Reg.No.:												

VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 80010

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – NOV. / DEC. 2025
Fifth Semester
Electrical and Electronics Engineering
U23EE514 – CONTROL SYSTEMS
(Regulation 2023)

Time: Three Hours — Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

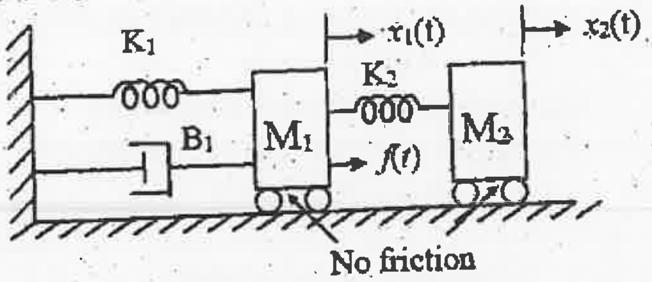
PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	Define transfer function.	2	K1	CO1
2.	Differentiate AC and DC servo motors.	2	K2	CO1
3.	How order of a system is determined from its transfer function?	2	K2	CO2
4.	Interpret the effect of P, I and D controllers on transient and steady state response.	2	K2	CO2
5.	Comment on stability of a system based on frequency domain specifications.	2	K2	CO3
6.	Correlate time and frequency domain specifications.	2	K2	CO3
7.	Mention the necessary conditions for stability.	2	K2	CO4
8.	Draw the electrical network for lag and lead compensator.	2	K2	CO4
9.	List any four advantages of state variable analysis.	2	K1	CO5
10.	What inference is made from controllability matrix?	2	K1	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.		Questions	Marks	KL	CO
11.	a)	Write the differential equations governing the behavior of the mechanical system shown in Figure. Obtain transfer function $X_1(s)/F(s)$. Also obtain an analogous electric circuit based on force-voltage analogy. 	13	K2	CO1
		(OR)			
	b)	Construct signal flow graph for the following set of equations and obtain the transfer function (X_6/X_1). $X_2 = G_2X_1 - H_1X_3; X_3 = G_4X_2 + G_8X_4; X_4 = G_3X_1 - H_2X_5;$ $X_5 = G_5X_4 + G_1X_2$ and $X_6 = G_6X_3 + G_7X_5$	13	K2	CO1
12.	a)	A system has $G(s) = 20/(s^2 + 5s + 5)$ and unity feedback. Find ω_n, ε, T_d, T_r, T_p, M_p and T_s.	13	K2	CO2
		(OR)			
	b)	Consider a unity feedback system with a closed loop transfer function $\frac{C(s)}{R(s)} = \frac{ks+b}{s^2+as+b}$. Find the open loop transfer function G(s). Show that the steady state error with unit ramp input is given by $\frac{a-k}{b}$.	13	K2	CO2
13.	a)	Draw the Bode plot for a unity feedback control system whose transfer function is $G(s) = \frac{10(1+0.1s)}{s(1+0.5s)(1+0.25s)}$.	13	K3	CO3
		(OR)			
	b)	Sketch the polar plot for the system whose open loop transfer function is $G(s)H(s) = 10(s+2)(s+4)/s(s^2 - 3s + 10)$.	13	K3	CO3
14.	a)	A feedback control system has a characteristic equation $s^7 + 13s^6 + 34s^5 + 46s^4 + 65s^3 + 53s^2 + 32s + 20 = 0$. Determine whether the system is stable using Routh-Hurwitz criterion. Comment on stability of the system with respect to poles and zeros of the system. Also determine the value of the roots.	13	K4	CO4
		(OR)			

	b) Draw the Nyquist plot for the system whose open loop transfer function is, $G(s)H(s) = \frac{K}{s(s+2)(s+10)}$. Determine the range of K for which the closed loop system is table.	13	K4	CO4
15.	a) Find the transfer function of the system whose representation in state space is $$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \\ \dot{x_3} \end{bmatrix} = \begin{bmatrix} -2 & -1 & 0 \\ 0 & -3 & 1 \\ -3 & -4 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$ $$y = \begin{bmatrix} 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}.$$	13	K4	CO5
	(OR)			
	b) Obtain the state space representation of the system using controllable canonical form of given transfer function $\frac{2}{s^3+2s^2+4s+8}$.	13	K4	CO5

PART – C

(1 x 15 = 15 Marks)

Q.No.	Questions	Marks	KL	CO
16.	a) Design a lead compensator for a unity feedback system with open loop transfer function $G(s) = \frac{k}{s(s+1)(s+5)}$ to satisfy the following specifications. i. Velocity error constant, $K_v \geq 50$. ii. Phase margin is ≥ 20.	15	K4	CO4
	(OR)			
	b) Consider a unity negative feedback control system with $G(s) = \frac{K}{s(s+1)}$. It is desired to have the velocity error constant $K_v = 10$. Design a lag compensator such that phase margin of the system be at least 45^0.	15	K4	CO4