Q. Code:564908

Reg. No. | | | | | | | | | | | | | |

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

Fourth Semester

EC18404 – LINEAR CONTROL SYSTEMS

(Electronics and Communication Engineering)

(Regulation 2018/2018A)

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

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Represent a control system and thereby to obtain the mathematical model	**3**
CO 2	Perform time domain analysis of control systems	**4**
CO 3	Perform frequency domain analysis of control systems	**4**
CO 4	Design compensators that can be used to design control systems with required specifications	**4**
CO 5	Understand the state variable analysis of systems	**4**

PART- A (10 x 2 = 20 Marks)

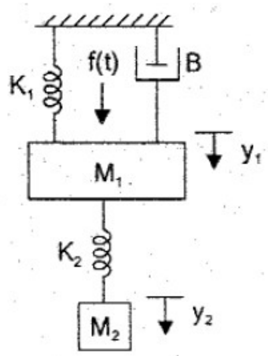
(Answer all Questions)

		CO	RBT LEVEL
1.	Define transfer function and mention its applicability in control system	1	1
2.	Identify the basic elements for modelling in mechanical translational system	1	2
3.	Express the type and order of the system $\frac{G(s)}{H(s)}=\frac{10}{s^3(s^2+2s+1)}$	2	3
4.	State Nyquist stability criterion	2	1
5.	Define corner frequency, gain cross over frequency and phase cross over frequency.	3	1
6.	Summarize the properties of Nyquist plot.	3	2
7.	Sketch the block diagram of State space model.	4	2
8.	Define controllability and observability of a system.	4	1
9.	Discuss the effect of adding a pole to open loop transfer function of a system.	5	2
10.	Predict the need for compensators.	5	2

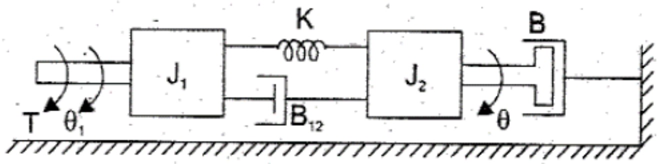
PART- B (5 x 14 = 70 Marks)

			Marks	CO	RBT LEVEL
11.(a)	**(i)**	Determine the transfer function $\frac{Y_2(s)}{F(s)}$ of the system shown in	**(7)**	1	3

figure.

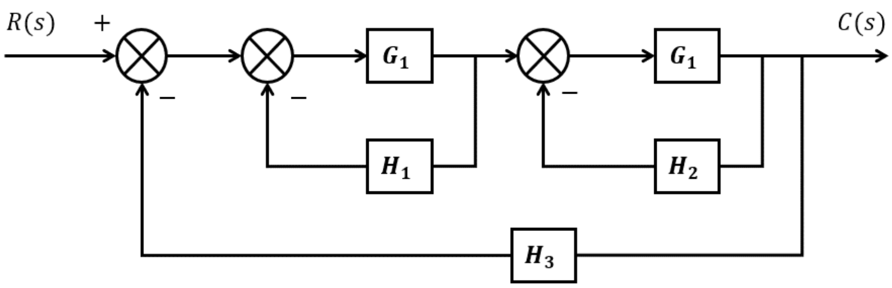


(ii)	Write the differential equations governing the mechanical rotational systems shown in the figure and determine the transfer function $\frac{\theta(s)}{T(s)}$.	**(7)**	**1**	**3**

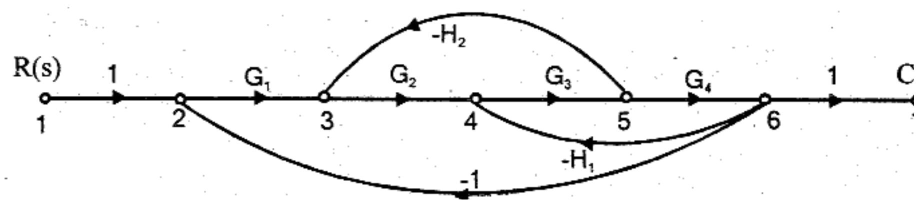


(OR)

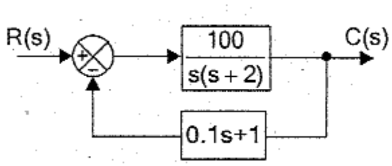
b)	**i)**	Using block diagram reduction technique find the transfer function $C(s)/R(s)$ for the system shown in figure.	**(7)**	**1**	**3**



ii)	Find the overall gain for the $C(s)/R(s)$ for the signal flow graph shown in the figure.	**(7)**	**1**	**3**



12.(a)	**i)**	A positional control system with velocity feedback is shown in figure. What is the response of the system for unit step input?	**(7)**	**2**	**3**



ii) For a unity feedback control system the open loop transfer function, $G(s)=\frac{10(s+2)}{s^2(s+1)}$. Find the steady state error when the input is $R(s)$, where $R(s)=\frac{3}{s}-\frac{2}{s^2}+\frac{1}{3s^3}$. (7) 2 3

(OR)

b) i) Construct the Routh Hurwitz criterion and determine the stability of a system representing the characteristic equation $s^5+s^4+2s^3+2s^2+3s+5=0$. Comment on location of the roots of the characteristic equation. (10) 2 3

ii) Write in detail on relative stability with its roots on s-plane. (4) 2 3

13.(a) The open loop transfer function of a unity feedback system is given by (14) 3 3

$$G(s)=\frac{64(s+2)}{s(s+0.5)+(s^2+10s+64)}$$

Plot the bode plot and compute the gain and phase margins of the closed loop system. Also comment on the stability of the closed loop system.

(OR)

(b) Sketch the polar plot of a unity feedback system whose open loop transfer function is given by, (14) 3 3

$$G(s)=\frac{50}{s(s+1)+(s+5)(s+10)}$$

Calculate the gain and phase margins of the closed loop systems and comment on the stability of the closed loop systems.

14.(a) (i) Obtain the state space model for an LTI system whose transfer function is given by (7) 4 3

$$G(s)=\frac{-2s+1}{s^3+5s^2+3s+1}$$

(ii) Obtain the transfer function of LTI system. Also check the stability of the systems. (7) 4 3

$$X = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u ; Y = \begin{bmatrix} 1 & 0 \end{bmatrix} X$$

(OR)

b) Consider the system defined by $X = Ax + BU ; Y = Cx$ **(14)** **4** **3**

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} ; B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} ; C = \begin{bmatrix} 10 & 5 & 1 \end{bmatrix}$$

Check the controllability and observability of the system.

15.(a) Consider the open loop transfer function is given by **(14)** **5** **3**

$$G(s) = \frac{1}{s(s+1)(0.5s+1)}$$

It is desired to compensate the system so that the static velocity error constant K_v is 5 sec^{-1}, the phase margin is at least 40, and the gain margin is at least 10 dB using lag compensator.

(OR)

(b) Consider a unity feedback system whose **(14)** **4** **3**

$$G(s) = \frac{1}{s(s+1)(0.5s+1)}$$

It is desired to design a compensator for the system so that static velocity error constant K_v is 20 sec^{-1}, the phase margin is at least 50 and gain margin is at least 10 dB.

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	Obtain a state space model for an armature controlled d.c. motor. Neglect load torque, assume armature inductance to be zero and consider the angular position of the motor shafts as the output. Use standard notations.	**(10)**	**4**	**4**