(3 Hours) **[Total marks: 80]**

Instructions:
1. **Question 1 compulsory**.
2. Attempt any **three** questions from the remaining **five** questions.
3. Assume suitable data, **if necessary**.
4. **Figures/sketches** carry weightage.

Q1) a) Consider the characteristic equation $s^4 + 2s^3 + (4+k)s^2 + 9s + 25 = 0$, using the Hurwitz stability criterion , determine the range of "k" for stability. 08

b) Differentiate between open loop and closed loop system with examples. 06

c) Explain the following terms with respect to the measuring system:
i) Span and Range ii) Drift and Threshold 06

Q2) a) Explain the construction and working of a Nozzle Flapper with a neat sketch 08

b) Illustrate the working principle of Optical Encoder with a neat sketch 08

c) Illustrate the terms state variables and state space with reference to state space modelling of a control system. 04

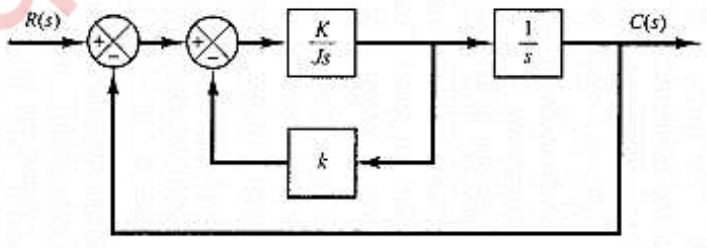
Q3) a) Explain the constructional features and working of a "Ionization Gauge" for pressure measurement. 08

b) A McLeod Gauge has volume of bulb and measuring capillary V= 100×10^{-6} m^3 and measuring capillary diameter of 1 mm. Calculate the pressure indicated when the reading of the measuring capillary is 30 mm in case approximate formula is used. What is the error if the exact formula is used for measurement of pressure? 06

c) Illustrate the working of Ultrasonic flow meters. 06

Q.4 a) Illustrate the constructional features and working of LVDT with a neat sketch 07

b) Determine the values, of "K" and "k" of the closed-loop system shown in figure so that the maximum overshoot in unit-step response is 25% and the peak time is 2 sec. Assume that 08
J = 1 kg-m^2.



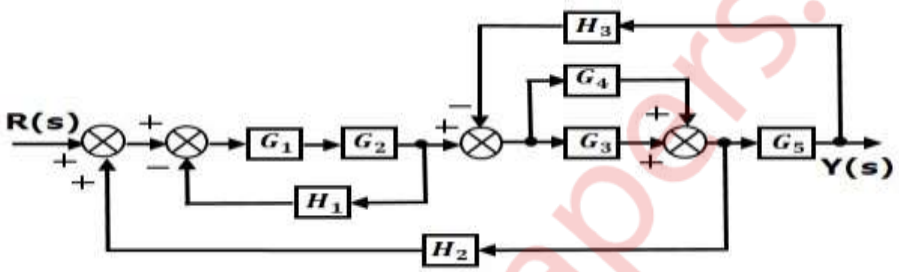
c) A system is described by $\frac{d^2y}{dt^2} + 10\frac{dy}{dt} + 30\,y(t) = 60\,x(t)$, find the natural frequency and damping ratio. 05

Q.5 a) For a system with unity feedback having , G(s) = $\frac{800\,(s+2)}{s^2\,(s+10)s+40)}$ 10

Sketch Bode plot and determine G.M., P.M and comment on stability.

b) A unity feedback system is represented by the equation G(S)= $\frac{20\,(S+3)}{S(S+1)(S+4)}$, find (i) type of the system (ii) static error co-efficients and steady state error for ramp input of magnitude "5". 10

Q6) a) Reduce the given block diagram to its canonical form and hence obtain its equivalent transfer function, for the block diagram shown below. 10



b) Obtain the state-space equation and output equation for the system defined by the equation 10

$$\frac{Y(s)}{U(s)} = \frac{2s^3 + s^2 + s + 2}{s^3 + 4s^2 + 5s + 2}$$

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