

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: INSTRUMENTATION & CONTROL ENGINEERING (17)

SUBJECT NAME: Industrial Drives and Control

SUBJECT CODE: 2171707

B.E. 7th SEMESTER

Type of course: Core Engineering

Prerequisite: DC machine and AC machine and Power Electronics.

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.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination						Total Marks
L	T	P		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:

S. N.	Content	Total Hrs	Weightage %
1	Electrical Drives- An Introduction Electrical Drives-Advantages of electrical drives-components of electrical drives-selection of electrical drives.	04	10
2	Modelling of DC Machines Theory of operation-Induced Emf-equivalent circuit & Electromagnetic Torque-Electro-mechanical Modelling-State-Space Modelling-Block Diagram & Transfer Function-Field Excitation-Measurement of Motor Constants.	06	14
3	Control of DC Drives: Controlled rectifier based drives, Modes of operation-Speed control & Drive classification-Closed Loop speed control of Drives	08	19
4	Chopper Controlled DC Motor Drive Introduction-Principle of operation of the Chopper-Four-quadrant Chopper Circuit-Chopper for Inversion-Model of Chopper-Input to the Chopper-Other Chopper Circuits-Closed Loop Operation.	08	19
5	Frequency Controlled Induction Motor Drives: Introduction-static Frequency Changers-Voltage Source Inverter- Voltage Source Inverter driven induction motor---Voltage Waveforms, Real power, Reactive power, Speed control, Constant Volts/Hz control— Relation between voltage & frequency, Implementation of Volts/Hz strategy. Induction motor Speed control by the use of adjustable frequency PWM inverters—properties of PWM waveforms, single pulse	08	19

	modulation, Multi-pulse modulation, sinusoidal modulation		
8	Special motor drive: Stepper Motor Drive Stepper motors-variable reluctance, Permanent Magnet, Important Features of stepper motor, torque versus stepping rate characteristic, Drive circuit for stepper motors Introduction of Brushless DC motor Introduction of dc servo control	08	19

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	21	14	21	7	0

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 Electrical Drives- Gopal K.Dubey, Alpha Science Int. Ltd., Pangbourne
2. Power Electronics & Motor Control - Shepherd Hullay & Liag, Cambridge Univ. Press
3. Power Semiconductor controlled Drives, -Gopal K Dubey, Prentice Hall pub.
4. Electric Motor Drives–Modelling, Analysis and Control, -R. Krishnan, Pearson Education, 2003
5. Thyristorised DC Drives - P.C. Sen, Krieger pub.
6. Power Semi conductor controlled Drives - S.B.Dewan, G.R.Slemon & A.Stranghan; John-Willey pub.

Course Outcome:

After learning the course the students should be able to:

1. identify the need and select various drives.
2. gain the knowledge about operation of d.c. motor speed control using choppers.
3. acquire the knowledge of different speed control methods in a.c. motors using thyristors based control schemes.

List of Experiments:

1. To study different methods of speed control of dc. Motor.
2. To study and simulate 1- Φ Semi Controlled rectifier based dc separately excited motor.
3. To study and simulate 1- Φ Fully Controlled converter of dc separately excited Motor.
4. To study various control techniques used in dc chopper.
5. Design and implement logic sequencer circuit for bi-directional four phase, 1 phase ON stepper

motor.

6. Speed control of dc motor using L293D by PWM technique.
7. To study the position control of DC motor using PI controller.
8. To study speed control of stepper motor using microcontroller.
9. To simulate PWM inverters.
10. Study of V/F control of induction motor (MATLAB or equivalent software demo could be preferred)

Design based Problems (DP)/Open Ended Problem:

1. Design Choppers for the speed control of DC motor drives for four-quadrant operation with current limit.
2. Design controllers for closed-loop operation of a separately excited DC motor drive

Major Equipment:

Digital Multimeter, Digital Tachometer, Digital Storage Oscilloscope, Various Trainer boards for DC Drives, etc.

Any one simulation software (Open source software preferred): Scilab/ Matlab and Simulink toolbox

List of Open Source Software/learning website:

1. <http://www.electrical4u.com/electrical-drives/>
2. <http://nptel.ac.in/courses/108104011/>
3. <http://electrical-engineering-portal.com/download-center/books-and-guides/siemens-basics-ofenergy/basics-of-dc-drives>

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.