GANPAT UNIVERSITY

FACULTY OF DIPLOMA ENGINEERING

Programme	Diploma in Electrical Engineering				
Semester	IV		Version	1.0.0.0	
Effective from Academic Year	2026-27		Effective for the batch Admitted in		JULY 2025
Course code	1EE4102	Course Name	Power Electronics & Electrical Drives		

I. TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Type	Course code	Course Title	Teaching & Learning Scheme									Examination Scheme							
			Credit				Actual Contact Hrs/week			SLH	Total Learning Hrs/Week	TH			PR			SLA	Total
			CL	TL	LL	Total	CL	TL	LL			CE	SEE	Total	CE	SEE	Total		
DSC	1EE4102	Power Electronics and Electrical Drives	4	0	1	4	4	0	2	2	8	40	60	100	30	20	50	20	170

Abbreviation:			
	CL- Classroom Learning	**TL -** Tutorial Learning	**LL -** Laboratory Learning
	SLH - Self Learning Hours	**SLA -** Self Learning Assessment	**SA -** Summative Assessment
	CE – Continuous Evaluation		**SEE –** Semester End Examination

II. PRE-REQUISITES

Basic knowledge of Electronics.

III. INDUSTRY / EMPLOYER EXPECTED OUTCOMES

The purpose of this course is to help the student to learn about the basic concepts related to electrical engineering.

IV. COURSE LEARNING OUTCOMES

At the end of the course, students will be able to achieve the following course learning outcomes:
CO1. Use power semiconductor devices in different applications.
CO2. Maintain SCR protection and commutating Circuits.
CO3. Troubleshoot chopper circuits.
CO4. Maintain inverters and cyclo-converter circuits.
CO5. Maintain power electronic circuits used in various 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 Semi Conductor Devices and Controlled Rectifier	**TLO 1.1** Classification of Thyristor family. **TLO 1.2** Explain the working of various power electronics devices **TLO 1.3** Three-phase half wave, full wave or bridge rectifier and Six-phase half wave rectifier **TLO 1.4** Effect of transformer reactance. **TLO 1.5** Working of A.C. load control and pulse transformer	**1.1** Classification of Thyristor family. **1.2** Working of SCR, IGBT, GTO, MCT, DIAC and TRIAC. **1.3** Three-phase half wave, full wave or bridge rectifier and Six-phase half wave rectifier. **1.4** Effect of transformer reactance. **1.5** Working of pulse transformer. And principle of A.C. load control.	**12**	**12**
Unit-2 SCR Protection and Commutating Circuits	**TLO 2.1** Justify the need of SCR protections. **TLO 2.2** Describe working of snubber circuit, freewheeling diode, thermistor and heat sink for SCR. **TLO 2.3** State the need to turn off SCR. **TLO 2.4** Differentiate various	**2.1** Need of SCR protections : Over voltage and over current protection. **2.2** Snubber circuit, freewheeling diode, thermistor, heat sink. **2.3** Turn off (commutation) method and types-Natural commutation, Forced commutation, Series resonance/ current commutation, Voltage commutation.	**12**	**12**

	types of commutation methods with sketches	**2.4** Auxiliary SCR for commutation and external pulse commutation.		
Unit-3 Choppers	**TLO 3.1** Explain the working principle of Chopper and its applications **TLO 3.2** Compare the salient features of different types of choppers with sketches and quadrant operation.	**3.1** Function and working of choppers **3.2** Types of chopper circuits: A type to E-type, Jone's Chopper and Morgan's chopper circuit	**8**	**6**
Unit-4 Inverters and Cycloconverter	**TLO 4.1** Explain basic working principle of inverter **TLO 4.2** Classify inverters **TLO 4.3** Working of inverter circuit using transistors and SCR. **TLO 4.4** Distinguish the working of series and parallel inverters using SCR. **TLO 4.5** Describe pulse width modulation techniques. **TLO 4.6** Explain the working principle of cyclo-converter. **TLO 4.7** Compare the salient features of various types of cyclo-converters.	**4.1** Explain basic working principle of inverter. **4.2** Classify inverters. **4.3** With sketches, explain the working of inverter circuit using transistors and SCR. **4.4** Distinguish the working of series and parallel inverters using SCR. **4.5** Describe pulse width modulation technique. **4.6** Operating principle of cyclo converter. **4.7** Types of cyclo-converters: Single-phase to single-phase cyclo converter. **4.8** Working of Single-phase to bridge cyclo converter.	**14**	**12**
Unit-5 Industrial Applications & Electrical Drive	**TLO 5.1** Speed control of D.C. Motor using armature voltage control. **TLO 5.2** Speed control of D.C. Motor using SCR chopper circuit. **TLO 5.3** Speed control of D.C. drive using PLL method. **TLO 5.4** Different types of speed control methods for induction motor such as stator voltage control, frequency control **TLO 5.5** Static circuit breaker **TLO 5.6** Concepts of Electric drives **TLO 5.7** Power Modulators and motors **TLO 5.8** 4 Quadrant operation of D.C. Drives **TLO 5.9** D.C. drive using chopper control **TLO 5.10** Single-phase D.C. drives	**5.1** With sketches, explain the speed control of a D.C. series motor using SCR chopper circuit **5.2** Working of D.C. Motor using armature voltage control, D.C. drive using PLL method. **5.3** With sketches, describe the use of power electronics for speed control methods of induction motor such as stator voltage control, frequency control **5.4** With sketches, describe the use of power electronics devices in static circuit breaker **5.5** Block diagram of electric drives **5.6** Different parts of electric drives **5.7** Power Modulators **5.8** A.C. Drives – Inverter based **5.9** D.C. Drives- Rectifier and Chopper based **5.10** Four Quadrant operation of D.C. drive	**14**	**12**

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL

Sr. No.	Practical/Laboratory Learning Outcome (LLO)	Practical Titles	Relevant COs
1	Understand operation & analyse performance of rectifier	Wire the Bridge rectifier & test the performance.	**CO1**
2	Learn half-wave rectification in three-phase systems	Wire the three-phase half wave rectifier & test the performance.	**CO1**
3	Study full-wave rectification efficiency and output	Wire the three-phase full wave rectifier & test the performance.	**CO1**
4	Analyse complex rectification and enhance power quality	Wire the six-phase half wave rectifier & test the performance.	**CO1**
5	Control output voltage via phase control	To perform single-phase full wave controlled bridge rectifier.	**CO1**
6	Learn triggering and phase control techniques	To control single-phase A.C. voltage using DIAC and TRIAC.	**CO5**
7	Observe waveform characteristics and harmonics	Simulate polyphase rectifier circuit, observe and print the various waveforms.	**CO1**
8	Understand operation and analyse behaviour of chopper circuits	Simulate chopper circuit, observe and print the various waveforms.	**CO3**
9	Learn inverter function & analyse output waveforms	To study the operation of a Parallel Inverter.	**CO4**
10	Study speed control methods and their effectiveness	To perform speed control of D.C shunt motor using SCR and UJT.	**CO5**
11	Learn commutation techniques and applications	Understand SCR commutating circuits.	**CO2**
12	Design reliable timing circuits	Build a time delay relay circuit using UJT and SCR.	**CO5**
13	Analyse control methods for universal motors	Test the speed control of a universal motor using SCR-UJT circuit.	**CO5**
14	Study solid-state control techniques in motor applications	Test the speed control of a three-phase induction motor using solid state devices.	**CO5**
15	Analyse specifications for power electronics components	Compare the ratings and packages of IGBT, GTO, MCT using a data sheet.	**CO1**

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

- Prepare a report on various types of drives used in nearby industries.
- Prepare chart displaying various Power semiconductor devices and their symbols
- Simulate following circuits in syllabus and take print out of various wave forms.

(a) Three-phase half wave rectifier
(b) Three-phase full wave rectifier
(c) Six-phase half wave rectifier
(d) Step up & Step-down chopper circuit
(e) Single-phase half & full bridge inverter

- Make a market survey for various types of thyristors available in market.
- Present a dynamic animations prepared or collected from the internet to illustrate the following:

(a) Working principle of inverter
(b) Working principle of PWM inverter
(c) Working principle of chopper

- Build three-phase half wave rectifier circuit & prepare report on it.
- Build three-phase full wave rectifier circuit & prepare report on it.
- Build step up & step-down chopper & prepare report on it.
- Single-phase A.C. load control using Diac and Triac.
- Demonstration of commutation circuit for SCR.
- Single-phase inverter using 2 MOSFET and transformer.

- Square wave inverter using 4 MOSFET, IGBT, Transistor.
- Overcurrent protection using crowbar circuit.
- Design of snubber circuit.
- Speed control of D.C. Motor using Chopper
- Speed control of D.C. motor using 4 diode and 1 SCR

VIII. LIST OF INSTRUMENTS / EQUIPMENT / TRAINER BOARD	
1	DIAC, TRAIC, SCR, IGBT, GTO and MCT - 5 Nos. each of current rating at least 20 amps or above
2	Trainer Kits for testing the V-I characteristics of the following - 2 Nos. each: a) DIAC b) TRAIC c) SCR d) Power transistor e) Power MOSFET f) IGBT g) GTO h) MCT
3	Trainer kit to check the performance for different types of loads of the following - 2 Nos. each: a) Three-phase uncontrolled half wave rectifier b) Three-phase uncontrolled full wave rectifier
4	Electric D.C. Drive Trainer consisting of the following controlling schemes - set: a) Speed control of D.C. shunt motor using single-phase fully controlled converter b) Speed control of D.C. shunt motor using three-phase fully controlled converter c) Armature and field control of D.C. shunt motor d) Speed control of D.C. shunt motor using SCR dual converter e) Thyristor chopper for D.C. motor drive f) D.C. series motor controller using jones chopper
5	Experimental set up to perform Speed control of a three-phase induction motor using V/f method - 1 set
6	Experimental set up to perform speed control of a D.C. shunt motor using open loop and PID control system through computer interfacing - 1 set

IX. LIST OF REFERENCE BOOKS

Sr. No.	Title	Author	Publication
1	Power Electronics	Rashid, Muhammad H.	PHI Learning, New Delhi latest edition
2	Power Electronics	Singh,M. D. K. Khanchandani	Tata Mc. Graw Hill, New Delhi
3	Power Electronics	Bimbhra, P.S.	Khanna Publisher, New Delhi latest edition
4	Industries and power Electronics	Rai, H.C.	Umesh Publications. New Delhi latest edition
5	Industries and power Electronics	Dubey, G. K.	Narosa Publishing house New Delhi latest edition

X. LINK OF LEARNING WEB RESOURCE	
1	www.nptel.iitm.ac.in
2	www.alldatasheet.com
3	Power Simulator (PSIM)
4	https://www.electrical4u.com/electrical-engineering-articles/Power Electronics/
5	www.khanacademy.org

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 Semi Conductor Devices and Controlled Rectifier	CO1	12	6	4	2	12
2	SCR Protection and Commutating Circuits	CO2	12	6	4	2	12
3	Choppers	CO3	6	4	2	2	8
4	Inverters and Cycloconverter	CO4	14	8	4	2	14
5	Industrial Applications of Power Electronic Devices	CO5	12	8	4	2	14
		Grand Total	56	32	18	10	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	2	2	0	1	1	1	1
CO2	3	2	1	2	2	0	2	2	2	1
CO3	3	0	1	2	2	0	1	2	2	2
CO4	3	1	1	1	2	0	2	2	2	1
CO5	3	1	1	0	2	0	1	3	1	2
Legends: - *3- High* *2-Moderate/Medium* *1-Slight/Low* *0-None*										