GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: AC POWER ELECTRONIC CONVERTERS
(COURSE CODE: 3352403)

Diploma Programme in which this course is offered	Semester in which offered
Power Electronics	5th Semester

1. RATIONALE

The most important application of AC power electronic converters is speed control of AC drives in industries. So this course mainly related with AC power control, its circuits and applications. In this course principle of working of AC Voltage controller and Cycloconverter used for conversion of fixed AC to variable AC along with Inverter related to conversion of DC to AC power are discussed. And finally applications of AC power control in industries for AC drives are emphasized. Hence, this course is designed so that the diploma engineers will be able to operate and maintain the AC power electronic converters.

2. LIST OF COMPETENCY

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

- **Maintain AC Power Electronic converter**

3. COURSE OUTCOMES

The theory should be taught and practical should be undertaken in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domains to demonstrate the following course outcomes

i. Maintain AC voltage controller.
ii. Maintain Cycloconverter.
iii. Maintain Inverters.
iv. Apply power factor improvement methods
v. Use special power electronics devices for various 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	150
3	1	2	6	70	30	20	30	

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

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (Major outcomes in cognitive domain)	Topics and Sub-topics
Unit – I AC Voltage Controller	1a. Explain the principle of AC voltage control for Integral cycle control and phase control. 1b. Compare the various topologies of AC voltage controller with sketches.	1.1 Principle: Integral cycle control, phase controls. 1.2 Topologies: fixed frequency
	1c. Explain the working principle of 1-phase voltage controller using R and RL load with sketches.	1.3 1- phase voltage controller: R and RL load.
	1d. Explain the principle of sequential control of AC voltage controller for two stage and multi stage configuration with sketch.	1.4 Sequential control of AC voltage controller: Two stage, Multi stage.
	1e. Describe the working principle of AC chopper regulator with R and RL load. 1f. Describe the working principle of AC chopper regulator with multiple PWM control for R and RL load.	1.5 AC chopper regulator: R, RL load, Multiple PWM control technique with R and RL load.
Unit – II Cycloconverter	2a. Explain the working principle of cycloconverters. 2b. Explain the working principle of 1-phase midpoint and bridge cycloconverters for step up and step down frequency with sketches.	2.1. 1- phase Cycloconverter: midpoint, bridge; step up, step down.
	2c. Explain the working principle of 3-phase to 1-phase and 3-phase to 3-phase cycloconverters with sketches.	2.2. 3- phase cycloconverter: 3-phase to 1-phase, 3- phase to 3- phase.
Unit – III Inverters	3a. Explain the working principle of 1-phase half bridge voltage source inverter for R, RL and RC load with sketches.	3.1. 1- phase half bridge voltage source inverter: R, RL and RC load.
	3c. Explain the working principle of 1-phase full bridge inverter for R and RL load with sketches.	3.2. 1- phase full bridge inverter: R, RL load.
	3d. Explain different methods of PWM with sketches.	3.3. PWM inverters: single pulse, multiple pulse, sinusoidal pulse modulation.
	3e. Describe the working principle of 3-phase inverter for 180° and 120° conduction mode with sketches.	3.4 3-phase inverter: 180° conduction mode, 120° conduction mode.
	3f. Explain the working principle of 1-phase current source inverter with ideal switches.	3.5 Current source inverter: 1-phase with ideal switches.

Unit	Major Learning Outcomes (Major outcomes in cognitive domain)	Topics and Sub-topics
	3g. Describe the working principle of Modified Mc Murray half bridge and full bridge inverter. 3h. Describe the working principle of Modified Mc Murray-Bedford half bridge and full bridge inverter.	3.6 Forced commutated inverter: Modified Mc Murray inverter, modified McMurray-Bedford inverter; half bridge, full bridge.
	3i. Explain the working principle of various voltage control methods for inverter with block diagram.	3.7 Voltage control of inverter: control of input DC voltage, External control of AC output voltage, Internal control of Inverters
Unit – IV Power factor improvement	4a. State the effects of poor power factor. 4b. Explain various methods of reactive power compensation with figure.	4.1. Reactive power compensation: fixed capacitor, switched capacitor, thyristor controlled reactors(TCRs), Thyristor switched capacitors (TSCs)
	4c. Describe operations of static VAr compensators.	4.2. Static VAr compensator (SVC)
Unit – V Special Power Electronic Device Applications	5a. Explain working principle of various AC static relay with circuit diagram.	5.1. AC static relay
	5b. Describe the static AC circuit breaker with relevant current and voltage waveform.	5.2. Static AC circuit breaker
	5c. Differentiate the operation of online and offline UPS using block diagram	5.3. UPS: online, offline

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	AC Voltage Controller	10	4	10	2	16
II	Cycloconverter	6	2	8	0	10
III	Inverters	15	6	12	7	25
IV	Power factor improvement	5	4	5	0	9
V	Special Power Electronic Device Applications	6	2	6	2	10
Total		**42**	**18**	**41**	**11**	**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 EXERCISES/PRACTICAL

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/course outcomes. Following is the list of practical exercises for guidance.

Note*: outcomes in psychomotor domain are listed here 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 Exercises** (Major Outcomes in Psychomotor Domain)	**Approx. Hrs. Required**
1.	I	Troubleshoot single phase AC voltage controller with R and RL load.	4
2.	I	Troubleshoot two stage sequential AC voltage controller.	4
3.	I	Troubleshoot AC chopper regulator with R and RL load.	4
4.	I	Troubleshoot AC chopper regulator using PWM control with R and RL load.	4
5.	II	Troubleshoot single phase midpoint step up and step down Cycloconverter.	4
6.	II	Troubleshoot single phase bridge step up and step down Cycloconverter.	4
7.	III	Troubleshoot single phase half bridge voltage source inverter with R, RL and RC load.	4
8.	III	Troubleshoot single phase full bridge inverter with R and RL load.	2
9.	III	Troubleshoot pulse width modulated inverter.	2
10.	III	Test and simulate three phase 180° conduction mode inverter.	4
11.	III	Test and simulate three phase 120° conduction mode inverter.	2
12.	III	Test and simulate Modified Mc Murray half bridge and full bridge inverter.	4
13.	III	Test and simulate Modified Mc Murray-Bedford half bridge and full bridge inverter.	4
14.	IV	Simulate thyristor controlled reactors(TCRs) and Thyristor switched capacitors (TSCs) methods for power factor improvement.	4

S. No.	Unit No.	Practical Exercises (Major Outcomes in Psychomotor Domain)	Approx. Hrs. Required
15.	V	Test performance of AC solid state relay.	2
16.	V	Test performance of static AC circuit breaker.	2
17.	V	Test and simulate online and off line UPS.	4
	Total (Perform any practical for total 28 hours so that the most units are covered)		**58**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

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

9. INSTRUCTIONAL STRATEGY (If Any)

i. Lecture and demonstration
ii. Online animation/flash for working of converters
iii. Practical exercises
iv. Mini projects
v. Visit to nearby industry where Power electronic devices are used for drive control.

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,1st edition, 2009 or latest
2.	Power electronics	Bimbhra P. S.	Khanna Publishers, New Delhi 5th edition, 2013 or latest
3.	Power Electronics and Its Applications	Jain Alok	Penram International, 2nd edition, 2011 or latest
4.	Power Electronics: Circuits, Devices and Applications	Muhammad, H. Rashid	Pearson (2003), New Delhi 3rd edition or latest
5.	Power Electronics	Singh M.D., Khanchandani K.B.	Tata McGraw-Hill Education New Delhi (2006), 2nd edition or latest
6.	Power Electronics : Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Wiley India, New Delhi 3rd edition 2007 or latest

B. List of Major Equipment/Materials

i. Digital multi meter
ii. Clamp-on meter

iii. Digital Oscilloscope
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. & S. S. Ghandhy College of Engg. and 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

- **Prof. A.S.Walkey**, Associate Professor, Dept. of Electrical & Electronics Engg.
- **Dr. Joshua Earnest**, Professor, Dept. of Electrical & Electronics Engg.