MECHATRONICS

Course Code:13ME1140

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Course Educational Objectives:

To make the student

- Understand various elements of a mechatronic system and how they integrate.
- Understand the concept of signal conditioning and digital signal processing.
- Know various components of hydraulic and pneumatic systems.
- Know the working of electrical actuation systems.
- Learn how different types of control systems are used for various practical applications.

Course Outcomes:

The student will be able to

- Grasp the significance of a mechatronics system
- Describe the functions of various signal conditioning and digital processing devices.
- List various components of hydraulic and pneumatic systems
- Explain the working of electrical actuation systems
- Illustrate the use of control systems for various applications.
- Explain how complex systems integrate various elements in the mechanical, fluid power, and controls domain.
- Work in a team environment with people of different areas of expertise.

UNIT-I (12 Lectures)

INTRODUCTION:

Elements of mechatronic system, system, measurement systems, control systems - open loop, closed loop systems, feedback and feed forward control systems, servomechanisms, applications of mechatronic system.

BASIC SYSTEM MODELS:

Basic concepts of mechanical, electrical, fluid and thermal systems building blocks.

UNIT-II (12 Lectures)

SIGNAL CONDITIONING:

Introduction, analog signal processing; operational amplifiers- circuits for inverting, non- inverting, difference amplifiers, integrator, differentiator, comparator, sample and hold applications (no analytical treatment.)

NOISE REDUCTION AND FILTERING:

Passive and active filters, types of filters, ADC, DAC, Data acquisition, digital signal processing.

UNIT-III (12 Lectures)

ACTUATION SYSTEMS:

Pneumatic and hydraulic systems, overview of components of hydraulic system, overview of components of pneumatic system, basic hydraulic circuits-single acting cylinder, double acting cylinder, sequencing circuit

ELECTRICAL ACTUATING SYSTEMS:

Relays, types of DC motors, AC motors, stepper motor, servo motor, induction motor.

UNIT-IV (12 Lectures)

INTRODUCTION TO DIGITAL LOGIC:

Logic gates-AND, OR, NOT, NAND, NOR, XOR, Boolean algebra, simple applications of logic gates, sequential logic, Introduction to flip-flops, registers.

MICROPROCESSORS AND MICROCONTROLLERS OVERVIEW:

Structure of microcomputer, block diagram of microprocessor, block diagram of microcontroller, applications of microprocessor control:

temperature monitoring system, washing machine system.

Process controllers- Introduction to P, PI, PID Control modes.

UNIT-V (12 Lectures)

Programmable logic controllers - Basic structure, programming, ladder diagram, timers, internal relays, counters, shift registers, master and jump controls.

PROGRAMMABLE MOTION CONTROLLERS:

Multi axis Interpolation, PTP, Linear, Circular; Core functionalities: Home, Record position, Go to Position.

DESIGN OF MECHATRONIC SYSTEM:

coin counter, engine management system, antilock brake system.

TEXT BOOKS:

1. Bolton W., *"Mechatronics – Electronics Control Systems in Mechanical and Electrical Engineering"*, 4th Edition, Pearson Education Press, 2010.
2. R.K. Rajput, *"A text book of Mechatronics"*, 1st Edition, S. Chand and Company Ltd., 2007.

REFERENCES:

1. K.P. Ramachandran, *"Mechatronics-integrated mechanical Electronic systems"*, 1st Edition, Wiley India Pvt, Ltd., 2008.
2. Histand B.H., Alciatore D.G., *"Introduction to Mechatronics and Measurement Systems"*, 3rd Edition, Tata McGraw Hill Publishing Company Ltd, 2007.