INSTRUMENTATION AND AUTOMATION

ENCH 256

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 3/2

Course Objectives:
The objective of this course is to provide a comprehensive understanding of the functional elements, classification, and performance characteristics of measurement instruments and their applications in process industries. It aims to equip students with knowledge of sensors, transducers, signal conditioning, and data acquisition systems essential for accurate measurement and control in engineering processes. Furthermore, the course introduces the fundamentals of automation and explores industrial automation systems such as Programmable Logic Controllers (PLC), Distributed Control Systems (DCS), and Supervisory Control and Data Acquisition (SCADA).

1 Introduction (7 hours)

1.1 Functional elements of measurement system and instrument system
1.2 Classification of instruments
  1.2.1 Deflection and null types, manually operated and automatic types, analog and digital types
  1.2.2 Self-generating and power-operated types, contacting and non-contacting types, dumb and intelligent types
  1.2.3 Application of instrument systems
1.3 Standard and calibration

2 Characteristics of Instruments (6 hours)

2.1 Types of errors and uncertainties in instrumentations
2.2 Static performance parameters: Accuracy, repeatability, precision, threshold, sensitivity, resolution, linearity, range and span, hysteresis, dead band, drift, backlash, selection of instrument
2.3 Dynamic response: Periodic input-harmonic type, general periodic input – non-harmonic type, transient type input and random input; compensation

3 Process Instrumentation (9 hours)

3.1 Working principles of instruments used for the measurement of flow, level, force, pressure, temperature, density, viscosity, humidity, pH value, turbidity

3.2 Advantage and disadvantage of instruments
3.3 Application considerations

4 Building Blocks of Instrument (8 hours)

4.1 Classification, principles and applications of sensors and transducers
4.2 Transducer, amplifier, signal, conditioner
4.3 Signal isolation, signal transmitter, display
4.4 Data acquisition modules, I/O devices, signal convertors, interfaces

5 Control System and Automation Strategy (6 hours)

5.1 Evolution of instrumentation and control
5.2 Types of industries and automation
5.3 Role of automation in industries
5.4 Benefits of automation and automation strategy evolution

6 Computer Based Control Systems (9 hours)

6.1 Introduction, evolution, types, architecture and applications of PLC system
6.2 Introduction, evolution, architecture, types and applications of DCS system
6.3 Introduction, evolution, types, architecture and applications of SCADA system

Tutorial (15 hours)

1. Practical application of instrument
2. Sensors and Primary transducers
3. Working principle of instrument used for the measurement of pH, turbidity, density
4. Role of automation in industry
5. Role of PLC in automation

Practical (22.5 hours)

1. Calibration of differential pressure transmitter
2. Calibration of thermocouples
3. Control valve characterization
4. Calibration of pressure guage using a dead weight calibrator
5. Study of I/P and P/I converter
6. Familiarization and simple programming exercise
7. Logic operation in ladder logic
8. Basic level control
9. Tank filling sequence

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks distribution*
1	7	9
2	6	8
3	9	12
4	8	11
5	6	8
6	9	12
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Dunn, W. C. (2009). Fundamentals of Industrial Instrumentation and Process Control. Tata McGraw Hill.
2. Nakra B. C. Chaudhary K. K. (2004). Instrumentation, Measurement and Analysis. Tata McGraw Hill.
3. Singh, S. K. (2004). Computer added process control. PHI