R22

Question Paper Code: R22A31EE02

ANURAG Engineering College

(An Autonomous Institution)

III B.Tech I Semester Regular Examinations, December – 2024

LINEAR CONTROL SYSTEMS

(ELECTRICAL AND ELECTRONICS ENGINEERING)

Time: 3 Hours | Max. Marks: 60

Section – A (Short Answer type questions) (10 Marks)

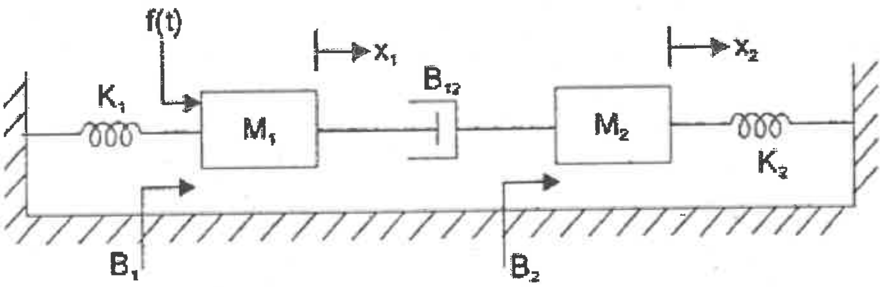
Answer All Questions

No.	Question	Course Outcome	B.T Level	Marks
1.	Illustrate the effect of feedback on the performance of a closed-loop control system.	CO1	L1	1M
2.	State two characteristics of non-linear system with an example?	CO1	L1	1M
3.	What is the significance of the time constant in a first order systems response?	CO2	L2	1M
4.	In the context of relative stability, what does the distance of poles from the imaginary axis signify?	CO2	L2	1M
5.	State Nyquist Stability criterion.	CO3	L1	1M
6.	How does the phase margin relate to the stability of a closed loop system?	CO3	L2	1M
7.	How does feedback improve disturbance rejection?	CO4	L2	1M
8.	What factors influence transient accuracy in a system?	CO4	L1	1M
9.	How do you perform a similarity transformation in state-space analysis?	CO5	L1	1M
10.	What is the significance of the controllability matrix in pole placement design?	CO5	L2	1M

Section B (Essay Questions)

Answer all questions, each question carries equal marks. (5 X 10M = 50M)

11. A) Determine the transfer function $\frac{X1(S)}{F(s)}$ and $\frac{X2(S)}{F(s)}$ for the system shown in Figure. — CO1 L3 10M



OR

B) Derive the transfer function for the closed loop negative and positive feedback system? — CO1 L2 10M

12. A) Consider a unity feedback system with closed transfer function $\frac{C(S)}{R(S)} = \frac{kS+b}{S^2+aS+b}$. Determine the open loop transfer function G(s). Show that the steady- state error with unit-ramp input S given by $\frac{a-k}{b}$ — CO2 L3 10M

	OR			
B)	For the characteristic equation $2S^6+S^5+8S^4+7S^3+8S^2+S+8$, determine the location of roots on the S-plane and find the stability of the system using Routh stability criterion?	CO2	L3	10M
13. A)	A unity feedback control system has an open loop transfer function, $G(s) = \frac{1}{(1+s)(2+s)(3+s)}$. Sketch the Nyquist plot and determine the stability.	CO3	L3	10M
	OR			
B)	Plot the Bode diagram for the following transfer function and obtain gain and phase cross over frequencies. $G(s) = \frac{5}{s(1+0.2s)(1+0.1s)}$.	CO3	L3	10M
14. A)	Explain PI, PD, PID controllers.	CO4	L3	10M
	OR			
B)	Describe how a lead compensator and lag compensator is designed in the frequency domain to improve system response?	CO4	L2	10M
15. A)	A system is described by the following state and output equations $\dot{X}_1 = -3X_1 + X_2 + U,\ \dot{X}_2 = -X_2 + U,\ Y = X_1 + X_2$ Check: i. Controllability ii. Observability	CO5	L3	10M
	OR			
B)	A system is described by the following state model $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}-10 & 0\\ 0 & -6\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}1\\ 1\end{bmatrix}[u]$ $[y] = \begin{bmatrix}2 & 2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + [0][u]$ $X(0) = \begin{bmatrix}2\\ 2\end{bmatrix}$, input is units step signal Calculate: i) State transition matrix ii) Zero input response iii) Zero state response	CO5	L3	10M