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 the following questions (*any Four*). **20**

i) Differentiate between systematic errors and random errors.

ii) How can flatness be checked with the help of an optical interferometer?

iii) Define: Reproducibility, Hysteresis, Threshold, Range and Span of measuring instruments.

iv) Illustrate the working principle of nozzle flapper for displacement measurement.

v) Explain open loop and closed loop control systems.

vi) Using Routh's criterion examine the stability of a control system whose characteristic equation is $S^5 + 2S^4 + 3S^3 + 4S^2 + 5S + 6 = 0$

2. (A) Derive an expression for "Two-wire Method" for effective diameter measurement of a screw thread **10**

(B) Calculate the limits, tolerances and allowances on a 25 mm shaft and hole pair. Designated H7/g6 to get precision fit. The fundamental tolerances is calculated by following equations: **10**

$$i = 0.4533\,D + 0.001D \text{ micron}$$

The following data is given:

a) Upper deviation of shaft = $-2.5\,D^{0.4}$
b) 25 mm falls in the diameter step of 18 - 30 mm
c) IT7 = 16i
d) IT6 = 10i
e) Wear allowance = 10% gauge tolerance

3. (A) With neat sketch, explain the constructional features and working of **10**

i) LVDT
ii) Parkinson's Gear Tester

(B) Draw the Root-Locus of the system having **10**

$$G(s)H(s) = \frac{K}{S(S+1)(S+3)(S+4)}$$

4. (A) 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**

(B) A system has transfer function given by **10**

$$\frac{C_{(s)}}{R_{(s)}} = \frac{\mathbf{100}}{\boldsymbol{s^2 + 15s + 100}}$$

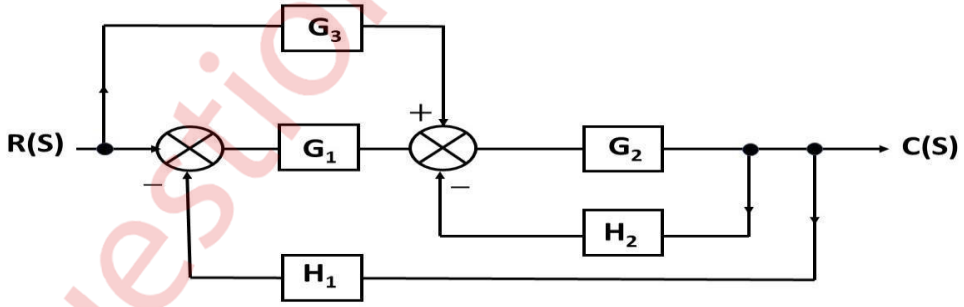
Determine, peak time, percent overshoot, settling time and rise time.

5. (A) With neat sketch, explain the constructional features and working of **10**

i) Ultrasonic Flow Meter

ii) Ionization Gauge

(B) Reduce the given block diagram to a its canonical form and hence obtain equivalent transfer function, $\frac{C(s)}{R(s)}$. **10**



6. Write short note on ***(any Four)*** **20**

i) Interference Fit

ii) Strain Gauge based load cell

iii) Frequency Domain Specifications

iv) Tomlinson Surface Tester

v) Static Calibration

vi) RTD
