

Course Name : Electronics Engineering Group
Course Code : ET/EN/EX/EJ/DE/ED/EI/IE/IS/IC
Semester : Fourth
Subject Title : Power Electronics
Subject Code : 174

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	25#	--	25@	150

NOTE:

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work. (SW)

Rationale:

Day by day the change in Electronics Industry is dynamic. The role of Diploma engineers changed over the years. Engineers should have concepts of industrial electronics. Electronic control circuits have major role in Industries for which study of power devices is essential.

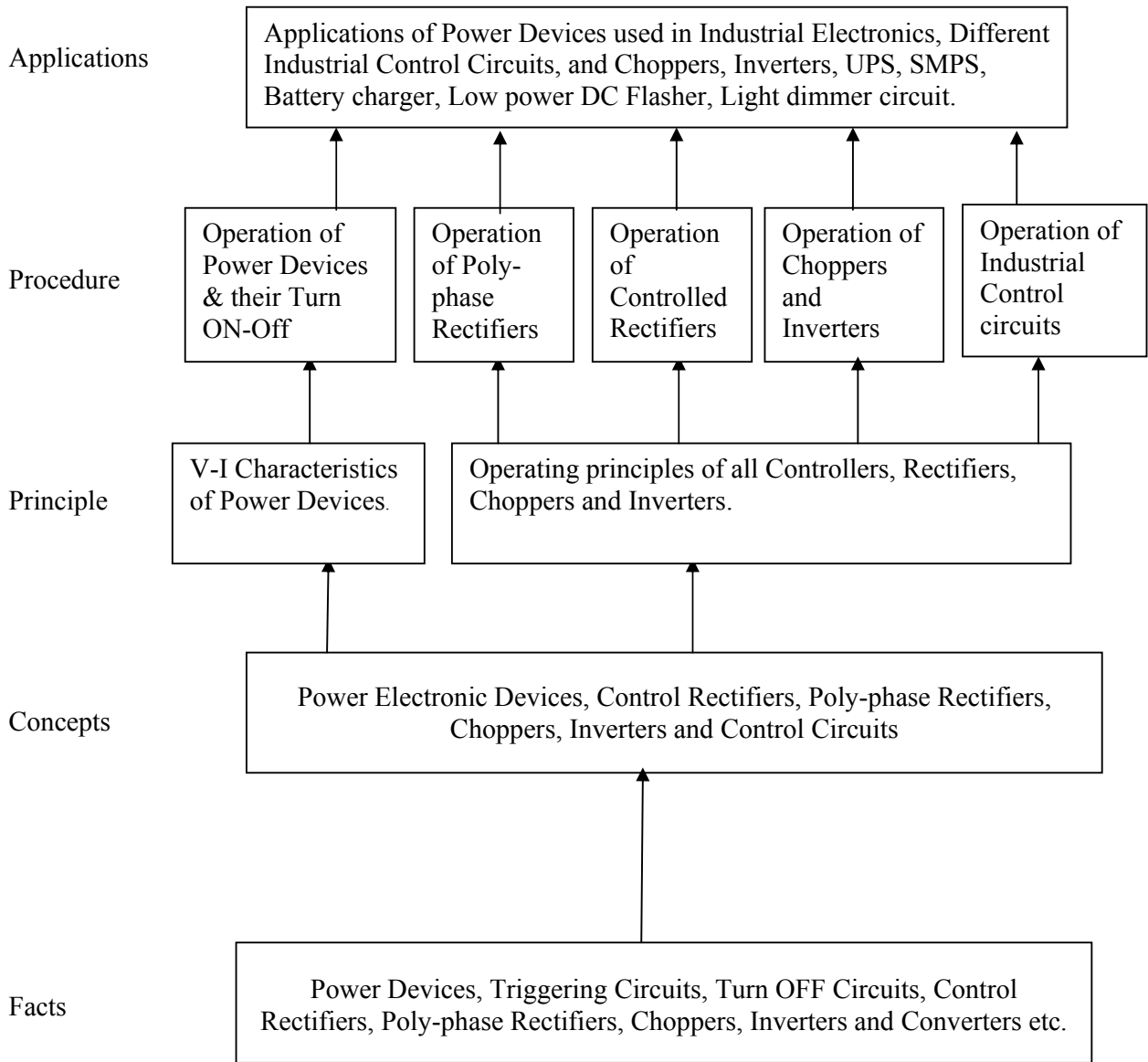
Concepts of electronic devices and circuits along with their applications are necessary. Industrial electronic is the foundation subject to study industrial drives, and advanced industrial electronics.

Objectives:

Students will be able to:

1. Understand construction and operating principle of various power electronic devices.
2. Study construction and operation of controlled rectifiers, choppers, inverter and industrial control circuits.

Learning Structure:



Theory:

Topic No	Contents	Hours	Marks
1	<p>Power Electronics</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Realize construction, working principle of different Power Devices. ➤ To select proper power device for particular applications. <p>Contents:</p> <ul style="list-style-type: none"> • Introduction to power electronics. • Power transistor: Construction, Operating Principle, V-I characteristics and Uses of power transistors. • Power MOSFET- Construction, Operating Principle, V-I characteristics and Uses of Depletion and Enhancement type power MOSFET. • IGBT- Construction, Operating Principle, V-I characteristics and Uses of IGBT. 	04	10
2	<p>Thyristor Family Devices</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Classify different power devices. ➤ Identify thyristors and triggering devices. ➤ Describe the operation of thyristor. ➤ Interpret V-I characteristics of different power devices. <p>Contents:</p> <ul style="list-style-type: none"> • SCR: Construction, Operating Principle with Two transistor analogy, V-I characteristics, Latching Current (I_L) and Holding Current (I_H). Applications of SCR, LASCR, SCS, GTO and TRIAC. • Thyristor family devices LASCR, SCS, GTO and TRIAC: Construction, Operating Principle, V-I characteristics and applications. • Triggering Devices- Construction, Operating Principle, V-I characteristics and applications of UJT, PUT, SUS, SBS and DIAC. 	10	20
3	<p>Turn ON and Turn OFF methods of SCR</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Classify Turn ON and Turn OFF circuits. ➤ Compare low power and high power triggering circuits <p>Contents:</p> <ul style="list-style-type: none"> • Concept of Turn ON mechanism of SCR: High Voltage triggering, thermal triggering, Illumination triggering, dv/dt triggering Gate triggering of SCR. • Gate trigger circuits –Resistance triggering circuit, Resistance Capacitance triggering circuit (Operation, applications and limitations) • SCR triggering using UJT, PUT-Relaxation Oscillator circuit and Synchronized UJT triggering circuit: (Operation and applications). • Pulse transformer used in triggering circuit (Operation and applications). • Concept of Turn OFF mechanism and methods of - Class A- 	08	16

	Series resonant commutation circuit, Class B-Shunt resonant commutation circuit, Class C-Complimentary Symmetry commutation circuit		
4	<p>Phase controlled Rectifiers Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Draw and explain concept of phase control. ➤ Draw and interpret the phase control waveforms. ➤ Derive the expression of average voltage of control rectifier. ➤ Solve the numerical examples on control rectifier. <p>Contents:</p> <ul style="list-style-type: none"> • Concept of phase control. (Firing Angle α and conduction angle \emptyset) • Circuit diagram, working, equations for and Waveforms of V_{DC} of following rectifiers. • Single phase half wave controlled rectifier with R, RL load. Effect of freewheeling diode. • Single phase centre tapped full wave controlled rectifier with R, RL load. Effect of freewheeling diode. • Single phase Bridge type full wave controlled rectifier with R, RL load. Effect of freewheeling diode. • Basic three phase half wave uncontrolled and controlled rectifier. • Need and Uses of Polyphase rectifier. 	16	24
5	<p>Converters Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand the concept of Chopper. ➤ Realize the concept of Inverter. ➤ Explain operation of Chopper and Inverter. ➤ List different applications of Chopper and Inverter. <p>Contents:</p> <ul style="list-style-type: none"> • Concept of Choppers • Chopper: basic circuit and its operation using MOSFET • Step Up and Step down Chopper using MOSFET basic circuits. • Inverters-Need of an inverter, Classification of inverters Important applications of inverter. • Working principle of single phase half bridge inverter. • Definitions of performance parameters of inverter. 	04	14
6	<p>Industrial Control Circuits. Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand the concept of Industrial Control Circuits. ➤ Draw the Circuit diagram and explain working of Industrial control circuits. ➤ Draw the Block diagram and explain working of SMPS and UPS. <p>Contents: Circuit diagram, working and applications of :</p> <ul style="list-style-type: none"> • Low power DC flasher. • Light dimmer circuit using DIAC-TRIAC. • Electronic timer using SCR. 	06	16

	<ul style="list-style-type: none"> • Battery charger using SCR. • Emergency Lighting System. • Temperature Controller using SCR. • Speed Control of fan using TRIAC. • Block diagram and Concept of UPS. • Block diagram and Concept of SMPS. 		
	Total	48	100

Practical:

Skills to be developed:

Intellectual Skills:

- 1) Selection of proper devices and instruments.
- 2) Interpretation of characteristics under various conditions.

Motor Skills:

- 1) Make accurate measurements.
- 2) Adjust proper firing angle.
- 3) Observe and draw the output waveforms
- 4) Conduct test on control circuits.

List of Practicals:

- 1) Plot output characteristics of power transistor.
- 2) Plot V-I characteristics of IGBT.
- 3) Determine the break over voltage using of DIAC.
- 4) Determine latching current and holding current using I-V characteristics of SCR.
- 5) Effect of variation of R, C in R and RC triggering circuits on firing angle of SCR.
- 6) Effect of variation of R in UJT Triggering technique.
- 7) Draw the output waveforms of three phase half wave Rectifier using diodes.
- 8) Draw the output waveform of half wave controlled rectifier with resistive load and determine load voltage.
- 9) Draw the output waveform of full wave controlled rectifier with resistive load, resistive-Inductive load, freewheeling Diode and determine load voltage.
- 10) Determine the effect of firing angle using DIAC and TRIAC on output power (using different loads such as bulb, motor or heater).

Learning Resources:**1. Books:**

Sr. No	Author	Title	Publisher
01	Alok Jain	Power Electronics and Its Applications	Penram International Publishing (India) Pvt. Ltd.
02	S. K. Bhattacharya	Fundamentals of Power Electronics	ISTE Learning materials centre.
03	M D Singh K B Khanchandani	Power Electronics	Tata McGraw-Hill
04	Muhammad H. Rashid	Power Electronics Circuits Devices and Applications	Prentice Hall of India

2. Websites:

www.vikaspublishing.com
www.scitechpublications.com
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