

Time: 3 Hours

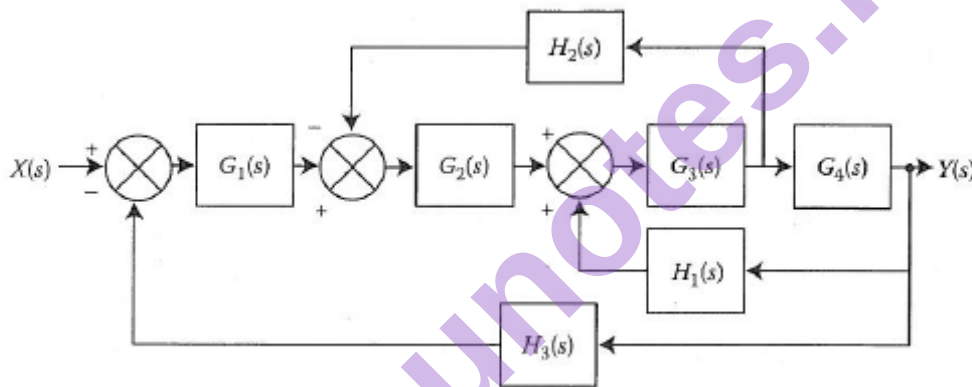
Marks: 80

- 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 questions .

[20]

- Explain needs of compensation in control system also explain different types of Compensation with suitable example.
- What are the properties of state transition matrix?
- Define Gain margin and Phase margin. Explain how these margins are used for stability analysis
- Give comparison between open loop and closed loop control systems.
- 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) Determine breakaway points and break-in points for the characteristics equation given as [10]

$$1 + \frac{K(s+2)(s+3)}{s(s+1)} = 0$$

Plot the Root Locus for the system .

Q3. A) Derive an expression for peak time and settling time of an under damped second order system. [10]

Q3. B) Obtain the state variable model of the transfer function – [10]

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

Q4. A) Apply Kalmans test for checking the controllability of given state equation. [10]

$$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$

Q4. B) Ascertain stability of the system whose characteristic equation is $s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$. Also find the number of roots lying on the left half, right half and imaginary axis of the s-plane. [10]

Q5. A) Construct the Bode Plot for the following transfer function. Determine the following: [10]

i) Gain Margin ii) Phase margin iii) Closed loop stability [10]

$$G(s)H(s) = \frac{4}{s(s+0.5s)(1+0.08s)}$$

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

Q6. A) State Adaptive Control System significance in engineering applications [05]

Q6. B) Explain PID Controller. [05]

Q6. C) Explain the effect of adding a pole to a system on time response. [05]

Q6. D) Draw polar plot for the transfer function given by [05]

$$G(s) = \frac{8}{s(1+s)}$$