GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: DC POWER ELECTRONIC CONVERTERS
(Code: 3342401)

Diploma Programme in which this course is offered	Semester in which offered
Power Electronics	4th Semester

1. RATIONALE

A DC power electronic converter is a subject that concerns with the power electronic converters based on DC power processing. Many converter devices are available for the most important application in speed control of DC drives in industries. An effort is made in this course to provide understanding of the various DC power electronic converters to enable the students to acquire some core skills related to DC power electronic converters.

2. COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills in the students so that they are able to acquire following competency:

- **Operate and Maintain DC Power Electronic Converters**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Operate and Maintain 1- Ø AC-DC converter.
ii. Operate and Maintain 3- Ø AC-DC converter.
iii. Operate and Maintain DC-DC Converters.
iv. Operate and Maintain Resonant switch Converters.
v. Use relevant thyristor commutation techniques for specific applications.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	1	2	6	70	30	20	30	**150**

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

5. DETAILED COURSE CONTENT

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
UNIT – I **1- Phase Ac-Dc Converters**	1a. Explain the working of 1- phase AC-DC uncontrolled converter for different load conditions with sketches. 1b. Compare half wave and full wave uncontrolled converter with varying types of load.	1.1 Classification 1.2 Half wave uncontrolled converter; R, RL(with and without freewheeling diode) and RC load 1.3 Full wave uncontrolled converter; R, RL and RLE load
	1c. Explain the working of 1- phase AC-DC controlled converter for different load conditions with sketches. 1d. Compare half wave and full wave controlled converter with varying types of load.	1.4 Half wave full controlled converter: R, RL(continuous and discontinuous conduction mode) load 1.5 Full wave half controlled converters: R, RL load 1.6 Full wave full converter: R, RL and RLE(with and without freewheeling diode) load 1.7 Single phase parallel dual converters: R load
UNIT – II **3- Phase Ac-Dc Converter**	2a. Explain the working of 3- phase AC-DC converter with appropriate sketches. 2b. Compare various three phase uncontrolled and controlled converter.	2.1. Three phase, three pulse, half wave uncontrolled converter: R load 2.2. Six pulse full wave, uncontrolled converter: R load 2.3. Three phase three pulse, fully controlled converter: R load 2.4. Three phase six pulse, fully controlled converter: R load
UNIT – III **Dc-Dc Converter**	3a. Explain the working of non-isolated DC-DC Converters with sketches. 3b. Select non isolated DC-DC converter for specific application.	3.1. Non-isolated DC-DC converter: buck, boost, buck-boost, cuk
	3c. Explain the working of isolated DC-DC Converters with sketches. 3d. Select isolated DC-DC converter for specific application.	3.2. Isolated DC-DC converter: forward, cuk, push-pull, half bridge, full bridge
UNIT – IV **Resonant Converters**	4a. Explain the working principle of ZVS converter.	4.1. Classification of resonant converter 4.2. ZVS Resonant switch converter
	4b. Explain the working principle of ZCS converter. 4c. Compare the features of ZCS and ZVS converters.	4.3. ZCS Resonant switch converter
UNIT – V **Commutation**	5a. Explain force commutation techniques with sketches. 5b. Select suitable commutation techniques for specific application.	5.1. Voltage commutation 5.2. Current commutation 5.3. Load commutation

6. SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (Theory)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	1- Ø AC-DC Converters	12	5	15	3	23
II	3- Ø AC-DC Converters	10	3	13	0	16
III	DC-DC Converters	8	2	8	4	14
IV	Resonant Converters	5	2	5	0	7
V	Commutation	5	2	8	0	10
Total Hrs		**42**	**14**	**49**	**7**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised 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.

7. SUGGESTED LIST OF PRACTICALS / EXERCISES

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(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 outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of* ***Course Outcomes*** *related to affective domain. Thus over all development of* ***Programme Outcomes (****as given in a common list at the beginning of curriculum document for this programme) would be assured.*
Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical/Exercise (Outcomes' in Psychomotor Domain)	Approx. Hrs. Required
1.	I	Test half wave uncontrolled converter with R, RC and RL (with and without freewheeling diode) load.	4
2.	I	Test full wave uncontrolled converter with R and RL and RLE load.	4
3.	I	Test half wave full controlled converter with R and RL load.	4
4.	I	Test full wave half controlled converter with R and RL load.	2
5.	I	Test full wave full converter with R, RL and RLE load.	4
6.	I	Test parallel dual converter with R load.	2
7.	II	Test three phase, three pulse, half wave uncontrolled converter with R load.	2
8.	II	Test three phase, six pulse, full wave uncontrolled converter with R load.	2
9.	II	Test three phase, three pulses, and fully controlled converter with R load.	2
10.	II	Test/simulate three phase, six pulse, and fully controlled converter with R load.	4

S. No.	Unit No.	Practical/Exercise (Outcomes' in Psychomotor Domain)	Approx. Hrs. Required
11.	III	Test buck converter.	2
12.	III	Test boost converter.	2
13.	III	Test buck-boost converter.	2
14.	III	Test Cuk converter.	2
15.	III	Test forward converter.	2
16.	III	Test push pull converter.	2
17.	III	Test half bridge DC-DC converter.	2
18.	III	Test full bridge DC-DC converter.	2
19.	IV	Test ZVS resonant switch converter.	2
20.	IV	Test ZCS resonant switch converter.	2
21.	V	Build/test voltage commutation circuit.	2
22.	V	Build/test current commutation circuit.	2
23.	V	Build/test load commutation circuit.	2
Total Hrs (perform practical worth 28 hours so that most units are covered)			**56**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

i. Students have to find practical applications of different converter in home appliances and have to list various parameters of those applications.
ii. Students are instructed to list various practical applications available of above converters and draw block diagram of those applications to see the use of converter.
iii. Students are instructed to take any one applications of converter and to develop practical circuit for that converter.

9. SPECIAL INSTRUCTIONAL STRATEGY (If Any)

i. Show video/animation films explaining working principles, constructional features, testing and maintenance of different types of DC Power Electronic Convertors.
ii. Arrange a visit to nearby manufacturer of DC Power Electronic Convertors and show students their constructional features and testing.
iii. During tutorials ask students to draw input and output waveforms for various conditions of different type of convertors and help students if they are not able to do it on their own.

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Books	Author	Publication/Year
1.	Power electronics	Asghar Jamil	PHI Learning, New Delhi, latest edition
2.	Power electronics	Bimbhra P. S.	Khanna Publishers, New Delhi, latest edition
3.	Power Electronics and Its Applications	Jain Alok	Penram International, Mumbai, latest edition

4.	Power Electronics: Circuits, Devices and Applications	Muhammad H. Rashid	Pearson Education New Delhi, latest edition
5.	Power Electronics	Singh M.D., Khanchandani K.B.	Tata McGraw-Hill New Delhi, latest edition
6.	Power Electronics : Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Wiley India, New Delhi, latest edition

B) List of Major Equipment/Materials with Specification

i. Digital multi meter (4 ½ digit hand held 9 V battery operated)
ii. Clamp-on meter (3 1/2 digits, Acc. +/-1%, DC Voltage: 0 to 0.1 V – 600 V, AC Voltage: 0 to 0.1 V – 600 V, AC Current: 0 to 0.1 A – 999.9 A, DC Current: 0 to 0.1 A – 999.9 A)
iii. Digital Oscilloscope(100Mhz,Dual trace)
iv. Power Oscilloscope
v. Various Trainer boards for Converters
vi. Any one simulation software.

C) Learning Websites/ List of Software

i. http://freevideolectures.com/Course/2351/Power-Electronics
ii. http://brightelectricals.blogspot.in/2008/12/lecture-notes-on-power-electronics.html
iii. http://en.wikipedia.org/wiki/Power_electronics
iv. SEQUEL (open source)
v. PSIM
vi. ORCAD.

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

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

Coordinator and Faculty Members from NITTTR Bhopal

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