

GUJARAT TECHNOLOGICAL UNIVERSITY

POWER ELECTRONICS & ELECTRICAL DRIVES (45)

SOLID STATE AC DRIVES

SUBJECT CODE: 2724501

SEMESTER: II

Type of course: Engineering Science (ELECTRICAL)

Prerequisite: N.A

Rationale: N.A

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	CONVENTIONAL CONTROL OF INDUCTION MOTORS Introduction of speed-torque characteristics of an induction motor. Speed Control method of an induction motor: Voltage Control, Rotor resistance Control and frequency control.	05	70
2	STATIC VOLTAGE CONTROL METHODS; Single phase AC regulator based IM drive; three phase AC regulator based IM drive, Forward and reverse operation.	05	
3	STATIC ROTOR RESISTANCE CONTROL METHODS: Controlled Rectifier Based Rotor Resistance Control of an Induction Motor, Chopper Based Rotor Resistance Control of an Induction Motor, Static Slip Power Recovery Scheme.	05	
4	STATIC FREQUENCY CONTROL METHODS: Constant voltage operation, constant v/f operation (high frequency operation & low frequency operation), constant e/f operation, controlled current operation of induction motor, controlled slip operation of an induction motor, voltage and frequency control methods of VSI, open loop v/f controlled IM drive, closed loop v/f controlled IM drive. CSI Feed induction motor drive, close loop CSI drive.	12	
5	FIELD ORIENTED CONTROL Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation.	05	15
6	DIRECT TORQUE CONTROL Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy.	05	
7	SYNCHRONOUS MOTOR CONTROL Synchronous motor control - Brush and Brushless excitation – Load	05	15

	commutated inverter fed drive.		
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Reference Books:

1. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education Asia 2002.
2. Vedam Subramanyam, "Electric Drives – Concepts and Applications", Tata McGraw Hill, 1994.
3. W. Leonhard, "Control of Electrical Drives", Narosa Publishing House, 1992.
4. Murphy J.M.D and Turnbull, "Thyristor Control of AC Motors", Pergamon Press, Oxford, Delhi, 2001.
5. P. Vas – Vector control of ac machines, Clarandon Press, Oxford.
6. G. K. Dubey – Power semiconductor controlled drives, Prentice-Hall, Eaglewood cliffs.
7. J. Murphy, "Power Electronic Control of Ac Motors", Pergamon Publication

Course Outcome:

After learning the course the students should be able to:

1. Understand significance of speed-torque characteristics of AC motors and possible ways to modify the characteristics as per load demand.
2. Understand applications and limitations of AC voltage controller for an induction motor drive.
3. Select speed control technique suitable to the application
4. Implement VSI feed v/f controlled AC motor drive
5. Implement CSI feed AC motor drive
6. Understand concept of field oriented control of an induction motor.
7. Realize advantages of Direct torque control (DTC) of an induction motor drive
8. Understand speed control methods of synchronous motor.

List of Experiments:

In laboratory duration student can be given following titles as an experiment.

Sr. No.		Aim of Experiment
Practical	1	To perform and analyze different speed control techniques of an induction motor
	2	Performance analysis of AC regulator based motor speed control of single phase induction motor
	3	Performance analysis of three phase AC regulator based speed control of an induction motor
	4	To perform and analyze controlled rectifier based rotor resistance method of induction motor speed control
	5	To perform and analyze chopper based rotor resistance method of induction motor speed control
	6	Performance analysis of VSI based speed control method of induction motor drive with constant voltage
	7	Performance analysis of VSI based speed control method of induction motor drive with constant v/f method (open-loop and closed-loop)
	8	To perform and analyze DTC of an induction motor drive
Simulation	9	To simulate and analyze AC regulator based motor speed control of single phase induction motor
	10	Simulation and analysis of three phase AC regulator based speed control of

		an induction motor
	11	To simulate and analyze controlled rectifier based rotor resistance method of induction motor speed control
	12	To simulate and analyze chopper based rotor resistance method of induction motor speed control
	13	Simulation and analysis of VSI based speed control method of induction motor drive with constant voltage
	14	Simulation and analysis of VSI based speed control method of induction motor drive with constant v/f method (open-loop and closed-loop)
	15	To simulate and analyze DTC of an induction motor drive

Design based Problems (DP)/Open Ended Problem:

The course coordinator has to define at least 3 open ended problems related to the course.

Major Equipment:

The necessary motors, power electronics drives, measuring equipments, accessories and instruments to be provided to conduct the above practical in a group of 4 to 5 students.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website