SUBJECT : **MTS, 336 Instrumentation and Measurements**

CREDIT HOURS : 3-1

CONTACT HOURS : 6 Hours per Week

TEXT BOOKS:
1. **Process Control Instrumentation Technology** by Curtis D. Johnson
2. **Electric Drives and their Control** by R. M. Crowder

REFERENCE BOOKS: Any book on Process Control and Instrumentation.

MODE OF TEACHING: Lectures, Practicals and Demonstrations.

COURSE OBJECTIVES: One of the most daunting challenge in engineering education is to enable the students to integrate all they have learned – science, mathematics, engineering fundamentals – in the solution of a real-world engineering problems. Fundamentals of Industrial Controls and Instrumentation deal with the integrated and optimal design of a physical system, including sensors, actuators, electronic components, and the embedded digital control system. The integration is respect to both hardware components and information processing.

COURSE OUTCOMES: At the completion of the course the students will understand the following important concepts:

1. General understanding of instrumentation and measurement principles and terminologies.
2. Understand the operating principles of basic instrumentation circuits.
3. Comprehend various signal conditioning techniques: Analogue-to-digital and digital-to-analogue conversion.
4. Ability to undertake analogue-to-digital and digital-to-analogue conversion using microcontrollers/PCs.
5. Understand/use various sensors: Temperature, displacement & position, force, pressure, strain, vibration, velocity, flow rate.
6. Understand various types of actuators and use them practically.
7. Comprehend different experimental techniques: Impulse inputs, ramp inputs and ssinusoidal & swept sine testing

TOPICS COVERED:

1. Introduction: Measurement terminologies (resolution, sensitivity, accuracy, precision & uncertainty
2. The Industrial Control Environment

a. Introduction to process control
b. Control loop characteristics

3. Basic Instrumentation
   a. Principles of different measurement techniques
   b. Bridge circuits for measurement of resistance, inductance and capacitance
   c. Microprocessor based instrumentation circuits.
4. Signal Conditioning
   a. Analogue signal conditioning
   b. Instrumentation amplifiers
   c. Analogue filters
   d. Analogue-to-Digital converters
   e. Digital-to-Analogue converters
5. Sensors
   a. Temperature measurement (Thermocouples, RTDs, Thermisters)
   b. Displacement and Position measurement (Digital encoders, shaft encoders, absolute and relative encoders, linear encoders)
   c. Sensors for force, pressure, strain, vibration, velocity, flow rates etc.
6. Actuators
   a. Various types of electrical, pneumatic and hydraulic actuators
   b. Brushless DC motors
   c. Stepper motors and servos
7. Experimental Techniques
   a. Impulse Inputs
   b. Ramp Inputs
   c. Sinusoidal testing and swept sine testing

List of Experiments

Week	Details
1-2	**Lab 1: Introduction and overview to Software** • Exp 1: Study Features of the software LabView • Exp 2: Integrating C codes with the LabView user interface • Q&A Session
3-4	**Lab 2: Serial Communication** • Exp 1: Communication between microcontroller card and PC • Exp 2: Communicating with microcontroller using LabView • Q&A Session

5-6	**Lab 3: LabView Experiments** • Exp 1: Using Digital I/O point status in LabView • Exp 2: Sending Digital commands through LabView • Q&A Session
7-8	**Lab 4: Using D/A and A/D Converters** • Exp 1: A/D conversion using microcontroller and PC • Exp 2: D/A conversion using microcontroller and PC • Q&A Session
9-10	**Lab 5: Switches** • Exp 1: Using Transistor as Switch • Exp 2: Using Opto-Coupler • Exp 3: Using IR Switch • Exp 4: Using Optical Switch • Q&A Session
11-12	**Lab 6: Motor Control** • Exp 1: Design Shaft Encoder • Exp 2: Speed and Direction Control of motor using H-Bridge • Q&A Session
13-14	**Lab 7: Project 1 and Project 2** • Q&A Session