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

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)
B.E/ B.Tech (Full Time) END SEMESTER EXAMINATIONS – NOV / DEC 2023

ELECTRONICS AND COMMUNICATION ENGINEERING
Semester – V
EC5503 – CONTROL SYSTEMS ENGINEERING

Allowed to use Polar Graph, Semi-Log Graph and Plain Graph Paper

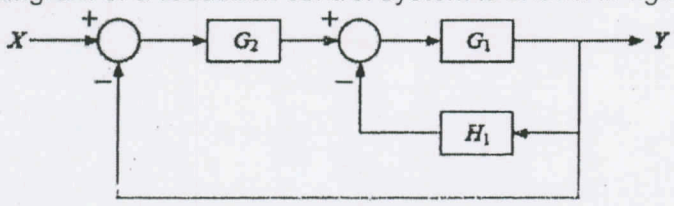
(Regulation 2019)

Time: 180 minutes | Answer ALL Questions | Max.Marks : 100

CO 1	Ability to comprehend the systems components and their representation using various control system
CO 2	Ability to compute the steady state response using various time domain parameters for various system
CO 3	Ability to analyze the frequency response characteristics for both open loop and closed loop system
CO 4	Ability to analyze the stability of various system using Routh Hurwitz Root locus techniques
CO 5	Ability to illustrate the state space model of various control system

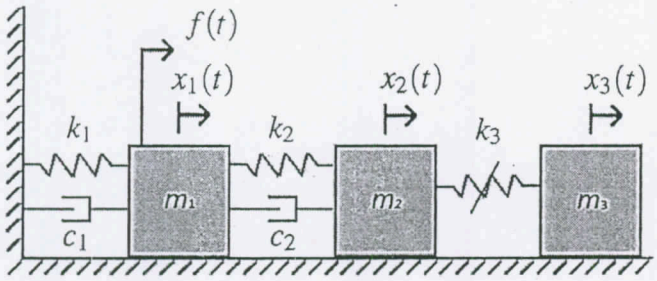
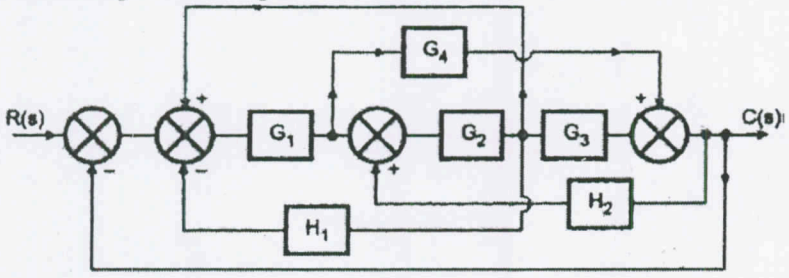
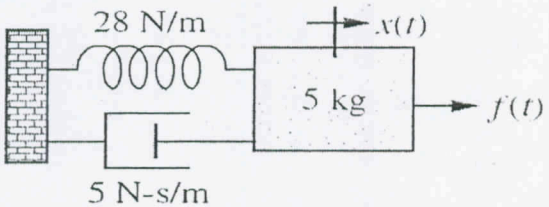
BL – Bloom's Taxonomy Levels
(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analysing, L5 - Evaluating, L6 - Creating)

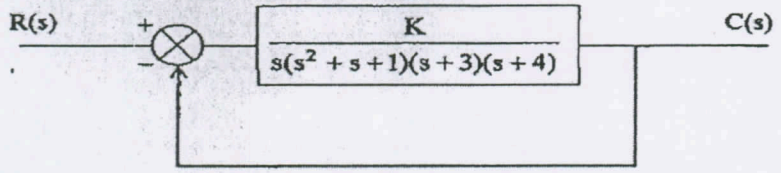
PART- A (10 x 2 = 20 Marks)

Q. No	Questions	Marks	CO	BL
1	Distinguish between open loop and closed loop control system.	2	1	2
2	Determine the overall closed – loop gain G of the system for the block diagram of a feedback control system is shown in fig.2  Fig.2	2	1	3
3	How does the controller play a significant role in the time-domain analysis of the system?	2	2	2
4	The closed loop transfer function of second order system is $\frac{C(s)}{R(s)} = \frac{10}{s^2+6s+10}$. What is the type of damping in the system?	2	2	3
5	Sketch the polar of $G(s) = s$	2	3	3

6	What is gain margin and phase margin?	2	3	2
7	Construct a Routh table and determine the number of roots with positive real parts for the equation $2s^3+4s^2+4s+12=0$	2	4	3
8	State the Nyquist stability criterion.	2	4	2
9	What are the properties of state transition matrix?	2	5	2
10	Define controllability and observability.	2	5	1

PART- B (5 x 13 = 65 Marks)

Q. No	Questions	Marks	CO	BL
11 (a)	For the mechanical system shown in Fig.11a obtain (i) Differential equations, (ii) F-V analogous circuit and (iii) F-I analogous circuits.  Fig.11a	13	1	3
	OR			
11 (b)	Obtain the transfer function C(s)/R(s) of the system shown in fig.11b using Mason's gain formula  Fig.11b	13	1	3
12 (a)	For the system shown in Fig.12a, do the following: i. Find the transfer function **G(s)=X(s)/F(s)** ii. Find ξ, ω_n, T_s, T_p and T_r  Fig.12a	13	2	3
	OR			
12 (b)	Determine the error constants and steady state error for unit step, unit ramp and unit acceleration inputs for the following system. $G(s)=\frac{K(s+3.15)}{s(s+1.5)(s+0.5)}$ and $H(s)=30$	13	2	3

13 (a)	Draw the Bode plot for a control system having transfer function $G(s)H(s)=\frac{100}{s(s+1)(s+2)}$. Determine the gain margin and phase margin.	13	3	3
	OR			
13 (b)	Consider a unity feedback system having an open loop transfer function $G(s)=\frac{2K}{s(1+0.6s)(1+3.5s)}$. Sketch the polar plot and determine the value of K so that the Gain margin is 20 dB	13	3	3
14 (a)	The open loop transfer function of a control system is given as $G(s)H(s)=\frac{K}{(s+1)(s+10)(s+30)}$. Draw the root locus of the system.	13	4	5
	OR			
14 (b)	Determine the range of values of K for the closed loop system in Fig.14b to remain stable and unstable. Find the frequency of sustained oscillations under limiting condition.  Fig.14b	13	4	5
15 (a)	Test the controllability and observability in the following system and determine the transfer function of the system. $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}2 & 1\\ -2 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}1\\ 1\end{bmatrix}u$ $y=\begin{bmatrix}3 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$	13	5	3
	OR			
15 (b)	Find the state equation and output equation for the system given by $\frac{Y(s)}{X(s)}=\frac{s^3+5s^2+6s+1}{s^3+4s^2+3s+3}$	13	5	2

PART- C (1 x 15 = 15 Marks)

Q. No	Questions	Marks	CO	BL
16	Construct the Nyquist plot for the system whose open-loop transfer function is $G(s)H(s)=\frac{K(1+s)^2}{s^3}$. Find the range of K for stability.	15	5	5