I YEAR M. TECH (MACHINE DESIGN) SECOND SEMESTER

17MEMD2T6B **MECHATRONICS** **Credits 4**

Lecture: 4 periods/week **Internal assessment: 40 marks**

Tutorial: - - **Semester end examination: 60 marks**

COURSE OBJECTIVES:

- Appraise the applications of mechatronics systems.
- Select appropriate types of sensors and actuators for the given application.
- Acquire knowledge on digital electronics, signal conditioning and controller applications.
- Familiarize with PLC Programming and system modeling and analysis.

COURSE OUTCOMES:

At the end of the course, the student shall be able to

1. Understand the fundamentals of mechatronics systems in a synergistic framework
2. Select appropriate sensors and transducers to devise an instrumentation system for collecting information
3. Design a control system for effective functioning of Mechatronics systems using digital electronics, microprocessors, microcontrollers and Programmable logic controllers
4. Determine the performance of a Mechatronics system

UNIT- I
OVERVIEW OF MECHATRONICS:
History of Mechatronics, Scope and Significance of Mechatronics systems, elements of mechatronics systems, needs and benefits of mechatronics in manufacturing.
CASE STUDIES:
Design of pick and place robot, Barcode, Washing machine, Car engine management system, automated manufacturing system, Automatic camera, Automatic parking system, Safety devices and systems.

UNIT-II
SENSORS:
Classification of sensors basic working principles, Displacement Sensor -Linear and rotary potentiometers, LVDT and RVDT, incremental and absolute encoders. Strain gauges. Force/Torque –Load cells. Temperature –Thermocouple, Bimetallic Strips, Thermistor, RTD, Accelerometers, Velocity sensors –Tachometers, Proximity and Range sensors –Eddy current sensor, ultrasonic sensor, laser interferometer transducer, Hall Effect sensor, inductive proximity switch. Light sensors –Photodiodes, phototransistors, Flow sensors –Ultrasonic sensor, laser Doppler anemometer tactile sensors –PVDF tactile sensor, micro-switch and reed switch Piezoelectric sensors, vision sensor.

ACTUATORS:

Electrical Actuators: Solenoids, relays, diodes, Thyristors, Triacs, BJT, FET, DC motor, Servo motor, BLDC Motor, AC Motor, stepper motors. Hydraulic & Pneumatic devices – Power supplies, valves, cylinder sequencing. Design of Hydraulic & Pneumatic circuits. Piezoelectric actuators, Shape memory alloys.

UNIT-III
DIGITAL ELECTRONICS:
Number systems, BCD codes and arithmetic, Gray codes, self-complimenting codes, Error detection and correction principles. Boolean functions using Karnaugh map, Design of combinational circuits, Design of arithmetic circuits. Design of Code converters, Encoders and decoders.
SIGNAL CONDITIONING:
Operational amplifiers, inverting amplifier, differential amplifier, Protection, comparator, filters, Multiplexer, Pulse width Modulation Counters, decoders. Data acquisition – Quantizing theory, Analog to digital conversion, digital to analog conversion.
CONTROLLERS:
Classification of control systems, Feedback, closed loop and open loop systems, Continuous and discrete processes, control modes, Two step Proportional, Derivative, Integral, PID controllers.

UNIT-IV
PLC PROGRAMMING:
PLC Principles of operation PLC sizes PLC hardware components I/O section Analog I/O section Analog I/O modules, digital I/O modules CPU Processor memory module Programming. Ladder Programming, ladder diagrams, timers, internal relays and counters, data handling, analogue input and output. Application on real time industrial automation systems
BASIC SYSTEM MODELS & ANALYSIS:
Modelling of one and two degrees of freedom Mechanical, Electrical, Fluid and thermal systems, Block diagram representations for these systems. Dynamic Responses of System: Transfer function, Modelling Dynamic systems, first order systems, second order systems.

Learning Resources:
Text books
1. Mechatronics, (5th edition) by W. Bolton, Addison, Wesley Longman Ltd, 2010
2. Introduction to Mechatronics and Measurement systems (4th edition) by Alciatore David G & Histand Michael B, Tata McGraw Hill, 2006

References.
1. Introduction to Robotics Analysis, Systems (2nd edition), Applications by Saeed B Niku, Pearson Education India, PHI, 2003.
2. Mechatronics System Design (3rd edition) by Devdas Shetty& Richard Kolk, PWS Publishing, 2009.

VIDEO REFERENCES:
1.http://video_demos.colostate.edu/mechatronics
2.http:// mechatronics.me.wisc.edu