Basic Instrumentation I

Code-S-4214

Teaching Scheme:
Lectures: 4hrs per week
Practicals: 2 hrs per week

Examination Scheme:

Test marks	25
Term Work	25
End of term	
Theory paper	75 (3 hrs duration)
Practical Exam	—
Total marks	125

		Hrs	Mks
I	**Introduction to Instrumentation Systems.**	**10**	**12**

1. Definition of Instrumentation.
2. Objectives of measurement and the need for control instrumentation.
3. Basic building blocks of a measurement system.
   - Brief description of basic functional elements
   - Brief description of auxiliary elements.
4. Classification of instruments and their comparison
   - Null and deflection types
   - Manually operated and Automatic types
   - Analog and digital types
   - Self generating and power operated types
   - Contacting and non-contacting types.
5. Typical applications of the Measurement system
   - Measurement of system parameters for monitoring of processes and operations
   - Control of processes and operations
   - Experimental Engineering analysis.
6. Standards and Calibration.
   - International standards
   - Primary standards
   - Secondary standards
   - Working standards
   - Primary calibration
   - Secondary Calibration
   - Direct calibration
   - Indirect Calibration
   - Routine calibration

II. **Introduction to the transducer Element** 06

1. Classification of transducers
   - Analog and Digital
   - Electro-mechanical and Opto-electrical
   - Self-generating and Power-operated

2. Principle of working of the following electrical transducers.
   a. Variable control parameter type
      - Resistance type
      - Capacitance type
      - Inductance type
      - Mutual inductance type.
   b. Self generating type
      - Electro-magnetic
      - Thermo-electric
      - Piezoelectric
      - Photovoltaic

3. Principle of working of the following Mechanical transducers
   - Spring
   - Cantilever
   - Diaphragm
   - Bourdon tube
   - Bellows
   - Flapper nozzle.

III. **Variable resistance transducers** 18

1. Mechanically varying types
   - Construction, characteristics and comparison of various types of potentiometers.
   - Application of potentiometers in measuring pressure and displacement (block diagrams with different measurement techniques and o/p waveform at each stage)
   - One practical example of displacement measurement system.

2. Resistivity change types
   a) Resistance strain gauges
      - types of strain gauges
      - constructional details of all types
      - comparison between the types
      - bonding techniques used.
      - temperature compensation techniques used

- measurement circuitry used for both static and dynamic strains

b) Application of resistance strain gauge in measurement of force/pressure(Block diagram with different measurement techniques and output waveform at each stage)

c) Typical practical example of a strain measuring system

3. Photoconductive cell (LDR)

   Application of photoconductive cell in measuring displacement and pressure.

4. Thermal resistance change

   a) Construction, characteristics and comparison of various types of
      - RTDs
      - Thermistors
      - IC sensors (LM series, AD series)

   b) Measurement of temperature using the above transducers (Block diagram showing measuring techniques)

   c) Compensation techniques used (three lead, four lead method)

   d) Typical practical example of a temperature measuring system (Block diagram)

IV. Variable Inductive transducers **15** **17**

1. Working principles and constructional details of variable inductance due to
   - change in self inductance
   - change in mutual inductance
   - change in production of eddy currents
2. Comparison of the above 3 types
3. Measurement of displacement and pressure using these transducers (Block diagram with o/p waveforms at each stage)
4. Single o/p and differential o/p arrangement.

V. Variable capacitive transducers **15** **18**

1. Working principle and constructional details of variable capacitance due to
   - change in area
   - change in distance between plates
   - change in dielectric constant.
2. Comparison of the above three types
3. Measurement of displacement, pressure and level using these transducers (Block diagram with o/p waveform at each stage)
4. Single output and differential o/p arrangement.

Total **64** **75**

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