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Total Number of Pages: 02

Course: B.Tech
Sub_Code: REI5C003

5th 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)**