Mechatronics

Chapters

1. Introduction to Mechatronics, Sensors and Actuators

1.1 Introduction to Mechatronics and its Applications
1.2 Measurement Characteristics
1.3 Motion Sensors
1.4 Force/Pressure Sensors
1.5 Temperature Sensors
1.6 Flow Sensors
1.7 Color Sensors
1.8 Biosensors
1.9 Motors: Servo Motors
1.10 Fluid-based Actuators
1.11 Electrical Actuators: Linear Electrical Actuators
1.12 Selection of Sensors and Actuators

2. Data Acquisition and Signal Communication

2.1 Signal Communication
2.2 Introduction to DAQ
2.3 Types of DAQ
2.4 Components of a Data Acquisition System (DAQ)
2.5 Signal Collection in Data Acquisition Systems
2.6 Isolation and Filtering in Signal Conditioning
2.7 Amplification in Signal Conditioning
2.8 Sampling
2.9 Aliasing
2.10 Sample and Hold Circuit
2.11 Quantization
2.12 Analog-to-Digital Converter (4-bit Successive Approximation Register)
2.13 4-bit R2R type DAC
2.14 Data Acquisition (DAQ) in Household Applications
2.15 Data Acquisition (DAQ) in Digital Pressure Gauges
2.16 Data Acquisition (DAQ) in Digital Flow Measurement
2.17 Data Acquisition (DAQ) in Digital Video Broadcast (DVB)
2.18 Data Acquisition (DAQ) in AM/FM Broadcasting

3. Control System and Transfer Function Modelling

3.1 Introduction to Control System
3.2 Types of Control Systems
3.3 Concept of Transfer Function
3.4 Block Diagram in Control Systems
3.5 Applications
3.6 Transfer Function Modeling
3.7 Concept of Poles and Zeros
3.8 Stability Analysis using Routh Hurwitz Criterion

4. Time and Frequency Domain Analysis

4.1 Time Domain Analysis
4.2 Unit Step Response Analysis
4.3 Transient Specifications in Control Systems
4.4 Frequency Domain Analysis
4.5 Frequency Domain Parameters
4.6 Damping Frequency and Damping Factor
4.7 Unit Step Response of Frequency Domain Analysis
4.8 Introduction to Bode Plot
4.9 Gain Margin and Phase Margin

5. Controllers

5.1 Introduction to Controllers
5.2 Need of Control
5.3 Proportional (P), Integral (I), and Derivative (D) Control Actions
5.4 PI (Proportional–Integral) Control
5.5 PD (Proportional–Derivative) Control
5.6 PID Control
5.7 Parallel Form Representation of PID Controller (Numerical/Discrete Approach)
5.8 Tuning of PID Controllers
5.9 Applications of Controllers

6. Programmable Logic Controller (PLC)

6.1 Introduction to PLC
6.2 Selection of PLC
6.3 Ladder Logic Programming for Different Types of Logic Gates

6.4 Latching; Timers; Counters
6.5 PLC Control of Hydraulics
6.6 Mechatronic Systems Involving Timing and Counting Operation