**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 systematic errors and random errors.

   ii)   What are optical flats? How can optical flats be used for checking flatness?

   iii)   The dead zone of a certain pyrometer is 0.15% of the span. The calibration is $500^0$C to $859^0$C. What temperature change may occur before it is detected?

   iv)   What is RTD? How does it work?

   v)   Define control system. What the requirements of a good control system?

   vi)   Using Routh's criterion examine the stability of a control system whose characteristic equation is   $S^5 + S^4 + 2S^3 + 2S^2 + 3S + 15 = 0$

2.   **(A)**   Explain the '*Three Wire Method*' used in screw thread measurement.                   **(10)**

   **(B)**   Draw the root locus and comment on the stability of the control system having open   **(10)**
loop transfer function as follows:

$$G(s)H(s) = \frac{K}{s^2(s+1)}$$

3.   **(A)**   Explain generalized measurement system elements with block diagram. Describe   **(10)**
functions with suitable examples

   **(B)**   With neat sketch, explain the constructional features and working of                    **(10)**

   i)         Ultrasonic Flow Meter

   ii)        Parkinson's Gear Tester

4.   **(A)**   Describe with neat diagrams the construction and working principle of ***Ionization and***   **(10)**
***Thermal Conductivity gauges*** for pressure measurement.

   **(B)**   A unity feedback system has                                                               **(10)**

$$G(s) = \frac{100}{S^2(0.5S + 1)(S + 2)}$$

   a.   Type of system

   b.   Error constants $K_p$, $K_v$, $K_a$

   c.   Find steady state error for unit parabolic input

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**5. (A)** Design a general type of Go and No Go plug gauge for inspecting a hole **25 d8.** Given that: (10)

$$i = 0.40 D^{1/3} + 0.001D \text{ micron}$$

    a) Tolerance for hole = **25 i**

    b) Fundamental deviation of hole = **16 $D^{0.44}$**

    c) Wear allowance = 10% gauge tolerance

**(B)** Define the terms a) Rise time, b) Peak time, c) Settling time d) Peak overshoot with respect to transient response of a system. (10)

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

    a)      Optical Encoder

    b)      Magnetic Flow Meter

    c)      LVDT

    d)      Repeatability and Reproducibility

    e)      Strain Gauge based load cell

    f)      Frequency Domain Specifications

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