GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: AC MOTOR DRIVES
(COURSE CODE: 3352401)

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

1. RATIONALE

Most of the modern AC motors and generators are controlled by power electronic circuits due to their versatility. The duty of the diploma engineers in the industry is to keep them in operating condition and reduce the downtime. It assumed that the students who take this course are already aware of the fundamentals of electronic devices and circuits. Hence this course is designed to maintain different types of AC motors and their circuits.

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 different types AC drives.**

3. COURSE OUTCOMES

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

i. Use power electronic-based speed control methods for AC machines.
ii. Maintain Stator Voltage control drives.
iii. Maintain Rotor Frequency control drives.
iv. Maintain Drives having control from rotor side.
v. Maintain Synchronous motor drives.

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
4	1	2	7	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 DETAILS

Unit	Major Learning Outcomes (Major outcomes in cognitive domain)	Topics and Sub-topics
Unit – I AC Drive Fundamentals	1a. Classify different types of AC Drives. 1b. Describe general AC Drive specifications. 1c. Explain basic working principle of a typical AC drives.	1.1 AC drive classification 1.2 Basic working principle of AC Drives general equations of induction motors. 1.3 General AC drive specifications.
	1d. Explain speed torque characteristics of induction Motors 1e. Explain various speed control methods of AC motors	1.4 AC motors; Speed- Torque characteristics of a induction motor 1.5 Speed control methods of AC motors: stator voltage, stator frequency, stator voltage and frequency, stator current, static rotor-resistance, slip-energy recovery.
Unit – II Stator Voltage control Drives	2a. State the advantages of squirrel cage induction motor drives. 2b. Describe the working of AC voltage controller for 3-Ø induction motor with sketches. 2c. With a block diagram describe the closed loop speed control of motor using stator voltage control.	2.1. Squirrel cage induction motor 2.2. AC voltage controller for 3-Ø induction motor 2.3. Closed loop speed control using stator voltage control
	2d. With sketches, describe working of four quadrant AC voltage controller 2e. State merits and demerits of stator voltage control.	2.4. Four quadrant AC voltage controller. 2.5. Merits and demerits of stator voltage control
Unit – III Rotor Frequency control drives	3a. Explain variable frequency characteristics of induction motor. 3b. With a block diagram describe the working of variable frequency speed control. 3c. Differentiate between VSI and CSI circuits 3d. Describe working of VSI fed drive With the help of sketches. 3e. Explain breaking and multi quadrant operation of voltage source inverter fed drive for induction motor	3.1. Variable frequency characteristics 3.2. Block diagram of variable frequency speed control. 3.3. Concept of Voltage source inverter (VSI) and current source inverter (CSI) 3.4. VSI fed induction motor drive: braking and multi quadrant operation.
	3f. With sketches describe the working of CSI fed drive. 3g. Explain braking and multi-quadrant operation of CSI fed drive.	3.5. Variable frequency control from a current source: (CSI), regenerative braking and multi-quadrant operation, closed loop control of CSI drives.

Unit	Major Learning Outcomes (Major outcomes in cognitive domain)	Topics and Sub-topics
	3h. Explain the working of cyclo-converter fed drive with the help of sketches 3i. Explain the working of PWM inverter fed drive with the help of sketches.	3.6. Cyclo-converter fed induction motor drive 3.7. Pulse width modulated (PWM) inverter fed induction motor drive.
Unit – IV Rotor-side control of Drives	4a. Explain concept of conventional rotor resistance control method. 4b. Explain the working of static rotor resistance control of doubly fed induction generator (DFIG) with sketches.	4.1. Conventional rotor resistance control 4.2. static rotor resistance control of a DFIG
	4c. Explain super synchronous speed control using DC link cascade and cyclo converter cascade. 4d. Explain the working of close loop control of static Scherbius drive using block diagram.	4.3. Slip power recovery scheme: Conventional Scherbius drive system, static scherbius drive, super synchronous speed control using DC link cascade and cyclo converter cascade
Unit – V Synchronous motor drives	5a. Describe the working of load commutated inverter (LCI) fed synchronous motor drive with sketches. 5b. Explain the working of close loop control of LCI fed synchronous motor drive using block diagram.	5.1. Load commutated inverter (LCI) fed synchronous motor drive. 5.2. Close loop control of LCI fed synchronous motor drive.
	5c. Describe the working of VSI fed synchronous motor drive using sketches. 5d. Explain the working of cyclo converter fed synchronous motor drive using sketches.	5.3. VSI fed synchronous motor drive: separate control, self control. 5.4. Cyclo converter fed synchronous

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 Drive Fundamentals	10	4	8	0	12
II	Stator Voltage control drives	10	3	5	5	13
III	Rotor Frequency control drives	14	4	8	5	17
IV	Rotor side control of Drives	12	4	8	4	16
V	Synchronous motor drives	10	4	4	4	12
	Total	**56**	**19**	**33**	**18**	**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	Test the performance of 1-ø induction motor using AC voltage controller.	2
2	I	Test the performance of 3- Ø induction motor using AC voltage controller.	4
3	II	Test the performance of closed loop speed control of motor using stator voltage control.	2
4	III	Test the performance of 1- Ø Induction motor using VSI drive.	2
5	II	Test the performance of 3- Ø Induction motor using VSI drive.	4
6	III	Test the performance of 3- Ø Induction motor using closed loop VSI drive.	2
7	III	Test the performance of 1- Ø Induction motor using CSI drive.	2
8	III	Test the performance of 3- Ø Induction motor using CSI drive.	4
9	III	Test the performance of cyclo converter fed induction motor drive.	4
10	III	Test the performance of pulse width modulated inverter fed induction motor drive.	4
11	IV	Test the performance of super synchronous speed control of motor using DC link cascade and cyclo converter cascade scheme.	4
12	V	Test the performance of load commutated inverter (LCI) fed synchronous motor drive.	4
13	V	Test the performance of close loop control of LCI fed synchronous motor drive	2
14	V	Test the performance of cyclo converter fed synchronous motor drive.	2
	Total		**42**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

i. Search the internet and analyse the specifications for various types of AC drives
ii. Find practical applications of AC drives in home appliances and have to list various parameters of those applications.
iii. Make comparative table for various drives based on its application and maximum power ratings.

9. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

i. Give simple exercises during tutorial session and ask students to present their work and have discussions on that.
ii. Use Flash/Animations to explain the working of different control devices and the characteristics of inputs and outputs of different devices.
iii. Give Mini projects to students

10. SUGGESTED LEARNING RESOURCES

A. List of Books

S. No.	Title of Books	Author	Publication/Year
1	Power semiconductor Drives	Sivanagaraju S., balasubba M. reddy and A. Mallikarjuna Prasad	PHI Learning, New Delhi,1st edition, 2010 or latest
2	Modern Power Electronics and AC Drives	Bose,.Bimal K.	PHI Learning, New Delhi 2nd edition, 2005 or latest
3	Power electronics	Dr. Bimbhra P. S.	Khanna Publishers, New Delhi 5th edition, 2013 or latest
4	Power Electronics and Its Applications	Jain, alok	Penram International, 2nd edition, 2011 or latest
5	Power Electronics: Circuits, Devices and Applications	Muhammad H. Rashid	Pearson (2003), New Delhi 3rd edition or latest
6	Power Electronics	Singh, M.D., Khanchandani K.B.	Tata McGraw-Hill Education New Delhi (2006), 2nd edition or latest
7	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/ Software

i. http://www.youtube.com/watch?v=MqbNoVTKdcM
ii. http://freevideolectures.com/Course/2351/Power-Electronics
iii. http://www.youtube.com/watch?v=dDp1ybbCQBM
iv. http://www.scribd.com/doc/6883802/AdjustableSpeedDrivesTutorial
v. http://brightelectricals.blogspot.in/2008/12/lecture-notes-on-power-electronics.html
vi. http://en.wikipedia.org/wiki/Power_electronics
vii. SEQUEL (open source)
viii. PSIM
ix. 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

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- **Prof. A.S.Walkey**, Associate Professor, Dept. of Electrical & Electronics Engg, NITTTR, Bhopal.
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