



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code: ME02000791

Subject Name: Advanced Electrical Drives

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	Electrical Machines, Power Electronics at UG level
Rationale:	To impart knowledge about fundamentals of Electric drives and control, operational strategies of dc and ac motor drives as per different quadrant operations.

Course Outcomes:

On the completion of the course, the student will be able

Sr. No.	CO statement	Marks % weightage
CO-1	Acquire the knowledge of selection of drives as per practical operational industrial requirement.	15
CO-2	Understand various speed and flux estimation techniques for sensorless vector control of the induction motor.	25
CO-3	Understand vector control and direct torque control of the induction motor.	25
CO-4	Analyze the control strategies for DC motor drives	10
CO-5	Understand control techniques of Permanent Magnet Synchronous Motor (PMSM)	15

Teaching and Examination Scheme

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE Viva (V)	PA (I)		
3	0	2	4	70	30	30	20	150



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Sr. No.	Content	Total Hrs	
1	DC Drive and its Control Strategies: Dynamic model of machine, Closed loop control using single (speed) and two loops (speed, current), Implementation using circulating current type three phase dual converter and four quadrant transistorized chopper.	4	10
2	AC Drives and its Control Strategies: Variable frequency operation of three phase Induction Motor, Scalar control methods for constant power and constant torque modes, Vector control of induction machine, Methods of field sensing and estimation, Field orientation methods: Implementation of IRFO scheme using current controlled PWM, VSI and implementation of DSFO scheme using CSI, Performance of vector controlled permanent magnet machine	10	25
3	Control and Estimation of AC Drives: Introduction to speed control of Switched Reluctance Machine, Induction motor drive, basic of Scalar & Vector control V/f Control, Sensorless vector control, Field Oriented Control, Direct torque control and flux observation, Speed control of wound rotor induction motors: Converter based static rotor resistance control, Static scherbius drive using line commutated converter cascade, Analysis and estimation of harmonics and power factor, Vector control of wound rotor induction machine using self-commutated converter cascade and improvement in power factor, Variable speed constant frequency (VSCF) generation.	12	25
4	Synchronous Motor Drives : Modeling of synchronous machines, open loop v/f control, vector control, direct torque control,	4	10
5	Control of Permanent Magnet Machine: Power Electronics Control of Permanent magnet synchronous machine, Brushless DC machine, Surface permanent magnet machine and interior.	7	15
6	Control of BLDC Motor Drives: Principle of operation and control of BLDC and PMSM Machine, Sensing and logic switching scheme, These motors as Variable Speed Synchronous motor-methods of reducing Torque pulsations -Three-phase full wave Brushless dc motor - current controlled Brushless dc motor Servo drive.	8	15
TOTAL		45	100



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List of Experiments

1. To study the dynamic model of a DC machine.
2. To study the scalar and vector control of induction motor drive.
3. To simulate the vector control of an induction motor drive and evaluate the performance of drive under steady state and dynamic condition.
4. To simulate the direct torque control of an induction motor drive.
5. To study the PMSM drive control topology.
6. To study the BLDC drive control topology
7. To simulate the close loop control of synchronous motor drive.
8. To study the different sensing circuit used in closed loop control of electric drive.
9. To perform the open-loop scalar control of induction motor drive.
10. To perform the closed-loop vector control of an induction motor drive.
11. To perform and investigate the performance of PMSM drive under rated/medium/low speed operation.
12. To perform and experiment the closed loop control of DC drive.

Reference Books:

1. Mohan, N., Electric Drives: An Integrative Approach, MNP PERE (2001).
2. Mohan, N., Advanced Electric Drives: Analysis, Control, and Modeling Using Simulink, MNP PERE (2001).
3. Krishnan, R., Electric Motor & Drives: Modeling, Analysis & Control, PHI Pvt. Ltd. (2001).
4. Bose B.K., Modern Power Electronics & AC Drives, PHI Pvt. Ltd., (2001)
5. Leonard, W., Control of Electric Drives, Springer-Verlag, New York, (1985)
6. Miller, T.J.E., Brushless Permanent Magnet and Reluctance Motor Drives, Oxford Science, Oxford (1989).
7. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC Press, 2009
