Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E / B. Tech (Full Time) END SEMESTER EXAMINATIONS – NOV/ DEC 2024

EE 5691 & INTRODUCTION TO CONTROL SYSTEMS

(Regulation2019)

Time:3hrs Max.Marks: 100

CO1	To impart knowledge on various representations of systems
CO2	To familiarize time response analysis of LTI systems and steady state error
CO3	To analyze the frequency responses and stability of the systems
CO4	To analyze the stability of linear systems in frequency domain and time domain
CO5	To develop linear models mainly state variable model and transfer function model

BL – Bloom's Taxonomy Levels

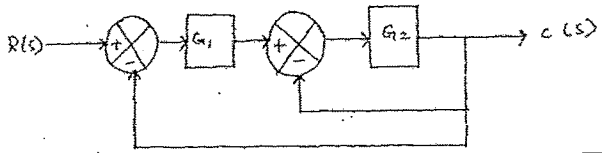
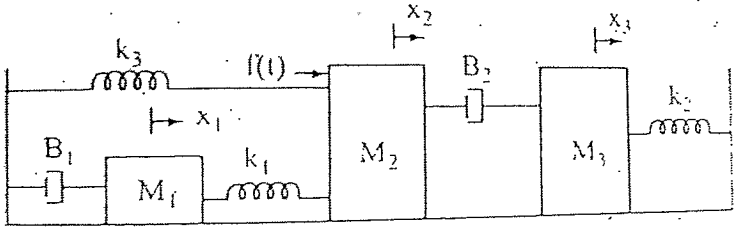
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

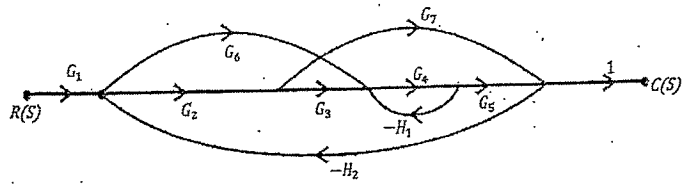
PART- A (10x2=20Marks)

(Answer all Questions)

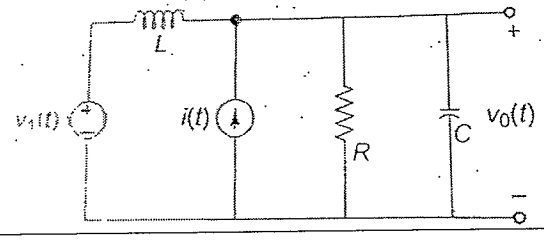
Q.No	Questions	Marks	CO	BL
1	Compare linear and nonlinear system with example.	2	1	1
2	Write the analogous electrical element in force- current and torque-current analogy?	2	1	1
3	Define peak time and rise time.	2	2	2
4	Closed-loop transfer function of second order system is $C(S)/R(S) = 10/ S^2 + 6S + 8$. What is the type of damping?	2	2	2
5	Draw a Polar plot for type 2 order 5 system.	2	3	1
6	Define cut-off rate and resonant peak.	2	3	1
7	Define Nyquist stability criterion.	2	4	2
8	How the roots of the characteristic equations are related to stability?	2	4	2
9	State the controllability theorem.	2	5	2
10	Mention the advantages of state space analysis.	2	5	2

PART- B(5x 13= 65Marks)

Q.No	Questions	Marks	CO	BL
11 (a) (i)	Find the transfer function C(S)/R(S) of block diagram shown below 	4	1	3
(ii)	Obtain the differential equations of the mechanical system shown in Figure. 	9	1	3

	OR			
11.(b) (i)	Find the overall gain of the SFG.  	8	1	3
(ii)	Describe any five block diagram reduction rules with examples.	5	1	2
12 (a) (i)	Derive the expression and sketch the response of second order under damped system for unit step input.	10	2	3
(ii)	The open loop transfer function of a servo system with unity feedback is $G(s) = \frac{10}{s(0.1s+5)}$. Evaluate the static error coefficients(K_p, K_v, K_a) for the system.	3	2	3
	OR			
12 (b)	Sketch the root locus of the system whose open loop transfer function is $G(S) = \frac{K}{S(S+3)(S^2+6S+25)}$	13	2	3
13 (a)	Draw a Bode plot for a unity negative feedback system, the open loop transfer function is $G(S) = \frac{10(1+0.1s)}{s(1+0.5s)(1+0.25s)}$	13	3	4
	OR			
13 (b)	Draw a Polar plot of the system function $G(S) = \frac{10(S+2)(S+4)}{S(S^2-3S+15)}$	13	3	4
14. (a)	i. Using Routh Hurwitz criterion and determine the stability of the systems represented by the following characteristic equation. $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$.	7	4	4
	ii. The open loop transfer function of a closed loop system with unity feedback is $G(S) = \frac{K}{(S+2)(S+4)(S^2+6S+25)}$ Using Routh criterion, determine the value of K.	6	4	4
	OR			
14 (b)	Using Nyquist stability criterion, Investigate the stability of a closed-loop system whose open-loop transfer function is given by, $G(S)H(S) = \frac{10}{(S+1)(S+2)}$	13	4	4
15. (a).	Check the controllability and observability of the system $\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -24 & -26 & -9 \end{bmatrix} [X] + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$ $y = [1 \quad 2 \quad 1\,] [X]$	13	5	4
	OR			
15.(b) (i)	Obtain the state space model of the system whose transfer function is given as function $\frac{Y(S)}{U(S)} = \frac{10}{S^3+3S^2+2S+1}$.	8	5	4
(ii)	Compute the state transition matrix. A= $\begin{bmatrix} -3 & 1 \\ 0 & -1 \end{bmatrix}$	5	5	4

PART- C(1x 15=15Marks)

Q.No	Questions	Marks	CO	BL
16. (i)	A system has $G(s) = 10/(s^2+5s+5)$ and unity feedback. Find ω_n, ς, ω_d, τ_d, τ_r, τ_p, M_p and τ_s	8	2	5
(ii)	For the electrical network shown in figure, write down the necessary equations to get an expression for $V_0(s)$ in terms of the sources $V_1(s)$ and $I(s)$. 	7	1	5