Q. Code: 638119

Reg. No.

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Fourth Semester

EC22402 – LINEAR CONTROL SYSTEMS

(Electronics and Communication Engineering)

(Regulation 2022)

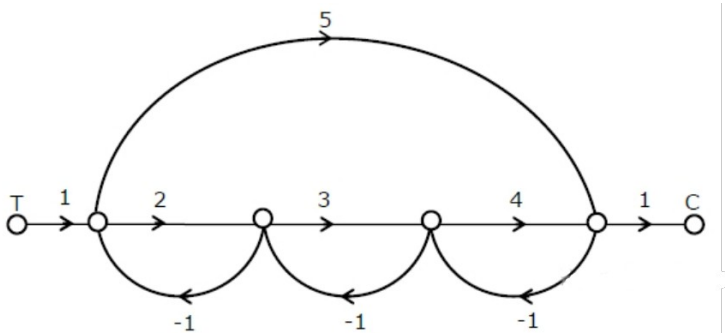
TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Compute the transfer function of different physical systems.	**3**
CO 2	Compute the time response and analyze the stability using various techniques.	**3**
CO 3	Illustrate the frequency response characteristics of open loop and closed loop systems.	**4**
CO 4	Illustrate the state space model of a physical system.	**4**
CO 5	Design compensators to satisfy the desired specifications of control systems.	**3**

PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Define transfer function.	**1**	**2**
2.	Compare open-loop and closed-loop systems.	**1**	**2**
3.	What are the basic elements used for modeling mechanical translational systems?	**1**	**2**
4.	Calculate the number of loops in the signal flow graph.	**1**	**3**

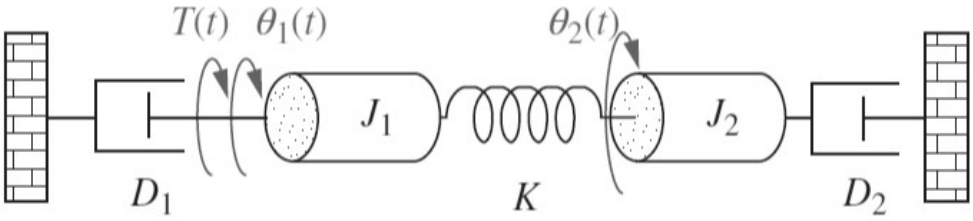


5.	What is the transient and steady-state response of a control system?	**2**	**3**
6.	Determine the damping factor and natural frequency for the given second order closed loop systems transfer function $G(s)=\frac{100}{S^2+10S+100}$.	**2**	**3**
7.	How centroid of the asymptotes found in the root locus technique?	**2**	**3**

8.	What is a proportional controller?	**2**	**2**
9.	Define phase margin.	**3**	**2**
10.	Find the corner frequency of $G(s)=\frac{10}{s(1+0.5s)}$	**3**	**4**
11.	Draw the approximate polar plot for a Type 0 second order system.	**3**	**3**
12.	Define Gain cross over?	**3**	**2**
13.	List the advantages of state space analysis.	**4**	**2**
14.	What is state variable?	**4**	**2**
15.	Write the properties of state transition matrix.	**4**	**2**
16.	Define State equation.	**4**	**2**
17.	What is the need for compensators?	**5**	**2**
18.	Draw the pole-zero plot of lead compensator.	**5**	**3**
19.	List the effects of adding lag compensator in the system.	**5**	**2**
20.	When is lag lead compensator is required.	**5**	**2**

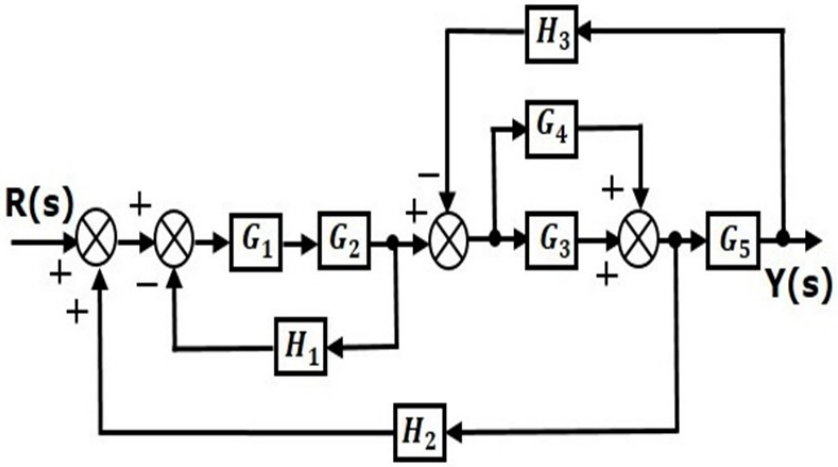
PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21. (a)	Write the differential equation governing the mechanical rotational systems and find the transfer function, $\frac{\theta_2(s)}{T(s)}$.	**(10)**	**1**	**3**



(OR)

(b) Determine the closed loop transfer function C(S)/R(S) of the system whose block diagram is shown below. **(10) 1 3**



22. (a) A unity feedback system has the forward transfer function $G(s)=\frac{K(2s+1)}{s(5s+1)(1+s)^2}$. The input r(t)=(1+6t) is applied to the system. Determine the minimum value of K if the steady-state error is to be less than 0.1. **(10) 2 3**

(OR)

(b) The open loop transfer function of a unity feedback system is given by $G(s)=\frac{K(s+9)}{s(s^2+4s+11)}$. Sketch the root locus of the system. **(10) 2 3**

23. (a) Sketch the Bode plot and hence find the Gain cross over frequency, Phase cross over Frequency, Gain margin and Phase margin. **(10) 3 3**

$$G(s)=\frac{10(1+0.1s)}{s(1+0.01s)(1+s)}$$

(OR)

(b) Sketch the polar plot for the following transfer function and find the Gain margin and Phase margin. **(10) 3 3**

$$G(s)=\frac{400}{s(s+2)(s+10)}$$

24. (a)	A system is characterized by a transfer function $\frac{Y(s)}{U(s)}=\frac{2}{s^3+6s^2+11s+6}$ Find the state and output equation in matrix form	**(10)**	**4**	**3**
	(OR)			
(b)	Examine the controllability and observability of the system with a state equation. $\dot{x}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & -2 & -3\end{bmatrix}x+\begin{bmatrix}0\\0\\1\end{bmatrix}u$ $y=\begin{bmatrix}3 & 4 & 1\end{bmatrix}x+\begin{bmatrix}0\end{bmatrix}u$	**(10)**	**4**	**3**
25. (a)	The open loop transfer function of the uncompensated system is $G(s)=\frac{5}{s(s+2)}$. Design a suitable lag compensator for the system so that the static velocity error constant K_v is 20/sec, the phase margin is at least 55^0 and the gain margin is at least 12db.	**(10)**	**5**	**4**
	(OR)			
(b)	The open loop transfer function of the uncompensated system is $G(s)=\frac{K}{s(s+1)(s+2)}$. Design a suitable lead compensator for the system so that the static velocity error constant K_v = 10/sec, the phase margin = 50^0 and the gain margin ≥10db.	**(10)**	**5**	**4**

PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	Construct the root locus and determine the stability of the system whose characteristic equation is $s^6+2s^5+8s^4+12s^3+20s^2+16s+16=0$. Also determine the number of roots lying on right half of s-plane, left half of s-plane and on imaginary axis.	**(10)**	**2**	**5**

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