

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: DC MOTOR DRIVES
(Code: 3342405)**

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

1. RATIONALE

Power Electronics employs thyristor based circuits to control electrical energy in different applications. The most important application is speed control of DC drives in industries, vehicles and renewable energy. So this course is mainly related with selection and troubleshooting of DC motor drives used in various applications. This course attempts to develop skills in operation and maintenance of power rectification, controlled rectifiers and choppers related to conversion of DC to DC power used for applications of power control in industries for DC drives.

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 different types DC motor drives.

3. COURSE OUTCOMES (COs)

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

- Select the proper DC motor for drives application
- Troubleshoot single phase converters.
- Troubleshoot three phase converters.
- Troubleshoot chopper drives.
- Maintain BLDC drives.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			C	ESE	PA	ESE	PA	
4	1	2	7	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. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
UNIT – I Selection Of Motor And Drives	1a. Describe the factors governing selection of motors and drives, overload capacity and selection of motor power capacity.	1.1 Factors governing selection Electric motors and drives: Nominal rating, Load diagram, overload capacity, Insulating materials, Heating, cooling,
	1b. Explain speed torque characteristics of different types of DC motors. 1c. Describe various techniques of braking in DC Motors.	1.2 Speed-torque characteristics: DC shunt motor, DC series motors and DC compound motors 1.3 Braking: rheostatic, counter current, regenerative, dynamic and others
	1d. Describe the structure of various Electric Drive systems.	1.4 Types of drives, Types of loads
UNIT – II Single Phase Power Converters	2a. Explain the working of three phase half wave and semi converter drives with sketches	2.1 Single phase half wave converter drives 2.2 Single phase semi converter drives
	2b. Explain the working of full wave converter drives with sketches 2c. Explain the working of dual converter drive with sketches	2.3 Single phase full converter drives 2.4 Single phase dual converter drives.
UNIT – III Three Phase Power Converters	3a. Explain the working of three phase half wave converter with sketches 3b. Explain the working of three phase semi converter with sketches	3.1 Three phase half wave converter drives 3.2 Three phase semi converter drives
	3c. Explain the working of full wave converter drives with sketches 3d. Explain the working of dual converter drives with sketches	3.3 Three phase full converter drives 3.4 Three phase dual converter drives
Unit – VI Chopper Drives	4a. Explain power control of DC series motor and regenerative braking control.	4.1. Power control to DC series motor 4.2. Regenerative braking control
	4b. Describe the operation of DC motor drives to satisfy two quadrant operation 4c. Describe the operation of DC motor drives to satisfy four quadrant operation	4.3. Two quadrant chopper drives 4.4. Four quadrant chopper drives
Unit – V BLDC Motor Drives	5a. Explain working of BLDC motor drives 5b. Differentiate the performance of BLDC and brushed DC motors	5.1. PMSM motor: construction operation
	5c. Explain closed loop control of PMSM drives with block diagram	5.2. Closed loop control of Drive

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	Selection of Motor and Drives	16	6	8	4	18
II	Single Phase Power Converters	10	2	9	4	15
III	Three Phase Power Converters	12	0	9	4	13
IV	Chopper Drives	10	2	8	4	14
V	BLDC Motor Drives	8	4	6	0	10
Total		56	14	40	16	70

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

Note: This specification table shall be treated as 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/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)	Apprx. Hrs. Required
1	I	Select motor for given specific application.	4
2	I	Test the of DC Series Motors.	4
3	II	Control the speed of DC motor using Single phase half wave converter.	2
4	II	Control the speed of DC motor using half controlled converter.	2
5	II	Control the speed of DC motor using full controlled converter	2
6	II	Control the speed of DC motor using dual converter.	2
7	III	Control the speed of DC motor using Single phase half wave converter.	2
8	III	Control the speed of DC motor using half controlled converter.	2
9	III	Control the speed of DC motor using full controlled converter.	4
10	III	Control the speed of DC motor using dual converter.	4
11	IV	Control the speed of DC series motor using DC-DC converter.	2

S.No.	Unit No.	Practical/Exercise (Outcomes' in Psychomotor Domain)	Apprx. Hrs. Required
12	IV	Perform Speed control using Regenerative breaking.	2
13	IV	Troubleshoot Two quadrant chopper drives.	2
14	IV	Troubleshoot Four quadrant chopper drives.	4
15	V	Troubleshoot BLDC motor drives.	4
Total Hrs (perform practical worth 28 hours so that most units are covered)			42

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- i. Students are advised to list various motor controlling parameters and find how they affect the performance of motor and drives.
- ii. Students are advised to find troubleshooting techniques and steps to troubleshoot DC drives.
- iii. Students are advised to simulate various DC motor drives.

9. INSTRUCTIONAL STRATEGY

- i. Show video/animation films explaining working principles, constructional features, testing and maintenance of different types of DC Motor Drives
- ii. Arrange a visit to nearby manufacturer of DC Motor Drives and show students their constructional features and testing.
- iii. During tutorials ask students to draw input and output waveforms for various conditions of DC Motor Drives 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
1	Electric Drives	De N. K., Sen P. K.	PHI Learning, New Delhi, latest edition
2	Fundamentals of Electric Drives	Mohamed A. El-Sharkawi	Cengage Learning, New Delhi, latest edition
3	Electric Drives: Concepts and Applications	Subrahmanyam Vedam	Tata McGraw-Hill, New Delhi, latest edition
4	Power Electronics	Bimbhra P. S.	Khanna Publishers, New Delhi, latest edition
5	Elements of Electrical Drives	Gupta J. B., Manglik Rajeev, Manglik Rohit	S. K. Kataria and Sons, New Delhi, latest edition

B) List of Major Equipment/Materials with Broad Specifications

- i. Digital multi meter
- ii. Clip-on meter
- iii. Four channel Digital Oscilloscope
- iv. Power Oscilloscope

- v. Various Trainer boards for DC Drives
- vi. Any one simulation software

C) List of Learning Websites /Software

- i. http://www.joliettech.com/dc_drives_principles_of_operatiron.htm
- ii. http://www.eetimes.com/document.asp?doc_id=1274114
- iii. <http://www.pacontrol.com/Motor1.html>
- iv. <http://nptel.iitm.ac.in/video.php?subjectId=108108077>
- v. <http://www.edumedia-sciences.com/en/a575-speed-controler-for-dc-motor>
- vi. <http://www.engineeringtv.com/video/Texas-Instruments-Brushless-DC>
- 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. 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

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