GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Power Electronics Engineering

Subject Code: DI04024041

Subject Name: Power Electronics Workshop

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

Prerequisite:	Basic knowledge of electrical circuits and measurements, understanding of semiconductor basics (PN junction, diode, transistor), Ability to observe waveforms using CRO / DSO, Familiarity with breadboard/soldering and safety precautions.
Rationale:	Power electronics is widely used in power supplies, motor drives, renewable energy systems, electric vehicles, industrial automation, and home appliances. This workshop trains students to identify power devices, build switching circuits, implement triggering and control, and finally apply them in Arduino-based practical motor drive applications.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Identify and test various power semiconductor devices.	R, U, A
02	Construct and analyze thyristor triggering and control circuits.	R, U, A
03	Implement transistor & MOSFET/IGBT switching circuits.	R, U, A
04	Design and test basic power converter circuits.	R, U, A
05	Develop Arduino-based motor control & real-world mini projects.	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
				Theory		Tutorial / Practical		
L	T	PR	C	ESE(E)	PA(M)	PA(I)	ESE(V)	
0	0	6	3	0	0	20	30	50

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Power Semiconductor Devices identification and testing** SCR, TRIAC, MOSFET, IGBT, BJT, DIAC, UJT, PUT identification with IC number its rating and testing.	12	14
2.	**Gate Triggering and Switching Control Circuits of Thyristor.** R, RC & Pulse Triggering of SCR. SCR triggering circuit using UJT, PUT &555 timer. Triggering of TRIAC / SCR using TCA 785 IC Use of Opto-couplers in control circuits.	18	20
3.	**Gate Triggering and Switching Control Circuits of Transistors** BJT used as a switch controlling a lamp or DC load. BJT Relay Driver Circuit (To control a relay using a transistor switch) MOSFET as a Switch (Switch an LED or DC motor using N-channel MOSFET.) MOSFET with Gate Driver IC (IR2110 / IRFZ Series) & 555 Timer. Switch resistive load using a standard IGBT (e.g., IRG4BC20).	18	20
4.	**Design a power electronic converter circuit.** Design of complete 1-phase Rectifier circuit using SCR, basic chopper circuits using MOSFET, Single-phase inverter circuit using MOSFET/IGBT, AC voltage control circuit suing TRIAC and DIAC. Speed control of DC motor using 555 timer PWM	20	22
5.	**Arduino-based Control, Motor Drives & Mini Project** Arduino Architecture & Pin Functions (Digital, Analog, PWM) PWM Generation & Duty Cycle Control for Power Switches. Interfacing Arduino with: BJT / MOSFET / IGBT Gate Drivers, Optocouplers, Gate Driver ICs (e.g., IR2110, L298N, L293D, DRV8833). DC/AC Motor speed control using Arduino, Project Documentation & Demonstration.	22	24
	Total	**90**	**100**

References/Suggested Learning Resources:

(a) Books:

1. Power Electronics – P. S. Bimbhra
2. Power Electronics – M. D. Singh & K. B. Khanchandani
3. Arduino Cookbook – Michael Margolis
4. Power Electronics Essentials & Applications by L. Umanand
5. The Art of Electronics by Paul Horowitz & Winfield Hill

6. Make electronics by Charles platt

(b) Open-source software and website:

- Arduino IDE for Microcontroller programming https://www.arduino.cc
- LTspice for Circuit simulation https://www.analog.com/ltspice
- KiCad for PCB design (open source) https://www.kicad.org

Suggested Course Practical List:

Sr. No	Suggested Course Practical
1.	Identification and testing of SCR, TRIAC, DIAC.
2.	Testing and characteristics of MOSFET.
3.	Identification and testing of IGBT / GTO.
4.	UJT relaxation oscillator as triggering source.
5.	Design control circuit of Power electronic switches using PUT.
6.	R and RC firing circuits for SCR.
7.	TRIAC triggering using DIAC (AC lamp/fan dimmer).
8.	SCR / TRIAC triggering using **TCA785** IC.
9.	BJT used as a switch to control relay / LED.
10.	MOSFET switching of DC motor.
11.	IGBT gate drive using opto-isolated driver (HCPL3120 / MCT2E).
12.	Single-phase SCR controlled rectifier circuit.
13.	Buck (step-down) converter.
14.	Boost (step-up) converter.
15.	Single-phase inverter using MOSFET / IGBT.
16.	Arduino PWM motor speed control.
17.	Arduino + Gate Driver control for power device switching.
18.	DC Motor Speed Control using 555 Timer + MOSFET
19.	Duty Cycle Variation using Potentiometer with 555 Timer

20.	Design SCR Triggering Circuit Using 555 Timer
21.	Design PWM Generator using 555 Timer (Astable mode)
22.	Design Control circuit to drive IGBT for R load.

List of Laboratory/Learning Resources Required:

Sr. No	List of Laboratory/Learning Resources
1.	Power Electronics Trainer Kits
2.	SCR, TRIAC, MOSFET, IGBT, GTO, UJT, DIAC, PUT Modules
3.	Buck / Boost Converter Kits
4.	Inverter & Rectifier Kits
5.	BLDC & DC Motor with Motor Driver Modules
6.	Arduino Uno + USB Cable
7.	Gate Driver IC**s:** IR2110, L298N, L293D, DRV8833, HCPL3120
8.	SMPS Bench Supply (0–30V / 5A)
9.	CRO/DSO, Multimeters, Function Generators
10.	Breadboards, Soldering Station, Patch wires & supporting passive components

Suggested Project List:

Project Title	Core Devices
Rectifier/chopper circuit using Arduino	Arduino+ PE switches.
Arduino-based DC fan speed controller	Arduino + MOSFET
Smart LED dimmer using TRIAC and DIAC	TRIAC + DIAC
Battery charger with auto cut-off	SCR + Comparator
BLDC motor speed control with feedback	Arduino + BLDC Driver + Hall Sensor
Stepper motor solar tracking system	Arduino + Stepper Drive

Overcurrent protection system using ACS712	Arduino + ACS712 + Relay
PWM based water pump speed control	MOSFET + Arduino

Suggested Activities for Students:

- Component datasheet reading and comparison charts.
- Circuit assembly on breadboard followed by soldered PCB version.
- Reverse engineering of old circuits like SMPS/converter or Inverter (disassembly safety demo).
- Writing Arduino code to vary PWM duty cycle & observe effect on speed/brightness.
- Mini project poster presentation & demonstration.

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