GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3161708
SUBJECT NAME: Motion Control

Type of course: Core Engineering

Prerequisite: DC machine and AC machine, Power Electronics, Control Theory and Motion Sensors Basics.

Rationale: Industrial Applications involves Motion Control as the major field to operate various drives involved. These Drives are selected based on power, torque, speed, size, load, control strategies, cost and many other factors. It is necessary for an engineer to select proper Machine for drive application based on these aspects. This Course deals with various machines, their models to understand its operation and finally its closed loop drive operation, to enable student to identify proper drive for motion control application.

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

Sr. No.	Course Content	Hrs	Weightage %
1	**Introduction** Components of a Motion Control System, Human–Machine Interface, Motion Controller ,Drives, Actuators, Transmission Mechanisms, Feedback	4	10
2	**DC Machines – Modeling & Motor Parameters** Induced Emf-equivalent circuit & Electromagnetic Torque-Electro-mechanical Modeling- State-Space Modeling- Block Diagram & Transfer Function-Field Excitation- Measurement of Motor Constants.	4	10
3	**Control of DC Drives:** Controlled rectifier based drives, Phase-Controlled Converters, Design of Controllers, Four-Quadrant DC Motor Drive, Closed Loop speed control of Drives. Chopper Control of DC Drives: 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.	10	24
4	**AC Machines – Modeling & Motor Parameters** Construction and Principle of Operation, Induction Motor Equivalent Circuit, Measurement of Motor Parameters, Modeling of Induction Machines, Control Principle of Induction Motor.	4	10
5	**Control of AC Drives:** Control of Induction Motor by AC Voltage Controllers, AC Voltage Controller Circuits, Frequency Controlled Induction Motor Drives, Voltage Source Inverters based control, Constant Volts/Hz Control, Current Source Inverter based control, Current Controlled PWM Inverters, Induction motor Speed control by the use of adjustable frequency PWM inverters—properties of PWM waveforms, single pulse modulation, Multi-pulse modulation, sinusoidal modulation.	10	24
6	**Permanent Magnet Synchronous and Brushless DC Motor Drives:** Synchronous Motors with PM, Control Strategies, Speed Controller Design, PM Brushless DC Motor, Sensorless Control of PMBDCM.	4	10
7	**Stepper Motor Drive:** Stepper motors - Variable reluctance, Permanent	6	12

	Magnet, Torque versus stepping rate characteristic, Drive circuit for stepper motors.		

Course Outcomes: Students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Construct Model of AC/DC Machine with all electrical and mechanical parameters consideration.	
CO-2	Design AC and DC Drive with Control parameters.	
CO-3	Design Special Motor Drives using BLDC and Stepper Motor	

Reference Books:

1. Electric Motor Drives–Modeling, Analysis and Control, -R. Krishnan, Pearson Education, 2003
2. Fundamentals of Electrical Drives- Gobal K.Dubey, Alpha Science Int. Ltd., Pangbourne
3. Power Electronics & Motor Control - Shepherd Hullay & Liag, Cambridge Univ. Press
4. Power Semiconductor controlled Drives, -Gopal K Dubey Prentice Hall pub.
5. Industrial Motion Control, Motor Selection, Drives, Controller Tuning, Applications– Hakan Gürocak, Washington State University Vancouver, USA, Wiley Publications.