

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. SEMESTER : VIII

INSTRUMENTATION AND CONTROL ENGINEERING

Subject Name: **MOTION CONTROL**

Sr. No.	Course Contents	Total Hrs
1	Incremental Motion Control: Introduction Mathematical Modeling Of Mechanical System Elements, Analysis Of Mechanical Systems, Incremental Motion, A Typical Incremental Motion Control Problem	2
2	Sensors And Encoders: Introduction, Potentiometers, The Incremental Encoders, Resolvers As Incremental Encoders, Magnetic Pickups As Encoders	2
3	D.C. Motors In Incremental Motion Systems: Introduction, Operation Principle, Basic Classes of D.C. Motors, Selection Criteria For Incremental Motion Applications, Conclusion.	3
4	Torsional Resonance in High- Performance Incremental Motion Systems: Introduction, The Effects Of Torsional Resonance On The System Response, Torsional Resonance In Two-Body Structures, Torsional Resonance In Three- Body Structures, Effects Of Torsional Resonance On System Stability, Techniques For Minimizing Resonance Effects.	4
5	Linear D.C. Servo Amplifiers: Introduction, Uni-directional Servo Amplifiers, Bi-directional Servo Amplifiers, Power Amplifier Design Considerations, Cross-over Distortion In Power Amplifiers, Current Limiting Techniques, Input-Output Relationships in Linear Amplifiers, Conclusions	4
6	Pulse-Width Modulated Amplifier For D.C. Servo Systems: Introduction, Modes Of Operation, Bi-Polar PWM Amplifiers, Uni-Polar PWM Amplifiers, Limited Uni-Polar PWM Amplifiers, Special Features, Summary	4
7	Velocity Control Systems: Introduction, System Block Diagram, System Design And Analysis, Velocity Variation	3
8	Position Control System: Introduction, Position Control System With Tachometer Feedback, Position Control Systems Without Tachometer Feedback	3
9	Phase-Locked Servo Systems: Introduction, System Model, System Analysis, System Design	2
10	Optimal Design Of Incremental Motion Servo Systems: Introduction, design Objectives, Control Selection, Component Selection, Conclusions.	4
11	Introduction-step motors Application of step Motors, Advantages and disadvantages of step Motors, Types of Step Motors, Step Motor Performance characteristics, Solenoid-Ratchet Types of Step Motors, Variable-Reluctance Types of Step Motors, Permanent-Magnet Types of Step Motors, Electromechanical Types of Step Motors, Electro hydraulic Step Motor, Conclusion	4
12	Drive Circuitry For Step Motors Introduction, Sequence Logic, Power Drivers, Pulse Sources	3
13	A High Performance Active Suppression Driver For Variable-Reluctance Step Motor Introduction, The Active-Suppression Controller, Current Waveform, Comparison of Dynamic Performance, Two phase on operation, Effects of the speed up capacitors	4

14	Step Motor Selection Introduction, Step angle Resolution, Torque Requirements, Pulling Rate versus Load inertia characteristics, Damp response time versus Load inertia characteristics, Step angle accuracy, Power input Limitation, Temperature Limitation, Heat dissipation Limitation, Environmental Factors, Space Limitation, Cost considerations, Mounting Provisions, Selecting Gearing for use with Step Motors	4
15	Closed Loop Control Of Step Motors Introduction, The Encoder, The Switching angle of the Lead angle, Direction sensing, effect of Lead angle in Closed loop control of Step Motor, Effect of Switching angle and pulse injections on the closed loop response of four phase step motors, Closed loop control of Step Motor with time Delayed feedback, Experimental result on close loop Step Motor Control, A close loop point to point controller with encoder feedback	4
16	Closed Loop Control by Current Sensing Introduction, Typical Current waveforms and Current peak detectors, Current Detection lead angles, Dynamic equations of a variable Reluctance Step Motors, Characteristics of the ON phase current waveform, Characteristics of the OFF phase current waveform, Design consideration for effective Current detection, Closed Loop Control by Current Sensing, Computer simulation of closed loop step motor operation with current detection, A complete Closed loop point to point controller with current sensing.	4
17	Speed Control of Step Motors Introduction, Description of the Fixed unit time delay speed control system, Description of the Variable unit time delay speed control system, Performance of the fixed unit speed controller	4

Reference Books:

1. Incremental Motion Control by B. C. Kuo Vol -1 and Vol - II; SRL Publishing Company – Illinois
2. Industrial Electronics by Thomas E. Kissell, Prentice – Hall Publication
3. National Instrument web site
4. Siemens web site