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Total Number of Pages: 02

Course: B.Tech  
Sub\_Code: REI5C003

5<sup>th</sup> Semester Back Examination: 2025-26  
SUBJECT: INSTRUMENTATION DEVICES & SYSTEMS  
BRANCH(S): AEIE  
Time: 3 Hours  
Max Marks: 100  
Q.Code: U442

Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.  
The figures in the right hand margin indicate marks.

**Part-I**

**Q1 Answer the following questions: (2 x 10)**

- a) Define sensitivity of an instrument.
- b) What are statistical characteristics of measurement?
- c) What is loading effect?
- d) Define signal-to-noise ratio (SNR).
- e) What is the gauge factor of a strain gauge?
- f) Define cold junction compensation in thermocouples.
- g) Define common-mode rejection ratio (CMRR).
- h) What is quantization error?
- i) Define gauge pressure and absolute pressure.
- j) State Bernoulli's theorem.

**Part-II**

**Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)**

- a) Discuss the dynamic characteristics of second-order instruments and derive expressions for natural frequency and damping ratio.
- b) Describe the loading effect in measurement systems. How does it influence measurement accuracy?
- c) Discuss various techniques of dynamic compensation used in measurement systems.
- d) Explain the construction, working, and applications of LVDT.
- e) Discuss the construction and working of Resistance Temperature Detectors (RTDs).
- f) Explain capacitive sensing with variable separation, variable area, and variable dielectric.
- g) Discuss the working of an instrumentation amplifier and derive its gain expression.
- h) A resistive Wheatstone bridge has the following arm resistances:  
 $R_1 = 120 \Omega$ ,  $R_2 = 100 \Omega$ ,  $R_3 = 120 \Omega$ ,  $R_4 = 100 \Omega$ . The bridge is excited with 10 V.
  - (I) Determine whether the bridge is balanced.
  - (II) Calculate the bridge output voltage.
  - (III) If  $R_1$  changes by + 1 %, compute the new output voltage.

- i) Explain the working of a U-tube and inclined manometer with diagrams.
- j) Describe the working principle of a Venturi tube with applications.
- k) Explain the working of Doppler shift flow meter and derive the Doppler frequency equation.
- l) Describe the construction and operation of a bimetal thermometer.

### Part-III

#### Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** a) Explain in detail the types of errors. Discuss statistical methods of error analysis and the complete calibration procedure. **(8 x 2)**
- b) A voltage measurement is taken 10 times using a digital voltmeter, and the readings (in volts) are: 9.8, 10.1, 9.9, 10.2, 10.0, 9.7, 10.3, 9.8, 10.1, 9.9. Calculate mean, average deviation, standard deviation, and variance of above readings.
- Q4** Explain different elastic sensing elements. Discuss their working principles, sensitivity, characteristics, and applications for pressure, force, and torque measurement. **(16)**
- Q5** Explain the design of resistive and reactive bridge circuits with derivations for output voltage, sensitivity, balancing, and methods to improve linearity. Discuss practical applications in instrumentation. **(16)**
- Q6** Explain the Hall effect transducer thoroughly. Discuss its construction, principle, characteristics, calibration, and applications in pressure measurement. **(16)**