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Question Paper Code : 81229

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 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

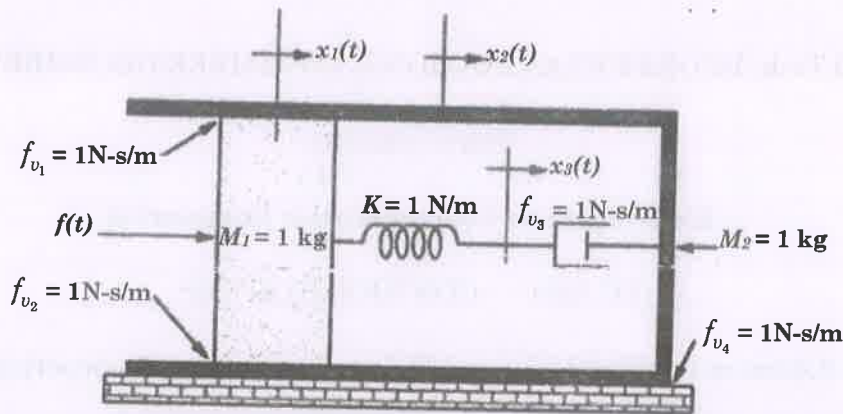
Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Distinguish between open loop and closed loop system.
2. What is the significance of servo system?
3. For the system with the transfer function as given below, determine type and order of the System
$$G(S)H(S) = (S + 5) / S(S + 10).$$
4. What is the effect of PD, PI controller on system performance?
5. Define gain margin with respect to bode plot.
6. What is frequency response of the system and List out the different frequency domain specifications?
7. What is the necessary and sufficient condition for stability?
8. Define relative stability of the system.
9. What are the advantages of state space approach?
10. Write the properties of state transition matrix.

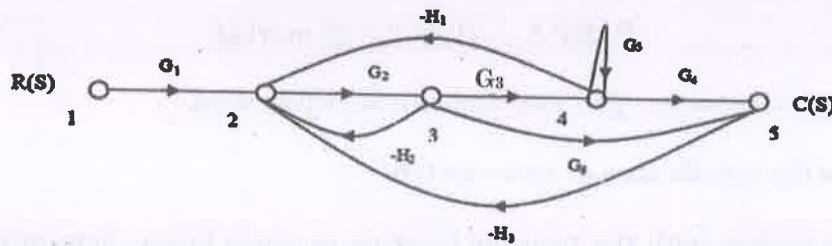
PART B — (5 × 13 = 65 marks)

11. (a) Write the differential equations governing the mechanical translational system as shown in figure and determine the transfer function $X_2(S)/F(S)$. f_{v_3}



Or

- (b) The signal flow graph for a feedback control system is shown in figure. Determine the closed loop transfer function $C(s) / R(s)$.



12. (a) Find all the time domain specifications for a unity feedback control system whose open loop transfer function is given by $G(S) = 25 / S(S+5)$.

Or

- (b) The open loop transfer function of a unity feedback system is given by $G(S) = 20 / S(S+2)$. The input function is $r(t) = 2 + 3t + t^2$. Determine generalized error coefficient and steady state error of the system.
13. (a) Sketch Bode plot for the following transfer function and determine the system gain K for the gain cross over frequency to be 5 rad/sec $G(S) = K S^2 / (1+0.2S) (1+0.02S)$.

Or

- (b) Explain the procedure for designing lead compensator using bode plot with necessary diagram. Also the effect of lead compensator on system performance.

14. (a) Determine the range of K for stability of unity feedback system whose open loop transfer function is $G(s) H(s) = K/S (S+1) (S+2)$ using Routh's stability criterion. Also comments about the roots.

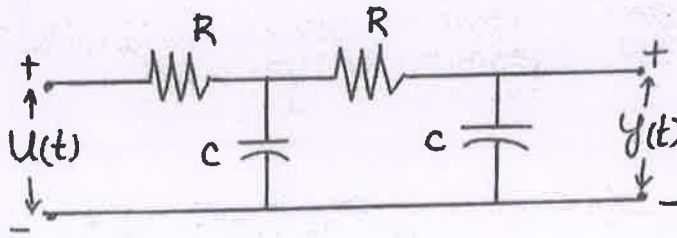
Or

- (b) Sketch the root locus of the system whose open loop transfer function is $G(s) H(s) = K / S (S + 2) (S+4)$. Also find the range of K for which the system to be stable.
15. (a) Test the controllability and observability of the system by any one method whose state space representation is given as

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 2 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} u; y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix}$$

Or

- (b) Obtain the appropriate state model for a system represented by electric circuit shown in Fig.



PART C — (1 × 15 = 15 marks)

16. (a) A Linear Time Invariant system is characterized by the state equation

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} [u]$$

where u is a unit step function. Compute the solution of these equations assuming initial conditions $x_0 = [1 \ 0]$.

Or

- (b) Consider a type 1 unity feedback system with an OLTF $G(S) = K/S (S+1) (S+4)$. The system is to be compensated to meet the following specifications $K_v > 5 \text{ sec}$ and $PM > 43 \text{ deg}$. Design suitable lag compensators.

1. The circuit is a series combination of a 10V DC source, a 10Ω resistor, and a 10V AC source. The AC source is represented by a sine wave with a peak value of 10V and a period of 2π seconds.

2. The current $i(t)$ in the circuit is given by the sum of the steady-state current and the transient current. The steady-state current is $i_{ss}(t) = 10\sqrt{2} \cos(\omega t)$ A, and the transient current is $i_{tr}(t) = -10\sqrt{2} e^{-t/10}$ A.

3. The total current $i(t)$ is $i(t) = 10\sqrt{2} \cos(\omega t) - 10\sqrt{2} e^{-t/10}$ A.

$$i(t) = 10\sqrt{2} \cos(\omega t) - 10\sqrt{2} e^{-t/10} \text{ A}$$

4. The average power P_{avg} in the circuit is $P_{avg} = 100$ W.



Figure 1: Circuit diagram for problem 1.

5. The average power P_{avg} in the circuit is $P_{avg} = 100$ W.

$$P_{avg} = 100 \text{ W}$$

6. The average power P_{avg} in the circuit is $P_{avg} = 100$ W.

7. The average power P_{avg} in the circuit is $P_{avg} = 100$ W.