

## GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

### Course Curriculum

#### ELEMENTS OF POWER ELECTRONICS (Code: 3332404)

Diploma Programme in which this course is offered	Semester in which offered
Power Electronics	3 <sup>rd</sup> semester

### 1. RATIONALE

Power electronics is a subject that concerns the applications of electronic principles in to situation that are rated at higher power level rather than small signal level power. Many semiconductor devices such as SCR, DIAC, TRIAC, MOSFET and power transistors are available for such higher power applications. This contents of the course will create a general understanding of these power electronic devices. Further, the course is intended to generate the requisite skills required in the industry for selecting and maintaining of various power electronic devices and related circuits.

### 2. COMPETENCY (Programme Outcome according to NBA Terminology)

The course content should be implemented with the aim to develop different types of skills leading to the achievement of the following competency:

- **Maintain various power electronic devices.**

### 3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
4	0	2	6	70	30	20	30	

**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit; ESE -End Semester Examination; PA - Progressive Assessment

#### 4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
<b>Unit – I Basics of Power Electronics Devices</b>	1a. Describe the significance of power electronics. 1b. With sketches differentiate the construction of the IAC, UJT, PUT, TRIAC, Thyristor, GTO, IGBT, MOSFET	1.1 Introduction to power electronic devices 1.2 Power electronic devices: DIAC, UJT, PUT, TRIAC, Thyristor, GTO, IGBT, MOSFET
	1c. Describe the construction, of general purpose diode 1d. Explain the working of a general purpose diode	1.3 General purpose diodes, fast recovery diodes, schottky diodes, silicon carbide diode.
<b>Unit – II Power Transistors</b>	2a. With sketches differentiate the construction of the MOSFET, IGBT 2b. Explain the working of the BJT, power MOSFET with typical ratings 2c. Explain the working of an IGBT with typical ratings	2.1. Power BJT: NPN, PNP, V-I characteristics 2.2. MOSFET: construction and working 2.3. IGBT: construction and working
<b>Unit – III Thyristor Family</b>	3a. Describe construction of SCR. 3d. Explain the working of an SCR with typical ratings 3b. Describe different SCR turn on methods. 3c. Describe the natural and forced commutation methods 3d. Explain different types of SCR protection.	3.1 SCR: symbol, construction, characteristics, diode analogy, two transistor model, di/dt and , dv/dt ratings, series and parallel operation 3.2 Turn on methods: radiation, temperature, dv/dt, gate 3.3 Commutation methods: natural and forced 3.4 Protection: di/dt, dv/dt, heat sink, over current, over voltage
	3e. With sketches differentiate the construction of the TRIAC, GTO, MCT, IGCT, LASCR 3f. Explain the working of TRIAC, GTO, MCT, IGCT, LASCR with characteristics 3g. State the steps to check the working of different types of power electronic devices	3.5 TRIAC, GTO, MCT, IGCT, LASCR; symbol, construction, and working
<b>Unit– IV Gate Triggering</b>	4a. With sketches differentiate the construction of the UJT, PUT, DIAC	4.1. UJT, PUT, DIAC

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
<b>Devices and Circuits</b>	4b.Explain the working of UJT as a relaxation oscillator	4.2. UJT as relaxation oscillator
	4c.Describe the working of different gate triggering circuits.	4.3.Triggering methods: R, RC, UJT and PUT based triggering circuit and waveform, DIAC triggering for TRIAC.
<b>Unit– V Power Electronic Converters</b>	5a.Classify the different power electronic converters 5b.Explain working principle of single phase converter using SCR and R load with waveform. 5c.State the steps to check the working of single phase thyristor converter	5.1.Types of Power electronic converter 5.2.Basic single phase converter circuits using SCR with R load.

## 5. SUGGESTED SPECIFICATION TABLE (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of Power electronics	08	03	04	2	09
II	Power Transistors	13	04	14	2	20
III	Thyristor Family	14	04	14	2	20
IV	Gate triggering devices and circuits	08	03	03	2	08
V	Power electronics converter	13	0	4	9	13
	<b>Total</b>	<b>56</b>	<b>14</b>	<b>39</b>	<b>17</b>	<b>70</b>

**Legends:**R = Remembrance; U= Understanding; A= Application 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.

## 6. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills (**Course Outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

**Note:** Here only course outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

S. No.	Unit No.	Practical/Exercises (‘Course Outcomes’ in Psychomotor Domain according to NBA terminology)	Approx. Hrs. Required
1	I	Test the performance of power diodes	02
2	II	Test the performance of BJT	02
3	II	Check the operation of BJT as switch	02
4	II	Test the performance of Power MOSFET	02
5	II	Test the performance of IGBT	02
6	III	Test the performance of SCR	02
7	III	Test series operation of SCR	02
8	III	Test parallel operation of SCR	02
9	III	Test performance of TRIAC	02
10	IV	Test performance of DIAC	02
11	IV	Test the performance of UJT as relaxation oscillator	02
12	V	Test controlled single phase rectifiers	04
13	V	Test AC to AC converters	04
14	V	Test DC to DC converters	04
15	V	Test DC to AC converters	04
16	V	Test AC to DC converters	04
<b>Total</b>			<b>42</b>

## 7. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Student may be asked to collect photographs from internet which is related to field application of various topics.
- ii. Teacher guided self-learning activities, course/library/internet/lab based mini-projects etc. These could be individual or group-based.
- iii. Student activities like: course/topic based seminars, internet based assignment

## 8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- i. Show video/animation films on working of DIAC, UJT, PUT, TRIAC, Thyristor, GTO, IGBT, MOSFET etc.
- ii. Give assignment/mini projects based on application of different power electronic devices and power converters.

## 9. SUGGESTED LEARNING RESOURCES

### A) List of Books

S. No.	Title of Book	Author	Publication
1	Power electronics	Bimbhra P. S.	Khanna Publishers (2010) or latest
2	Power electronics	Singh M. D., Khanchandani K. B.	Tata McGraw-Hill Education (2006), 2 <sup>nd</sup> edition or latest
3	Power Electronics	Asghar, M.S. Jamil	PHI Learning (2009), 1 <sup>st</sup> edition or latest
4	Power Electronics:	Muhammad, H.	Pearson 3 <sup>rd</sup> edition or latest

S. No.	Title of Book	Author	Publication
	Circuits, Devices and Applications	Rashid	
5	Power electronics	HariBabu, K.	Scitech Pub. (2011), 2 <sup>nd</sup> edition or latest
6	Power Electronics and Its Applications	Jain, alok	Penram International (2008), 2 <sup>nd</sup> edition or latest

**B) List of Major Equipment/ Instrument with Broad Specifications**

- i. Power Oscilloscope (dual channel 30 MHz.)
- ii. Digital Multimeters (3 ½ digit)
- iii. DC power supply (0-30V, 3A)
- iv. DIAC, UJT, PUT, TRIAC, Thyristor, GTO, IGBT, MOSFET of minimum ratings
- v. Trainer kits for DIAC, UJT, PUT, TRIAC, Thyristor, GTO, IGBT, MOSFET

**C) List of Software/Learning Websites**

- i. Electronic Work Bench/MULTISIM
- ii. [www.nptel.iitm.ac.in](http://www.nptel.iitm.ac.in)
- iii. <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv127-Page1.htm>
- iv. <http://www.completepowerelectronics.com/category/power-electronics-basics/>

**10. COURSE CURRICULUM DEVELOPMENT COMMITTEE**

**Faculty Members from Polytechnics**

- **Prof. K. J. Dhimar**, LPE, Dept. of Power Electronics, Dr. S. & S. S. Ghandhy College of Engg. & Technology, Surat
- **Prof(Smt). J. M. Patel**, ALPE, Dept. of Power Electronics, Dr. S. & S. S. Ghandhy College of Engg. & Technology, Surat
- **Prof. S. A. Patel**, LPE, Dept. of Power Electronics, Dr. S. & S. S. Ghandhy College of Engg. and Technology, Surat

**Coordinator and Faculty Members from NITTTR Bhopal**

- **A.S. Walkey**, Associate Professor, Department of Electrical and Electronics Engineering.
- **Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering.