



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Power Electronics Engineering

Subject Code: DI04024031

Subject Name: AC Power Electronic Converters

w. e. f. Academic Year:	2025-26
Semester:	4 th
Category of the Course:	PCC

Prerequisite:	Fundamentals of electrical circuits, Basic power electronics switches, measurement instruments (multimeter, oscilloscope).
Rationale:	AC power electronic converters such as AC voltage controllers, cycloconverters, inverters and SMPS are widely used in domestic appliances, industrial drives, automation systems, and renewable energy equipment. Knowledge of these converters enables Power electronics students to understand, operate and troubleshoot modern power control circuits. This subject build practical competence in waveform analysis, firing and PWM techniques, component selection, and real-life applications of power electronic devices, making students job-ready for power electronics industries.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Select and implement suitable AC voltage control techniques for real loads.	R, U, A
02	Apply cycloconverter topology to achieve low-speed AC drive operation based on type of load and frequency requirement.	R, U, A
03	Choose appropriate inverter configuration and PWM method to supply AC power efficiently to induction motors.	R, U, A
04	Select suitable SMPS topology and switching device for consumer and industrial DC power supply applications.	R, U, A
05	Use SCR and SSR to build practical power control circuits such as battery chargers, emergency lighting and time-delay switching.	R, U, A

*Revised Bloom's Taxonomy (RBT)

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR		C	Theory		Tutorial / Practical	
			ESE(E)		PA(M)	PA(I)	ESE(V)	
3	0	2	4	70	30	20	30	150



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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	AC Voltage Controller Classification, Applications, advantages and disadvantages. 1-Phase AC Voltage Controller: Integral cycle control, phase control, Half wave, full wave, various topologies with R & RL load. Sequence control: two stage, multi stage, sinusoidal voltage regulator.	9	20
2.	Cycloconverter Classification, Applications, Advantages and Disadvantages. 1-Phase to 1-phase cycloconverter: Mid-point type, Bridge type, step up & step-down operation with R & RL load.	6	13
3.	Inverter Classification, Applications, Advantages and Disadvantages. 1-Phase Inverter: Half bridge, Full bridge VSI with R & RL load, Cross conduction. Methods of voltage control of single-phase inverters: External, Internal-PWM control, SPWM control. 3-phase inverter: 180° & 120° Mode inverter with R load.	13	29
4.	Switched mode power supply Block diagram of SMPS, Isolated & non-isolated topologies — Flyback, Forward, Push-pull, Full-Bridge; MOSFET/IGBT role; Applications in consumer and industrial electronics.	8	18
5.	Special Power Electronic Device Applications Solid State Relay: AC, DC, UPS, Battery charger using SCR, Time Delay circuit using SCR. Emergency lighting system.	9	20
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
20	60	20			

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)



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References/Suggested Learning Resources:

(a) Books:

Sr. No.	Book Name	Author Name	Publication
1.	Power electronics	Bimbhra P. S.	Khanna Publishers, New Delhi
2.	Power Electronics	Singh M.D., Khanchandani K.B.	Tata McGraw-Hill Education New Delhi
3.	Power Electronics Circuits, Devices and Applications	Muhammad, H. Rashid	Pearson, New Delhi
4.	Power Electronics: Converters, Applications, and Design	Ned Mohan, M. Undeland, William P. Robbins	Wiley India, New Delhi
5.	Power Electronics: Essentials & Applications	Dr L. Umanand	Wiley India, New Delhi

(b) Open-source software and website:

- <https://www.nptel.ac.in>
- [www. Youtube.com](http://www.Youtube.com)
- <https://www.allaboutcircuits.com>
- <https://www.electronics-tutorials.ws>
- <https://www.st.com/>
- <https://www.infineon.com>

Suggested Course Practical List:

Sr. No.	Course Practical
1.	Study of DIAC–TRIAC characteristics using lamp/fan load.
2.	Phase angle control of single-phase AC voltage controller with R load (lamp dimmer).
3.	Phase angle control of single-phase AC voltage controller with RL load (fan/induction motor).
4.	Integral cycle control demonstration using TRIAC (burst firing).
5.	Sinusoidal voltage regulator (sequence control) using two-stage AC voltage controller.



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6.	Study Step-down single-phase Cycloconverter (AC to AC frequency converter) using mid-point configuration with R load.
7.	Study Step-down single-phase Cycloconverter using bridge configuration with R load.
8.	Study of single-phase Half-Bridge VSI with R load
9.	Study of single-phase Full-Bridge VSI with RL load
10.	Study of three-phase inverter (180° and 120° conduction mode)
11.	Study of various topologies used in SMPS.
12.	Study Operation of Solid-State Relay (SSR) for AC or DC switching and load control.
13.	Study Time-delay circuit using SCR and RC triggering (observe delayed firing effect).
14.	Study Emergency lighting system demonstration using SCR/relay and rechargeable battery.
15.	Study Battery charger using SCR (control of charging current using firing angle).

List of Laboratory/Learning Resources Required:

- Single-phase AC voltage controller kit (R load & RL load support)
- Phase angle & integral cycle control trainer
- Two-stage / sinusoidal voltage regulator
- Single-phase cycloconverter trainer kit (step-down)
- Single-phase Half-Bridge inverter trainer
- Single-phase Full-Bridge inverter trainer
- PWM / SPWM inverter demonstration board
- Three-phase inverter trainer (180° and 120° mode)
- SMPS trainer kit (isolated/non-isolated)
- Solid state relay (SSR) demonstration module
- Time delay circuit using SCR + RC triggering
- Emergency light system trainer
- Battery charger using SCR trainer

Suggested Project List:

- Automatic Lamp Dimmer based on Room Brightness (LDR + TRIAC)
- Cycloconverter-Based Low-Speed Drive for a Small Universal Motor
- Prototype of Single-Phase Induction Motor Drive using Inverter.



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- Solid State Relay (SSR)-Based Load Switching for AC Appliance
- Battery Charging Circuit using SCR with Current Control
- Emergency Lighting System with Auto Changeover using SCR/Relay
- Time Delay Power-ON Circuit using SCR and RC Trigger
- Automatic Water Pump Controller using SSR

Suggested Activities for Students:

- Demonstrate power saving using lamp dimmer.
- Prepare a comparison chart of step-up vs step-down cycloconverter.
- Identify IGBT and MOSFET positions in an inverter PCB with heat-sink arrangement.
- Prepare a poster on emergency lighting system with block diagram and real-world use.

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