GUJARAT TECHNOLOGICAL UNIVERSITY

MECHATRONICS ENGINEERING (20)
CONTROL OF ELECTRIC DRIVES
SUBJECT CODE: 2162003
B.E. 6th Semester

Type of course: Engineering Science

Prerequisite: N.A.

Rationale: In a fast growing industrial environment need of electrical drives are having very much importance to meet the requirement of various applications. To control these electrical drives, use of power electronics converters are very much needed. This course gives the basics of electric drives and their control using power electronics.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total
L	T	P	C	Theory Marks			Practical Marks			Marks
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction:** Electrical Drives, Advantages of electrical drives, parts of electrical drives, choice of electrical drives	3	6
2	**Dynamics of electrical drives:** Fundamental torque equation, speed torque conventions and multiquadrant operations, equivalent values of drive parameters, components of load torques, nature and classification of load torques, calculation of time and energy-loss in transient operations, steady state stability, load equalization	5	9
3	**Basics of drive control:** Modes of operation, speed control and drive classifications, closed- loop control of drives	5	10
4	**Concepts of Power Electronics:** **Thyristors:** terminal characteristics, turn on methods, design of snubber circuit, series and parallel operation, DIAC and TRIAC **Phase Controlled Rectifiers:** principle of phase control, single phase and three phase half wave and full wave controlled converters with various types of load. **Choppers:** principle of chopper operation, control strategies of chopper operation, step up and step down choppers, types of chopper circuits, steady state time domain analysis of type-A chopper. **Inverters:** single phase voltage source inverter, three phase bridge inverters, voltage control in single phase bridge inverters.	18	30

5	**DC motor drives:** starting of dc motors, braking of dc motors, transient analysis, speed control, methods of armature control, controlled rectifier fed DC drives, chopper fed DC drives.	10	20
6	**Induction motor drives:** Starting and braking of inductions motors, speed control of induction motors, voltage source inverter control of induction motors.	6	15
7	**Control of special machines:** Linear induction motor, stepper motor drives.	5	10

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40	**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. Fundamentals of Electric Drives By G K Dubey, Narosa Publications
2. Power electronics By Dr. P. S. Bimbhra , Khanna publications
3. Control of electric drives By W. Leonard , Springer internationals

Course Outcome:

After learning the course the students should be able to:

1. Understand concepts of electric drives
2. Understand concepts of power electronics
3. Learn various methods of control of DC and AC drives
4. Able to choose electric drive for particular application

List of Experiments:

1. Performance of half wave uncontrolled rectifiers with various load.
2. Performance of full wave uncontrolled rectifiers with various load.
3. To obtain the static VI characteristics of SCR.
4. Performance of half wave controlled rectifiers with various load.
5. Performance of full wave controlled rectifiers with various load.
6. Speed control of DC motor using choppers.
7. To obtain the static VI characteristics of TRIAC.
8. Control of single phase AC load using TRIAC.
9. Performance of SCR based inverter.
10. DC motor control using rectifiers.
11. 3 phase induction motor control using SIMULINK
12. Speed control of stepper motor.

Design based Problems (DP)/Open Ended Problem:

Faculty teaching the subject shall provide an application oriented course project. The students can work in a group to design a power electronic converter and its control scheme to target different applications.

Major Equipment:

Power semiconductor devices, power electronic converter kits, CRO/DSO, choke coil, load bank, voltage and current probes, simulation tools like MATLAB , various electrical motors/drives.

List of Open Source Software/learning website:

 http://nptel.iitm.ac.in/coursecontents_elec.php

http://ocw.mit.edu/courses/electrical.../6-334-power-electronics-spring-2007

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.