GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3724501
SUBJECT NAME: Solid State AC Drives
Semester II

Type of course: Engineering Science (ELECTRICAL)

Prerequisite: Power Electronics, Modelling and Analysis of Electrical Machines

Rationale: AC Drives are very popular and widely used in the industrial applications for automation and control. With the introduction of power electronics, it is possible to modify the speed-torque characteristics of AC machine without significant loss of performance. In recent years, many advanced control methods have been developed for the control of AC machines so that the machine can operate under given condition while energy efficiency of the system is improved.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	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 .	4	10%
2	**STATIC VOLTAGE CONTROL METHODS** Single phase AC regulator based IM drive; three phase AC regulator based IM drive, Forward and reverse operation	4	10%
3	**STATIC ROTOR RESISTANCE CONTROL METHODS:** Controlled Rectifier Based Rotor Resistance Control of an Induction Moor, Chopper Based Rotor Resistance Control of an Induction Motor, Static Slip Power Recovery Scheme**.**	6	15%
4	**STATIC FREQUENCY CONTROL METHODS:** Constant voltage operation, constant v/f 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.	8	20%
5	**FIELD ORIENTED CONTROL** Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect Field Oriented Control Methods – Flux vector estimation	8	20%
6	**DIRECT TORQUE CONTROL** Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy	6	15%

7	**SYNCHRONOUS MOTOR CONTROL** Synchronous motor control - Brush and Brushless excitation – Load commutated inverter fed drive	6	10%

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 Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Different methods to suitably modify the characteristics of Induction Motor	15
CO-2	Understand applications and limitations of AC voltage controller for an induction motor drive.	15
CO-3	Implement Inverter fed variable frequency controlled AC motor drive	20
CO-4	Categorize different field oriented control method of an induction motor.	20
CO-5	Compare Direct torque control (DTC) of an induction motor drive with Field Oriented Control	15
Co-6	Understand speed control methods of synchronous motor	15

List of Experiments:

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

Major Equipment:

1. Induction Motor Drive Module
2. Digital Storage Oscilloscope

3. MATLAB Student Version
4. Voltage Source Inverter

List of Open Source Software/learning website:

https://nptel.ac.in/courses/108108077/