GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3170315
Semester – VII
Subject Name: Power Electronics

Type of course: Professional Elective Course

Prerequisite: Analog Electronics, Basic Mathematics, Physics

Rationale: The objective of this course is to impart necessary theoretical and practical knowledge of basic principles and phenomena in the area of Power Electronics. This subject will enable students to understand the construction, design, operation and applications of Power electronic devices.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Introduction to Power Semiconductor Devices and Power Electronic Convertor**, **Thyristor:** Introduction, Principle of Operation of SCR, Static Anode-Cathode Characteristics of SCR, The Two-transistor Model of SCR , Thyristor Construction, Gate Characteristics of SCR, Turn-on Methods of a Thyristor, Turn-off Methods, Thyristor Ratings, Measurement of Thyristor Parameters, Comparison between Transistors and Thyristors. Firing of Thyristors, Pulse Transformers, Gate Trigger Circuits.	11
2	**Insulated Gate Bipolar Transistors (IGBT):** Basic Structure, VI Characteristics, Symmetric and Asymmetric IGBTs, Operating Principle, Switching Characteristics, Safe Operating Area (SOA). **Power MOSFETs:** Basic Structure, Types, Output Characteristics, Switching Characteristics, Safe Operating Area (SOA), Comparison between Power MOSFET and Power BJT. **Unijunction Transistor, The Programmable Unijunction Transistor (PUT), DIAC, TRIAC.**	10
3	**Rectifier:** Introduction, Control Techniques, Single Phase Half-Wave Controlled Rectifier, Single-Phase Full-Wave Controlled Rectifier (Two-quadrant Converters), Single-Phase Half Controlled Bridge-Rectifier. **DC Chopper:** Introduction, Chopper Classification, Basic Chopper Operation, Control Strategies, Chopper Configuration, Thyristor Chopper Circuits. **Inverters:** Introduction. Classification of Inverters, Single-Phase Half-Bridge Voltage-Source Inverters, Single-Phase Full-Bridge Inverters, Voltage Control of Single-Phase Inverters, Pulse-Width Modulated (PWM) Inverters.	12

4	**DC Motor and its Control:** Configuration of direct current motors, Modeling of direct current motors, Steady-state characteristics of direct current motors, Schemes for D.C. Motor Speed Control, Single-Phase Series D.C. Motor Drives, D.C. Chopper Drives.	6
5	**BLDC MOTOR and its Control:** Configuration of Brushless direct current motors, Driving Principle of BLDC, Modeling of BLDC, Control of BLDC, PWM techniques for BLDC.	6
	Total	45

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	25	20	20	15	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Power Electronics – M D Singh & K B Khanchandani, Tata Mackgrow Hill
2. Electric Motor Control DC, AC, and BLDC Motors – Sang-Hoon Kim, Elsevier
3. Power Electronics Devices, Circuits and Industrial Applications – V. R. MOORTHI, Oxford University Press
4. Power Electronics: Circuits, Devices and Applications – Rashid, Pearson
5. A Textbook of Electrical Technology, Vol. II – Thareja and Thareja, S. Chand

Course Outcomes:

At the end of this course students will be able to

Sr. No.	CO statement	% weightage
CO-1	Understand the basics of Power Semiconductor Devices, Power Electronic Convertor and construction, working, characteristics, turn-on & turn-off methods, and gate firing circuits of SCR.	25
CO-2	Explain construction, working and characteristics of various power devices like IJBT, Power MOSFET, UJT, PUT, DIAC, TRIAC.	25
CO-3	Describe the circuit diagram, circuit operation and control techniques for Rectifiers, DC Choppers and Inverters.	30

CO-4	Illustrate construction and working of DC motors with its motor speed control.	10
CO-5	Explain construction and working of BLDC motors with its motor speed control.	10

List of Experiments:

1. To study the basics of Power Semiconductor Devices and Power Electronic Convertor.
2. To study the Characteristics of SCR.
3. To study the Triggering circuit of SCR.
4. To study the Characteristics of IGBT.
5. To study the Characteristics of MOSFET.
6. To study the Characteristics of TRIAC.
7. To study the SCR Half & Full bridge converter.
8. To study the SCR based DC Chopper.
9. To study the SCR series Inverter.
10. To study the working of a DC motor with its motor speed control.
11. To study the working of a BLDC motor with its motor speed control.

Major Equipment: Power electronics trainer Kit.

List of Open Source Software/learning website: NI Multisim, Electronic Workbench.