

**GOVERNMENT POLYTECHNIC, PUNE**  
(An Autonomous Institute of Govt. of Maharashtra)

<b>Programme</b>	:	<b>Diploma in ET/CE/EE//ME/MT/CM/IT/DDGM</b>
<b>Programme Code</b>	:	<b>01/02/03/04/05/06/07/08/16/17/21/22/23/24/26</b>
<b>Name of Course</b>	:	<b>Power Electronics</b>
<b>Course Code</b>	:	<b>ET 387</b>

**Teaching Scheme:**

	<b>Hours /Week</b>	<b>Total Hours</b>
<b>Theory</b>	<b>04</b>	<b>64</b>
<b>Practical</b>	<b>02</b>	<b>32</b>

**Evaluation Scheme:**

	<b>Progressive Assessment</b>	<b>Semester End Examination</b>			
		<b>Theory</b>	<b>Practical</b>	<b>Oral</b>	<b>Term work</b>
<b>Duration</b>	<b>Two class tests, each of 60 minutes</b>	<b>3 Hrs.</b>	<b>3 Hrs.</b>	<b>3 Hrs. For batch of 20 students</b>	<b>--</b>
<b>Marks</b>	<b>20</b>	<b>80</b>	<b>--</b>	<b>25</b>	<b>--</b>

**Course Rationale:**

Engineers should have concepts of industrial electronics. Electronic control circuits have major role in Industries for which study of power devices is essential. Industrial electronic is the foundation subject to study industrial drives, and advanced industrial electronics. Industrial electronics makes Students conversant with major industrial applications.

**Course Objectives:**

**After studying this course, the student will be able to**

- Understand construction and operating principle of various power electronic devices. Study construction and operation of controlled rectifiers, choppers and inverter and industrial control circuits. Students will be able to identify faults in Circuits. Students will be able to state necessity of controls provided in industry.

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**Course Content:**

Chapter No.	Name of Topic/Sub topic	Hrs	Marks
<b>1.</b>	<b>Power Electronics</b>		
	<b>1.1</b> Introduction to power electronics.	<b>04</b>	<b>08</b>
	<b>1.2</b> Power MOSFET- Construction, Operating Principle, V-I characteristics and Uses of Depletion and Enhancement type Power MOSFET.		
	<b>1.3</b> IGBT- Construction, Operating Principle, V-I characteristics And Uses of IGBT.		
<b>2.</b>	<b>Thyristor Family Devices</b>		
	<b>2.1</b> SCR: Construction, Operating Principle with Two transistor analogy, V-I characteristics, Latching Current (IL) and Holding Current (IH). Applications of SCR, SCR protection circuits, Snubber circuit, gate protection circuit, SCR crowbar circuit, Series & parallel operations of SCRs.	<b>12</b>	<b>14</b>
	<b>2.2</b> Thyristor family devices LASCR, SCS, GTO and TRIAC: Construction, Operating Principle, V-I characteristics and Applications.		
	<b>2.3</b> Triggering Devices- Construction, Operating Principle, V-I characteristics and applications of UJT, PUT, SUS, SBS and DIAC.		
<b>3.</b>	<b>Turn ON and Turn OFF methods of SCR</b>		
	<b>3.1</b> Concept of Turn ON mechanism of SCR: High Voltage triggering, thermal triggering, Illumination triggering, dv/dt triggering Gate triggering of SCR.	<b>16</b>	<b>18</b>
	<b>3.2</b> Gate trigger circuits - Resistance triggering circuit, Resistance Capacitance triggering circuit (Operation, applications and limitations)		
	<b>3.3</b> SCR triggering using UJT, PUT-Relaxation Oscillator circuit And Synchronized UJT triggering circuit: (Operation and applications).		
	<b>3.4</b> Pulse transformer used in triggering circuit (Operation and Applications).		
	<b>3.5</b> Concept of Turn OFF mechanism and methods of - Class A-Series resonant commutation circuit, Class B-Shunt resonant commutation circuit, Class C-Complimentary Symmetry commutation circuit		

**GOVERNMENT POLYTECHNIC, PUNE**  
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<b>4.</b>	<b>Phase controlled Rectifiers</b>			
	<b>4.1</b>	Concept of phase control. (Firing Angle $\alpha$ and conduction angle $\theta$ )	<b>14</b>	<b>16</b>
	<b>4.2</b>	Circuit diagram, working, equations for and Waveforms of VDC of following rectifiers.		
	<b>4.3</b>	Single phase half wave controlled rectifier with R, RL load. Effect of freewheeling diode.		
	<b>4.4</b>	Single phase centre tapped full wave controlled rectifier with R, RL load. Effect of freewheeling diode.		
	<b>4.5</b>	Single phase Bridge type full wave controlled rectifier with R, RL load. Effect of freewheeling diode.		
	<b>4.6</b>	Basic three phase half wave uncontrolled and controlled Rectifier.		
	<b>4.7</b>	Need and Uses of Polyphase rectifier		
<b>5.</b>	<b>Converters</b>			
	<b>5.1</b>	Concept of Choppers	<b>10</b>	<b>12</b>
	<b>5.2</b>	Chopper: basic circuit and its operation.		
	<b>5.3</b>	Step Up and Step down Chopper, Jones chopper.		
	<b>5.4</b>	Inverters-Need of an inverter, Classification of inverters, Basic series & parallel inverter, Important applications of inverter.		
	<b>5.5</b>	Working principle of single phase half bridge inverter		
	<b>5.6</b>	Definitions of performance parameters of inverter.		
<b>6.</b>	<b>Industrial Control Circuits.</b>			
	<b>6.2</b>	Light dimmer circuit using DIAC-TRIAC	<b>08</b>	<b>12</b>
	<b>6.4</b>	Battery charger using SCR.		
	<b>6.5</b>	Emergency Lighting System		
	<b>6.7</b>	Speed Control of fan using TRIAC		
	<b>6.8</b>	Block diagram and Concept of UPS.		
	<b>6.9</b>	Block diagram and Concept of SMPS		

**List of Practical/Experiments/Assignments:**

<b>Sr. No.</b>	<b>Name of Experiment/Assignment</b>
<b>1.</b>	Study of SCR characteristics
<b>2.</b>	Characteristics of diac.
<b>3.</b>	Characteristics of triac.
<b>4.</b>	Plot transfer and output characteristics of Insulated - Gate Bipolar Transistor (IGBT).
<b>5.</b>	Observe the effects of variation of R, C in R and RC triggering circuits on firing angle of SCR.
<b>6.</b>	Observe the effect of variation of R on firing angle in synchronized UJT triggering circuit.
<b>7.</b>	Study of half controlled rectifier.
<b>8.</b>	Study of fully controlled rectifier.

**GOVERNMENT POLYTECHNIC, PUNE**  
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9.	Study of series inverter.
10	Study of parallel inverter.
11.	Study of chopper.
12.	Light Dimmer
13	Mini project based on application of power electronics

**Instructional Strategy:**

Sr. No.	Topic	Instructional Strategy
1.	Power Electronics	Class room teaching & Laboratory work
2.	Thyristor Family Devices	Class room teaching & Laboratory work
3.	Turn ON and Turn OFF methods of SCR	Class room teaching & Laboratory work
4.	Phase controlled Rectifiers	Class room teaching & Laboratory work
5.	Converters	Class room teaching & Laboratory work
6.	Industrial Control Circuits.	Class room teaching & Laboratory work

**Text Books:**

Sr. No	Author	Title	Publication
1.	Singh, Khanchandani	Power Electronics	Tata McGraw Hill Publication.
2.	Rashid	Power Electronics	Tata McGraw Hill Publication.
3.	Alok Jain	Power Electronics and Its Applications	Penram International Publishing (India) Pvt. Ltd

**Reference Books:**

Sr. No	Author	Title	Publication
1.		SCR Manual.	General Electric.




**Learning Resources :** Reference Books, Manuals and journals

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**Specification Table:**

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
1.	Power Electronics	04	02	02	08
2.	Thyristor Family Devices	08	03	03	14
3.	Turn ON and Turn OFF methods of SCR	10	04	04	18
4.	Phase controlled Rectifiers	08	04	04	16
5.	Converters	08	02	02	12
6.	Industrial Control Circuits.	04	02	06	12
<b>Total</b>		<b>42</b>	<b>17</b>	<b>21</b>	<b>80</b>

**Prepared By:**

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