GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (09)
ELECTRICAL DRIVES
SUBJECT CODE: 2160910
B.E. 6th SEMESTER

Type of course: NA

Prerequisite: Power Electronics - I

Rationale: Today's industrial and domestic loads demands precise and smooth variable speed control. The development of compact thyristor power converters has made this possible by smooth speed control of both AC and DC motors which are employed for several applications such as DC/AC drives, Vehicles and renewable energy. This course enables to develop the basics of electric drives and maintain different types of DC in industries. The competency in this area is highly required in diploma pass outs working in most of the industries since these industries employ large number of motors and drives and their smooth operation and maintenance requires lot of competent man power. Thus this course is must for students who want to work in industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1.	**Introduction:** • History Of Dc Drive -Electronic Control -Solid State Control • State Of Art Of Dc Drive • Block Diagram Of Drive - Part Of Electrical Drive	03	7
2.	**Dynamics of Electrical Drives** Types of Load-Quadratal diagram of speed –torque characteristics – Types and Characteristics of load torque – Dynamics of motor- load combination – steady state & transient stability of an electrical drive – Determination of moment of inertia.	04	10
3.	**Converters and control** a. Phase controlled converters b. Four quadrant operation c. Choppers d. AC to DC converters e. Inverters and PWM Techniques.	9	21
4.	**Adaptive control techniques for Electric Drives** a. Self tuning control b. Model Referencing Adaptive Control (MRAC) c. Sliding Mode Control	6	10

5.	**DC motor drives** a. Speed-torque characteristics DC shunt, PMDC and series motors b. Dynamic model c. Speed and position control methods	**8**	**20**
6.	**AC motor drives** a. d-q model of induction motor b. constant flux speed control structure c. vector control model d. vector control structure e. Synchronous motor and BLDC machine drive-Introduction	**08**	**20**
7.	**Applications of Electric Drives** a. Introduction to Solar and battery powered Drives b. Introduction to traction Drives c. Servo motor drive requirement – control and implementation	**04**	**12**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
10	**30**	**20**	**20**	**10**	**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. Bimal K. Bose, "Modern Power Electronics and AC Drives", Pearson Education
2. Vedam Subrahmanyam, "Electric Drives", TMH (I), Second Edition,
3. G.K. Dubey, " Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2nd ed. 2001.
4. Ned Mohan, Undeland and Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.
5. R.Krishnan, "Electric Motor Drives–Modeling, Analysis and Control" PHI
6. Theodore Wildi, "Electrical Machines, Drives and Power Systems", sixth edition, Pearson

Course Outcome:

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

After learning the course the students should be able to:

1. Select a drive for a particular application based on power rating.
2. Select a drive based on mechanical characteristics for a particular drive application.
3. Operate and maintain solid state drives for speed control of DC and AC machines.
4. Operate and maintain solid state drives for speed control of various special electrical machines

Laboratory Work:

Directions for Laboratory work:

- The list of experiments is given as a sample.
- Minimum 10 experiments should be carried out.
- At least one experiment should be selected from each group.
- Similar laboratory work fulfilling the objectives can also be considered.
- Each experiment should be simulated before verifying practically.
- As far as possible, **printed manual should be preferred** so that students can concentrate in laboratory experiments and related study.

List of Experiments:

1. To study the fundamental and block diagram of Electric drive.
2. To study different methods of speed control of D.C. Motor.
3. To study and simulate 1- Φ Semi Control of D.C. separately excited Motor.
4. To study and simulate 1- Φ Fully Controlled converter of separately excited Motor.
5. To study the control techniques used in D.C. chopper.
6. To study control of D.C. motor for (a) Current limit control (b) Closed loop torque control(c) Closed loop speed control.
7. To study chopper control of D.C. Motor for motoring and generating control.
8. To study D.C. Motor drive using PLL.
9. To study and simulate AC voltage controller based speed control of AC motor.
10. To study and simulate Inverter based speed control of Induction/Synchronous motor.
11. To study and simulate Cycloconverter based speed control of synchronous motor.
12. To study and simulate AC voltage controller based speed control of AC motor.
13. To study solar and battery powered drives.
14. To study traction drives.

Design based Problems (DP)/Open Ended Problem:

1. Specify the appropriate power circuit configuration amongst the phase controlled rectifiers
2. Choppers for the speed control of DC motor drives for four-quadrant operation with current limit.
3. AC voltage controllers and Inverter for speed control of AC motor drive.
4. Simulate/Implement speed control scheme for DC/AC motor drives.
5. Select an appropriate power semiconductor device and design a power converter for the required application for DC/AC Drive
6. Determine the power circuit configuration needed to fulfill the required power conversion with applicable constraints in view of DC /AC Drive.

Major Equipment:

1. 4 ½ digit Digital Multimeter
2. Digital Tachometer
3. Four channel Digital Oscilloscope
4. Various Trainer boards for DC and AC Drives.
5. Any one simulation software (Open source software preferred) : Scilab/Matlab and Simulink toolbox, CASPOC

List of Open Source Software/learning website:

1. http://www.electrical4u.com/electrical-drives/

2. http://nptel.ac.in/courses/108104011/
3. http://electrical4u.com/types-of-dc-motor-separately-excited-shunt-series-compound-dc-motor/
4. https://www.wisc-online.com/learn/career-clusters/stem/iau13208/fundamentals-of-a-dc-motor
5. http://www.ni.com/white-paper/3656/en/
6. http://www.minarik.com/drupal/content/products/Electrical%3E%3EControl%3E%3EDrives%3E%3EDC%20Drives/0
7. http://electrical-engineering-portal.com/download-center/books-and-guides/siemens-basics-of-energy/basics-of-dc-drives
8. https://www.joliettech.com/products/dc-variable-speed-drives/dc-drive-fundamentals/
9. http://www.eetimes.com/
10. http://www.ohioelectricmotors.com/a-guide-to-electric-drives-and-dc-motor-control-688
11. http://www.slideshare.net/psksiva13/63814075-electricaldrivesandcontrollecturenotes
12. http://metalab.uniten.edu.my

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.