Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 90980

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025

Third Semester

Electronics and Communication Engineering

EC 3351 – CONTROL SYSTEMS

(Common to : Electronics and Telecommunication Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

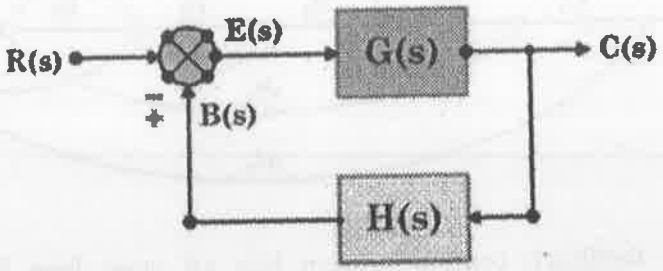
(Use of Semi-logarithmic and Linear graph sheets is permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define transfer function of the system.

2. Find the transfer function C(s)/R(s) of the given system.



3. For a given unity feedback system loop transfer function G(s). H(s) = 10 / S(S+5). Find the type and order number of the system.

4. Mention the effect of PI controller on the system performance.

5. List the Frequency Domain Specifications.

6. Signify the need of compensator. List the types of compensators.

7. Define Routh stability criterion.

8. State the advantages of nyquist stability criterion over routh criterion

9. Compare transfer function modeling and state space modeling.

10. Specify role of state transition matrix.

PART B — (5 × 13 = 65 marks)

11. (a) Write the differential equation governing the mechanical rotational systems shown in the figure 11(a) and find the transfer function $\theta(s)/T(s)$. Draw the Force-Voltage electrical analogous circuits.

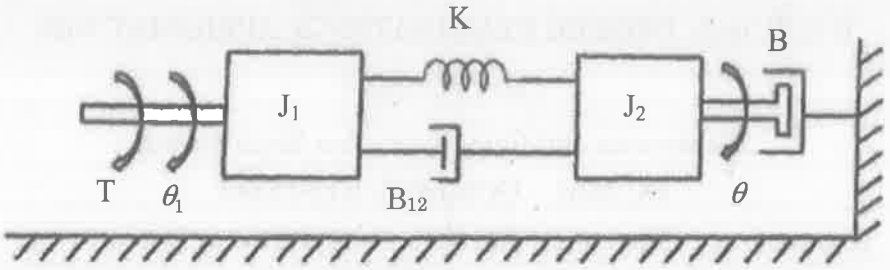
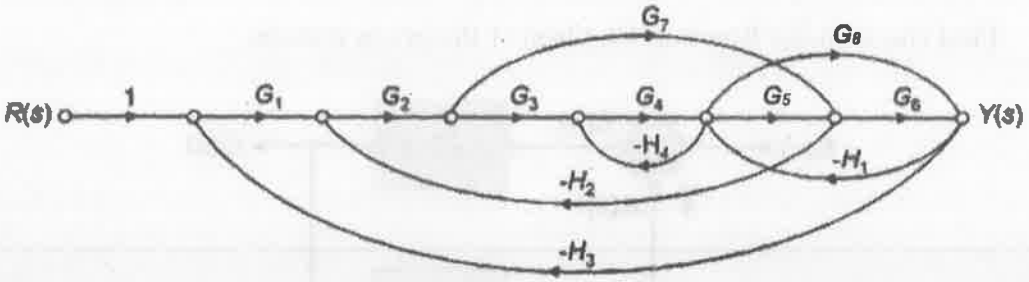


Fig. 11(a)

Or

(b) For the given signal flow graph find C(S) / R(S) using Mason's Gain formula



12. (a) A unity feedback control system has an open loop transfer function $G(S)=10/S(S+2)$

Find the rise time, percentage over shoot, peak time and settling time.

Or

(b) For a unity feedback control system the open loop transfer function

$G(S)=10(S+2)/S^2(S+1)$

Find (i) Position, velocity and acceleration error constants. (6)

(ii) The steady state error when the input is R(S) where $R(S)=3/S-2S^2+1/3S^3$. (7)

13. (a) Plot the Bode diagram for the following transfer function and obtain the gain margin and phase margin of the system.

$G(S)=10/S(1+0.4S)(1+0.1S)$

Or

(b) Demonstrate the design procedure for lag compensator with example.

14. (a) Using Routh criterion determine the stability of the system whose characteristics equation is

$S^6+S^5-2S^4-3S^3-7S^2-4S-4$

Or

(b) Sketch the root locus and find the value of K for the unit feedback system. Whose open loop transfer function is

$G(S)=K(S+1.5)/S(S+1)(S+5)$.

15. (a) Test the controllability and observability of the system whose state space representation is given as

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}0\\ 0\\ 6\end{bmatrix}u$$

$$y=\begin{bmatrix}1 & 0 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}.$$

Or

(b) Construct the state model of the system whose transfer function is given by $Y(s)/U(s)=10/(S3+4S2+2S+1)$

PART C — (1 × 15 = 15 marks)

16. (a) Compute state transition matrix for the system, given that the system matrix A is

$$A=\begin{bmatrix}0 & 1\\ 0 & -2\end{bmatrix}.$$

Or

(b) The open loop Transfer function of a unity feedback is G(s) = K / S (S+1). It is desired to have the velocity error constant K_V = 12 Sec^{-1} and phase margin as 40°. Design a lead compensator to meet the above specifications.