Q. Code:534344

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

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

Third Semester

EE18304 – CONTROL SYSTEMS

(Electrical and Electronics Engineering)

(Regulation 2018/2018A)

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

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Derive transfer functions for electrical and mechanical systems.	**3**
CO 2	Draw the root locus for a transfer function and interpret.	**4**
CO 3	Sketch Bode, Polar, Nyquist plots for a open loop transfer function	**4**
CO 4	Model a physical system with state variables and solve.	**4**
CO 5	Design a compensator using Bode plots.	**5**

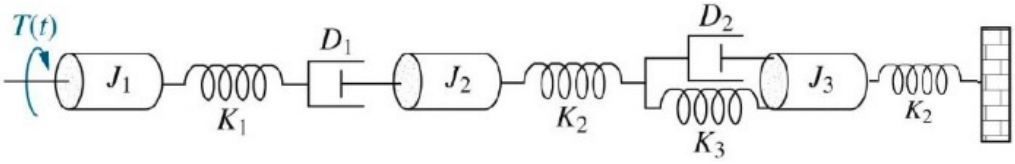
PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Identify the basic elements used for modeling mechanical translational system.	**1**	**3**
2.	Summarize the applications of servo motor mechanism.	**1**	**2**
3.	The closed loop transfer function of second order system is $\frac{C(S)}{R(S)} = \frac{10}{S^2 + 6S + 10}$. Determine the type of damping in the system.	**2**	**3**
4.	Outline the constants associated with the steady state error? Write the relation with steady state error.	**2**	**2**
5.	Define corner frequency.	**3**	**2**
6.	Write the procedure to determine Phase margin and gain margin with polar plot.	**3**	**2**
7.	Illustrate the draw back of state space analysis.	**4**	**2**
8.	Summarize the main properties of state transition matrix.	**4**	**2**
9.	Draw the Lag-Lead Compensator network.	**5**	**4**
10.	Discuss the necessity of compensator for the system and classify the various types of compensators.	**5**	**3**

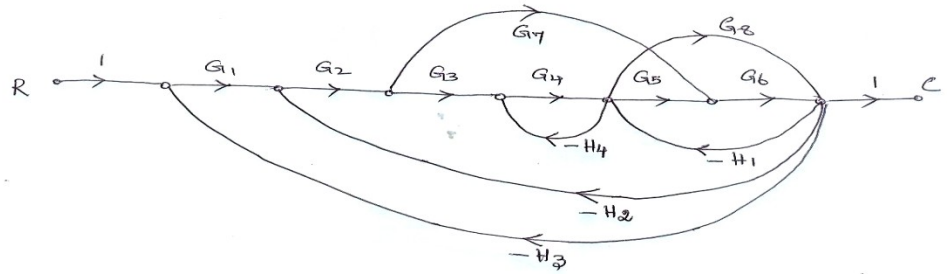
PART- B (5 x 14 = 70 Marks)

		Marks	CO	RBT LEVEL
11. (a)	A mechanical rotational system is presented below. Obtain Torque-Voltage and Torque current network.	**(14)**	**1**	**4**



(OR)

(b)	Obtain the transfer function for the signal flow graph shown below.	**(14)**	**1**	**4**



12. (a)	**(i)**	The open loop transfer function of a unity feedback system is given by **G(s) = 20 / (s ^{2} + 5s + 6)**. Determine the Damping ratio, Maximum overshoot, Rise time and Peak time.	**(7)**	**2**	**4**
	(ii)	A unity feedback system has the forward path transfer function **G(S) = 100 / (S+1)**. Find Generalized error coefficient for **r(t)=t**	**(7)**	**2**	**4**

(OR)

(b)	Sketch root locus for the unity feedback system whose open loop transfer function is $G(S)H(S)=\frac{K(S+1.5)}{S(S+1)(S+5)}$	**(14)**	**2**	**4**

13. (a)	Draw the bode plot for the open loop transfer function given below. Find the value of K for the phase margin 40 degree. $G(S)H(S)=\frac{K}{S(1+0.001S)(1+0.25S)(1+0.1S)}$	**(14)**	**3**	**4**

(OR)

(b)	Draw the Nyquist plot for the open loop transfer function given below and comment on the closed loop stability. $G(S)H(S)=\frac{2.2}{S(S+1)(S^2+2S+2)}$	**(14)**	**3**	**4**

14. (a)	Obtain the transfer function of the system defined by the following state	**(14)**	**4**	**4**

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -2 & 1 \\ 1 & -2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} U$$

$$Y = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

equations.

(OR)

(b)	The state space representation of a system is given below. Check for controllability and observability.	**(14)**	**4**	**4**

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} U$$

$$Y = \begin{bmatrix} 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix}$$

15.(a)	Derive the lead compensator's transfer function and outline the design procedure for lead compensated system.	**(14)**	**5**	**4**

(OR)

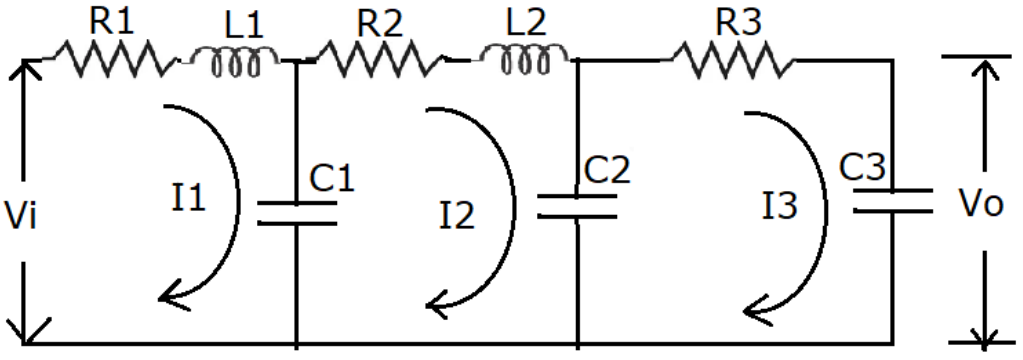
(b)	Find out the state feedback gain matrix K for the following system using two different methods such that the closed loop poles are located at 0.5, 0.6 and 0.7.	**(14)**	**5**	**4**

$$X(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -2 & -3 \end{bmatrix} X(k) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} U(k)$$

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	Construct the block diagram for the following electrical network	**(10)**	**1**	**5**



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