

- N.B. (1) Question number 1 is compulsory.
 (2) Attempt any 3 questions from remaining.
 (3) Assume suitable data if required.
 (4) Figure to the right indicates full marks.

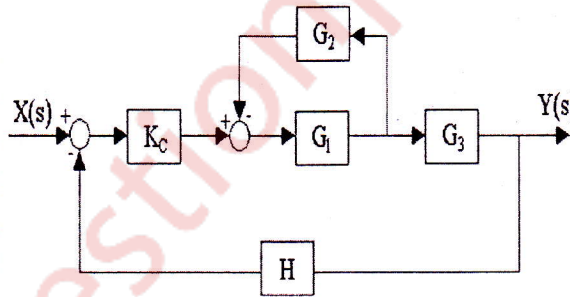
Q1. Attempt any four .

[20]

- Explain open loop & closed loop control systems by giving suitable examples & also highlight their merits & demerits.
- What are the properties of state transition matrix?
- What is a compensator? Why is it required?
- Explain Mason Gains' Formula with its need.
- Explain the effect of addition of pole and zero to a system.

Q2. A) Find the transfer function $C(s)/R(s)$ of the following system using block diagram technique.

[10]



Q2. B) Consider Unity feedback control system with open loop transfer function given as

[10]

$$G(s) = \frac{k(s+1)(s+2)}{(s+0.1)(s-1)}$$

Plot the Root Locus and find the gain at which system is critically damped.

Q3. A) Write a note on advances in control system.

[10]

Q3. B) Obtain the state variable model of the transfer function –

[10]

$$\frac{Y(s)}{R(s)} = \frac{s + 3}{s^3 + 5s^2 + 8s + 4}$$

Q4. A) Check controllability and observability for the system described by [10]

$$\dot{x} = \begin{bmatrix} 0 & 6 & -5 \\ 1 & 0 & 2 \\ 3 & 2 & 4 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix} u$$

$$Y = [1 \quad 2 \quad 3] x$$

Q4. B) Determine the stability of the system having characteristic equation [10]

$$S^5 + s^4 + 2s^3 + 3s + 5 = 0$$

Q5. A) Construct the Bode Plot for the following transfer function. Comment on stability. [10]

$$G(s) = \frac{K}{(s+3)(s+5)(s^2+2s+2)}$$

Q5. B) List the performance specifications of Time Response Analysis and derive any four of them. [10]

Q6. Write in short

- A) Explain with example Adaptive Control System. [20]
- B) Compare PI, PD, PID Controller.
- C) Explain the stability of $s^5 + 2s^4 + 2s^3 + 4s^2 + 4s + 8 = 0$ using Routh Method.
- D) Draw polar plot for the transfer function given by

$$G(s) = \frac{1}{(1+s)(1+4s)}$$
