Time: 3 Hours   **Total Marks: 80**

N.B: 1) **Question No. 1 is *compulsory*.**

2) **Attempt any *THREE* questions out of remaining *FIVE* questions.**

3) **Assume suitable data wherever necessary.**

4) **Use of Graph paper is allowed.**

5) **Figures to the right indicate full marks.**

1. **Answer of the following questions (*any Four*).**   **(20)**

   i) Differentiate between primary, secondary and tertiary standards.

   ii) Explain roughness and waviness with suitable diagram.

   iii) Define: Accuracy, Precision, Span and Range of measuring instruments.

   iv) What is RTD? How does it work?

   v) Define the term transfer function with its significance in control system.

   vi) Write a note on *Frequency domain specifications*.

2. (A) Define the term gauge factor of a strain gauge with its significance.   **(05)**

   (B) Describe with neat diagrams the working of *McLeod gauge* for the pressure measurement. **(05)**

   (C) Find the shaft and hole dimensions with tolerance for a **90 H8 e9 pair** with the following   **(10)**
   data:

   90 mm lies in the diameter step of **80 to 100 mm**
   Upper deviation for e shaft = $11\ D^{0.41}$
   Tolerance unit $i = 0.45\ D^{1/3} + 0.001D$ micron

   Also find the type of fit produced.

3. (A) Classify control system with suitable examples.   **(05)**

   (B) What is difference between unilateral and bilateral tolerances? Why is unilateral tolerance   **(05)**
   preferred over bilateral tolerance?

   (C) Describe with neat diagrams the working principle of the magnetic flow meter and   **(10)**
   ultrasonic flow meter for flow measurement.

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4. (A) What is the difference between direct and indirect measuring instrument? Give one example of each type. **(05)**

(B) A system is represented by the characteristic equation **(05)**

$$P(S) = S^6 + S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0,$$

Determine the stability of the system by using Routh's criterion.

(C) Define *Interferometry*. Describe with neat sketch the working principle of Laser interferometer. **(10)**

5. (A) Describe with neat sketch **'*Two Wire Method'*** in screw thread measurement. **(10)**

(B) Define desired input, modifying input and interfering input for measuring instruments with suitable examples. Also suggest the methods to minimize the effect of modifying and interfering input. **(10)**

6. (A) A unity feedback system is characterized by open loop transfer function **(10)**

$$G_{(S)} = \frac{25}{S(S+5)}$$

For a unit step input, determine a) Rise time, b) Peak time, c) Settling time d) Peak overshoot.

(B) A system is characterized by transfer function **(10)**

$$G_{(S)} \, H_{(S)} = \frac{K}{S \, (S+5) \, (S+10)}$$

Determine the stability of the system by using root locus method.

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