MECHATRONICS
(Professional Elective - I)

I Semester

Course Code: 19ME2153

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Course Outcomes: At the end of the course, the student will be able to
CO1: Explain mechatronics design process and various applications of mechatronics systems.
CO2: Recognize appropriate sensors and actuators for an engineering application.
CO3: Illustrate the working of microcontroller and fundamentals of PLC using simple ladder logic programs.
CO4: Explain building of various mathematical models and PID modes of controller operation.
CO5: Describe machine vision system and their engineering applications.

UNIT-I **(10-Lectures)**

Mechatronics system design: Introduction, key elements, Elements of Mechatronic system, measurement systems, control systems - open loop, closed loop systems, feedback and feed forward control systems, servomechanisms, applications the mechatronics design process, advanced approaches in mechatronics.
Applications: Integrated design issues in mechatronics engine management system, antilock brake system, modern washing machine.
Learning outcomes:

1. Identify the mechatronic system and associate the feedback and feed forward control to open and closed loop systems. (L1)
2. Use the measuring concepts to design a mechatronic process. (L3)
3. Describe few applications based on mechatronic systems. (L2)

UNIT-II **(10-Lectures)**

Sensors and transducers: Introduction to sensors and transducers, sensors for motion and position measurement, force, torque and tactile sensors, flow sensors, temperature-sensing devices.
Actuating devices: DC and AC drives – servo motors and stepper motor– hydraulic and pneumatic drives – piezoelectric and magnetostrictive actuators –Introduction to Micro Electro Mechanical Systems(MEMS).
Learning outcomes:

1. Describe different types of sensors and actuating devices. (L1)
2. Interpret the sensors to the measurement systems. (L2)
3. Identify suitable motors, drives and actuators. (L1)

UNIT-III **(10-Lectures)**

Microcontroller programming: Microcontrollers, 8051 microcontrollers, PLC basics programming, fundamentals, basic PLC programming using timers, counters, latches.
Learning outcomes:

1. Summarize PLC programming techniques. (L2)
2. Model different types of microcontrollers. (L3)
3. Illustrate the applications of timers counters and latches. (L4)

UNIT-IV **(10-Lectures)**

Concepts of System and Modelling Signals, systems and controls: Introduction to signals, system representation, linearization of nonlinear systems, time delays.
Modeling of physical systems: Development of mathematical models; of mechanical, electrical, fluid and thermal systems.

Introduction to PID controller-transfer function-P PI and PID modes of operation.
Learning outcomes:

1. Model system representations and calculate nonlinear systems and time delays. (L3)
2. Select mathematical model to design mechanical, electrical, fluid and thermal system and their correlations. (L4)
3. Classify P, PI and PID modes of operation. (L4)

UNIT-V **(10-Lectures)**

Introduction to Machine Vision: Human Vision - Machine vision and computer vision – HMI, hardware components-MVS camera-analog, digital- CID, CCD, CMOS, camera calibration - frame grabber, manual & auto shutter-type and selection-application of machine vision in automotive industries, manufacturing, electronics, printing, pharmaceutical, biomedical, robotics, agricultural applications.
Learning outcomes:

1. Contrast various vision systems (L2)
2. Categorize analog and digital components of camera. (L4)
3. Determine the method of application of machine vision in various fields (L3)

TEXT BOOKS:

1. Bolton W., *Mechatronics – Electronics Control Systems in Mechanical and Electrical Engineering*, 6th Edition, Pearson Education Press, 2019.

REFERENCE BOOKS:

1. Histand B.H. and Alciatore D.G., *Introduction to Mechatronics and Measurement Systems*, 4th Edition, Tata McGraw Hill,2017.
2. E. R. Davies, *Machine Vision: Theory, Algorithms*, *Practicalities*, 3rd Edition, Morgan Kaufmann,2005.