

Time: 3 Hours

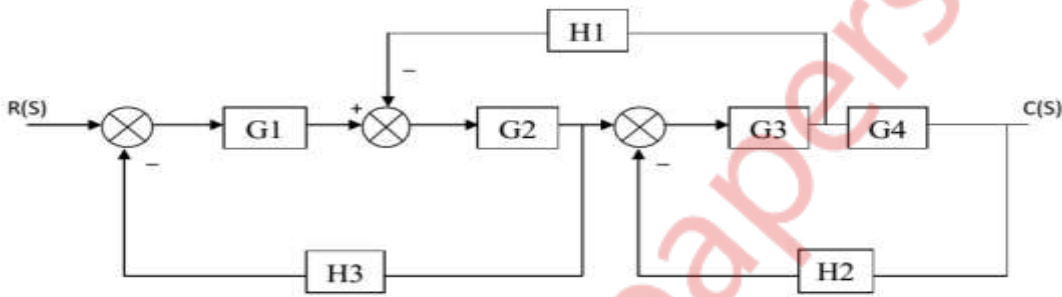
Marks: 80

- N. B. 1. Question no. **1** is compulsory.
 2. Attempt any **THREE** questions from remaining.
 3. Assume suitable data if required.
 4. Figure to the right indicate full marks.

Qu.1 : Solve any **Four** 20 M

- Explain the effect of addition of pole and zero to the system.
- Explain any five rules of Root Locus Plot in detail.
- Define Gain margin and Phase margin. Explain how these margins are used for stability analysis.
- Explain the Mason's gain formula with reference to Signal Flow Graph Technique.
- Explain needs of compensation in control system also explain different types of Compensation with suitable example.

Qu. 2: (a) Using block reduction technique, obtain the transfer function. 10 M



b) Construct SFG for the following set of equation. 10 M

- $Y_2 = G_1Y_1 - G_2Y_4$
- $Y_3 = G_3Y_2 + G_4Y_3$
- $Y_4 = G_5Y_1 + G_6Y_3$, Where Y_4 is the output.

Obtain the overall transfer function by using Mason's gain formula.

Qu. 3: (a) Explain Controllability and Observability with the necessary condition for stability and Check Controllability and Observability for the system 10 M

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

$$y = [1 \quad 3 \quad 0]x$$

(b) Explain PID Controller and Model Predictive control system in detail? Also list its advantages. 10 M

Qu. 4: (a) Construct the Routh array and determine the stability of the system whose characteristics equation is 10 M

$$S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0$$

(b) Sketch the root locus for a unity feedback control system and forward transfer function is 10 M

$G(S) = \frac{K(S+3)}{S(S+2)(S+1)(S+4)}$. Find the frequency and gain K for which the root locus crosses the imaginary axis. For what range of k is the system stable?

Qu. 5: (a) Construct the Bode Plot for the open loop transfer function. Comment on Stability. $G(S) = \frac{288(S+4)}{S(S+1)(S^2+4.8S+144)}$ and $H(S) = 1$. 10 M

(b) State and Prove properties of State Transition matrix. Obtain the state model for the system with transfer function $\frac{Y(S)}{U(S)} = \frac{3S+4}{S^2+5S+6}$ 10 M

Qu. 6: (a) Sketch the Nyquist plot for a given open loop transfer function 10 M

$G(s).H(s) = \frac{1}{(s+1)(s+2)}$ And comment on the stability of the system.

(b) A unity feedback system has $G(S) = \frac{20(S+1)}{S^2(S+2)(S+4)}$ Find 10 M

- i. All static error co-efficient (Kp, Kv, Ka).
- ii. Steady State Error of ramp i/p with magnitude 4.