and circuits

III. INDUSTRY / EMPLOYER EXPECTED OUTCOMES

Students will be able to apply fundamental and practical knowledge of power electronics to meet industry requirements. They will be capable of assisting in installation, testing, operation, maintenance, and troubleshooting of power electronic systems used in industrial drives, power supplies, renewable energy interfaces, heating systems, and domestic appliances, in alignment with current industry practices and employability skills.

IV. COURSE LEARNING OUTCOMES

At the end of the course, students will be able to achieve the following course learning outcomes:

CO1: Identify and explain the construction, characteristics, and applications of commonly used power semiconductor devices

CO2: Describe the operation of SCRs and analyze various triggering and commutation techniques used in power electronic circuits

CO3: Analyze and apply principles of phase-controlled rectifiers and converters for different load conditions

CO4: Diagnose, maintain, and troubleshoot power electronic circuits used in domestic and industrial applications by following standard safety practices.

CO5: Explain the working principles of UPS systems, SMPS, industrial battery chargers, and RF/dielectric/induction heating, and apply this knowledge to identify suitable domestic and industrial applications.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Name of Unit	Theory Learning outcomes (TLO's) aligned to CO's	Learning Content mapped with Theory Learning outcomes (TLO's) & CO's	Marks	Hours
Unit-1 Power Semiconductor Devices	**TLO 1.1** Explain the construction and working principle of power semiconductor devices. **TLO 1.2** Differentiate between power diodes, BJT, MOSFET, IGBT, and thyristor family devices based on characteristics and applications. **TLO 1.3** Select appropriate power semiconductor devices for given power electronic applications.	**1.1** - Power semiconductor device overview **1.2** - Device structure and symbols - Power Diodes - Power BJT - Power MOSFET - IGBT - UJT, PUT, TRIAC, DIAC, GTO, SIT **1.3** Characteristics comparison - Application-based selection criteria	**12**	**08**

Unit-2 Triggering and Commutation Methods of SCR	**TLO 2.1** Explain structure, operation, and characteristics of SCR **TLO 2.2** Describe SCR turn-on mechanisms **TLO 2 . 3** Analyze SCR triggering circuits **TLO 2.4** Explain commutation techniques. **TLO 2.5** Interpret SCR ratings and protection circuits	**2.1** - SCR construction - V–I characteristics - Two transistor model **2.2** - Gate triggering - dv/dt triggering - Thermal triggering **2.3** - Resistance triggering - RC triggering - UJT/PUT triggering - Pulse transformer triggering **2.4** – Natural commutation- Forced commutation (Class A-F) **2.5** SCR Rating and protection circuits	**15**	**13**
Unit-3 Phase Controlled Converters	**TLO 3.1** Explain principle of phase-controlled converters **TLO 3.2** Analyze controlled rectifiers with different loads **TLO 3.3** Explain significance of freewheeling diode **TLO 3.4** Describe half-controlled and dual converters	**3.1** Phase control concept - Control techniques **3.2** - Single-phase half-wave controlled rectifier - Single-phase full-wave controlled rectifier with R & RL load **3.3** - Freewheeling diode operation and wave-form **3.4** - Half-controlled bridge rectifier - Dual converters	**10**	**06**
Unit-4 Choppers, Inverters and Cyclo-converters	**TLO 4.1** Classify and explain choppers **TLO 4.2** Analyze chopper performance with loads **TLO 4.3** Explain inverter operation **TLO 4.4** Describe cycloconverter operation	**4.1** Step-down chopper - Step-up chopper using IGBT **4.2** Chopper with R load - Chopper with RL load **4.3** - Series inverter - Parallel inverter **4.4** Single-phase midpoint cycloconverter	**15**	**12**
Unit-5 Industrial Applications of Power Electronic Devices	**TLO 5.1** Explain UPS and SMPS operation **TLO 5.2** Describe battery charging systems **TLO 5.3** Explain heating applications **TLO 5.4** Identify applications of power electronics	**5.1** UPS working principle - SMPS block diagram **5.2** Industrial battery chargers **5.3** RF heating - Dielectric heating - Induction heating **5.4** Domestic & industrial applications	**08**	**06**

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL			
Sr. No.	**Practical/Laboratory Learning Outcome (LLO)**	**Practical Titles**	**Relevant COs**
1	**LLO 1.1:** Identify and test power semiconductor devices	Identification and V–I characteristics of Power Diode, SCR, TRIAC, MOSFET, and IGBT	CO1
2	**LLO 2.1**: Analyze SCR triggering techniques	Study of SCR triggering circuits using R and RC triggering	CO2
3	**LLO 3.1:** Implement UJT-based triggering circuits	Implementation of UJT relaxation oscillator for SCR triggering	CO2
4	**LLO 4.1:** Observe SCR commutation methods	Study of natural and forced commutation techniques of SCR	CO2
5	**LLO 5.1:** Analyze phase-controlled rectifier circuits	Single-phase half-wave controlled rectifier with R load	CO3
6	**LLO 6.1:** Evaluate effect of inductive load	Single-phase full-wave controlled rectifier with RL load and freewheeling diode	CO3
7	**LLO 7.1**: Analyze chopper operation	Study of step-down chopper using IGBT with R load	CO3
8	**LLO 8.1:** Evaluate chopper performance with inductive load	Study of step-up chopper using IGBT with RL load	CO3
9	**LLO 9.1: A**nalyze inverter operation	Study of single-phase half-bridge inverter	CO4
10	**LLO 10.1:** Analyze full-bridge inverter	Study of single-phase full-bridge inverter	CO4
11	**LLO 11.1:** Study industrial application systems	Study of UPS / SMPS trainer module	CO5
12	**LLO 12.1 :** Relate power electronics to heating applications	Study of induction heating or battery charger module	CO5

VII. SUGGESTED MICRO PROJECT / ASSIGNMENTS / ACTIVITIES FOR SELF LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

A. Self-Learning Assignments / Activities

- **Comparative Study of Power Semiconductor Devices**
  Prepare a chart comparing Power Diode, SCR, TRIAC, MOSFET, and IGBT based on ratings, characteristics, advantages, and applications.

- **SCR Triggering Circuit Analysis**
  Draw and explain R, RC, and UJT triggering circuits of SCR. Analyze their firing angle control mechanism using neat diagrams.

- **Waveform Analysis of Controlled Rectifiers**
  Study and sketch input/output waveforms of single-phase half-wave and full-wave controlled rectifiers for R and RL loads.

- **Application Study of Choppers and Inverters**
  Prepare a brief report on the use of choppers and inverters in electric vehicles, renewable energy systems, and motor drives.

- **Case Study on Industrial Power Electronics System**
  Study any one system such as UPS, SMPS, battery charger, or induction heating system and explain its block diagram and working.

- **Video / PPT-Based Learning Activity**
  Create a short PPT or video explaining the working of IGBT-based chopper or inverter circuits.

B. MINI PROJECTS (SKILL DEVELOPMENT FOCUSED)

- **Design and Demonstration of SCR Triggering Circuit**
  Design and demonstrate an SCR triggering circuit using RC or UJT method and observe firing angle control.

- **Single-Phase Controlled Rectifier Model**
  Design a working model or simulation of a single-phase controlled rectifier with R or RL load and analyze output voltage control.

- **DC Motor Speed Control Using Chopper**
  Implement a step-down chopper using IGBT/MOSFET to control DC motor speed and study performance.

- **Inverter-Based Emergency Lighting System**
  Design a basic inverter circuit for emergency lighting applications using a battery source.

- **Battery Charger Circuit**
  Design and simulate a simple battery charger circuit using controlled rectifier or SMPS concept.

UPS / SMPS Functional Study Model
Develop a block-level demonstration model or simulation explaining the working of UPS or SMPS

VIII. LIST OF INSTRUMENTS / EQUIPMENT / TRAINER BOARD

1	Power Electronics Trainer Kit
2	SCR / IGBT / MOSFET Modules

3	CRO/DSO and Multimeter
4	DC Power Supply
5	Resistive and Inductive Loads

IX. LIST OF REFERENCE BOOKS

Sr.No.	Title	Author	Publication
1	Power Electronics	M.D. Singh and K.B. Khanchandani	TMH Publications
2	Power Electronics: Circuits, Devices and Applications	M.H. Rashid	Prentice-Hall Publication
3	Power Electronic Systems: Theory and Design	J.P. Agrawal	Pearson Education.

X. LINK OF LEARNING WEB RESOURCE

1	https://onlinecourses.nptel.ac.in/noc19_ee37/preview
2	https://onlinecourses.nptel.ac.in/noc19_ee37/preview

XI. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	Power Semiconductor Devices	CO1	8	5	4	3	**12**
2	Triggering and Commutation Methods of SCR	CO2	13	4	7	4	**15**
3	Phase Controlled Converters	CO3	6	3	4	3	**10**
4	Choppers, Inverters and Cycloconverters	CO3	12	5	5	5	**15**
5	Industrial Applications Of Power Electronic Devices	CO4	6	3	2	3	**08**
		Grant Total	**45**	**20**	**22**	**18**	**60**

XII. COs AND POs AND PSOs MAPPING

Course outcome (Cos)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	1	0	3	2	2
CO2	3	3	2	2	1	1	0	3	2	3
CO3	3	3	3	2	2	1	1	3	3	2
CO4	2	3	2	2	2	2	1	2	2	3
CO5	2	2	2	1	2	2	1	2	2	2

Legends: - *3- High* *2-Moderate/Medium* *1-Slight/Low* *0-None*