



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**

**Subject Code: 3152407**

**Semester – V**

**Subject Name: Power Electronics Circuits-1**

**Type of course: Professional Core Course**

**Prerequisite:** Circuit Theory, Basic Power Electronics Devices, Circuits and Applications

**Rationale:** The Power Electronic converters are widely used where fixed/variable DC supply is required in domestic applications as well as in industrial applications. The course is aimed to provide construction, characteristics and operation of various converter circuits that provide variable DC voltage.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	2	5	70	30	30	20	150

**Content:**

Sr. No.	Content	Total Hrs
1	<b>AC-DC converters (Uncontrolled):</b> Principle of Operation – Classification – Applications Single Phase Uncontrolled Rectifier: Half Wave and Full wave – Analysis on Different Types of Load – Working along with Necessary Wave forms . Three Phase Uncontrolled Rectifier: Half Wave, Full wave - Analysis on Different Types of Load – Working along with Necessary Wave forms – Working Principle of Multi-pulse Rectifiers Effect of source and load inductance. Applications.	6
2	<b>AC-DC converters (Controlled):</b> Principle of phase controlled converter operation; Operation of single phase half wave converter with R, RL and RLE load; Significance of freewheeling diode ; Single phase full wave converter : Center-tapped and Bridge Configuration; Operation and analysis with R,RL, RLE load; Semi-converter/ Half controlled converter: Asymmetric and Symmetric Configurations; Rectification and Inversion Mode operation. Three Phase Half Wave and Full Wave Controlled Rectifier with R & RL Load – half bridge and Full Controlled Bridge Rectifier with R & RL Load. Dual Converter- Principle and operation; 1-phase and 3-phase configurations. Effect of source and load inductance. Various Triggering Circuits for 1 phase & 3 phase Controlled Rectifiers like Inverse Cosine Method, UJT Firing Scheme, Transistorised Firing, Using <b>Logic</b> Gates. Applications.	6
3	<b>Thyristorized Choppers:</b> Chopper – Principle of Operation – Control Strategies: TRC & CLC – Classification. Step Down and Step Up Choppers – First Quadrant (Type A) Chopper – Second Quadrant (Type B) Chopper – Two Quadrant (Type A or Type C) Chopper – Two	6



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	Quadrant (Type B or Type D) Chopper – Four Quadrant (Type E) Chopper. Principle of Working, Operation, Analysis and Applications of Jones Chopper and Morgan Chopper. Principle of Operation and Modes of Multi-phase Choppers. Applications.	
4	<b>DC-DC Converters:</b> Importance & Requirement of DC Power Supply – Principle – Classification based on various criteria – Performance Parameters. Non-Isolated DC-DC Converters: Buck, Boost, Buck-Boost and Cuk Converters in CCM & DCM – Their Operation – Analysis on Different Loads and Control along with Necessary Wave forms. Working Principle and Waveforms of Luo, Sepic and Zeta Converter	6
5	<b>Isolated DC-DC Converters:</b> Requirement and Importance of Isolation in Power Electronics Circuit – Advantages. Circuit, Working along with Wave forms, Analysis and Efficiency of: Fly-back – Forward – Push Pull – Half Bridge – Full Bridge Converters. Applications.	6
6	<b>Resonant Converters:</b> Review of Resonance – Advantages – Principle of Operation of Resonant Converters – Classification Series and Parallel Resonant Converters ZVS and ZCS Resonant Converters – Types (L & M) – Working Principle – Wave forms – Analysis – Comparison	6

### Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	30	15	15	10	---

**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: Converters, Applications and Design by Mohan, Undeland and Robbins, Wiley India
2	Power Electronics: Circuits, Devices and Applications, Third edition by M. H. Rashid, PHI.
3	Power Electronics: Essentials and Applications by L. Umanand, Wiley India.
4	Power Electronics by M. S. Jamil Asghar, PHI.
5	Power Electronics by Philips T. Krein, Oxford.
6	Power Electronics by Dr. P. S. Bhimbra, Khanna Publishers.
7	Advanced DC to DC Converters by Fang Lin Luo & Hong Ye, CRC Press



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## **Course Outcomes:**

**At the end of the course, student should be able to:**

Sr. No.	CO statement	Topics Mapped	Marks % weightage
CO-1	Illustrate the principle of operation of different power conversion circuits and their applications.	1,2,3,4,5,6	25
CO-2	Compare performance of various power converter circuits supplying DC output.	1,2,3,4,5,6	25
CO-3	Design and Analyze power converter circuits and to select suitable power electronic devices by considering the requirements of application fields	1,2,3,4,5,6	25
CO-4	To develop skills to build, and troubleshoot power electronics circuits.	1,2,3,4,5,6	25

## **List of Experiments:**

Lab experiments shall contain practical/ Lab Sessions related to various power converter circuits.

## **Major Equipment:**

Oscilloscope, Isolated Channel Power Scope, Power Converter Trainer Kits, Multi-meters, Variable Power Supply, etc.

## **List of Open Source Software/learning website:**

- **Learning website:**

- <http://nptel.iitm.ac.in/courses.php>
- <http://ocw.mit.edu/>
- <https://swayam.gov.in/>