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

B. E / B. TECH. DEGREE EXAMINATIONS, MAY 2023

Third Semester

EE18304 – CONTROL SYSTEMS

(Electrical and Electronics Engineering)

(Regulation2018A)

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

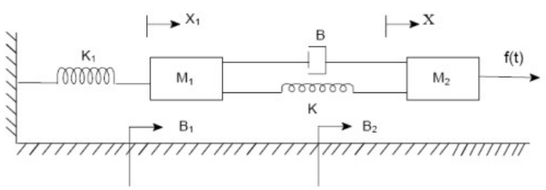
CO1 Derive transfer functions for electrical and mechanical systems.
CO2 Draw the root locus for a transfer function and interpret.
CO3 Sketch Bode and Polar plots for a transfer function.
CO 4 Model a physical system with state variables and solve.
CO 5 Design a compensator using Root locus / Bode plots.

PART- A(10x2=20Marks)
(Answer all Questions)

		CO	RBT LEVEL
1.	Distinguish the open loop and closed loop control systems.	**1**	**2**
2.	Write the torque balance equations for Ideal rotational mass element.	**1**	**2**
3.	Classify the second order system based on the value of damping.	**2**	**2**
4.	List the effect of PI controller on the system performance.	**2**	**2**
5.	Define Gain margin.	**3**	**1**
6.	State Nyquist Stability Criterion.	**3**	**1**
7.	List the advantages of state variable method over conventional method.	**4**	**2**
8.	How to check controllability of the given system?	**4**	**2**
9.	List the effect of adding poles and zeros in system.	**5**	**2**
10.	What is state feedback controller?	**5**	**2**

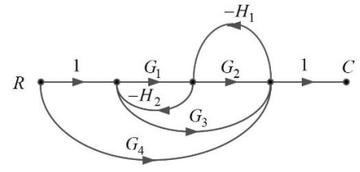
PART- B (5x 14=70Marks)

		Marks	CO	RBT LEVEL
11. (a)	Write the Differential equations governing the mechanical translational system shown in figure and obtain the transfer function X(s)/F(s) and X1(s)/F(s)	**(14)**	**1**	**3**



(OR)

(b)	Apply mason's gain formula and find the overall gain C(S) / R(S) for the given signal flow graph.	**(14)**	**1**	**3**



12. (a)	Derive the expressions for second order system for under damped case andwhen the input is unit step. Also draw the time response with time domain specifications.	**(14)**	**2**	**3**

(OR)

(b)	Sketch the root locus of the system whose open loop transfer function is $G(s)=\frac{K}{s(s+3)(s+4)}$. Find the value of K so that the damping ratio of the closed loop system is 0.5.	**(14)**	**2**	**4**
13. (a)	Plot the Bode diagram for the following transfer function and obtain the gainand phase Cross over frequencies. $G(s)=\frac{10}{s(0.4s+1)(0.1s+1)}$	**(14)**	**3**	**4**

(OR)

(b)	**(i)** Apply Routh criterion to check the stability of $S^6+9S^5+20S^4+12S^3+8S^2+16S+16=0$	**(8)**	**3**	**4**
	(ii) Determine the range of K for stability of $s^4+2s^3+2s^2+(3+K)s+K=0$, for $k>0$	**(6)**	**3**	**4**
14. (a)	A System is characterized by transfer function $\frac{Y(s)}{U(s)}=\frac{2}{(s^3+6s^2+11s+6)}$. Find the state and output equation in matrix form.	**(14)**	**4**	**4**

(OR)

(b)	The state space representation of a system is given below $\begin{pmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{pmatrix}=\begin{pmatrix}0&0&1\\ -2&-3&0\\ 0&2&-3\end{pmatrix}\begin{pmatrix}x_1\\ x_2\\ x_3\end{pmatrix}+\begin{pmatrix}0\\ 2\\ 0\end{pmatrix}u$ and $y=\begin{pmatrix}0&1&0\end{pmatrix}\begin{pmatrix}x_1\\ x_2\\ x_3\end{pmatrix}$ Check the controllability and observability of the given system.	**(14)**	**4**	**4**

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15. (a)	For a certain system, $G(s)=\frac{0.025}{s(0.5s+1)(0.05s+1)}$. Design a suitable lag compensator to give, velocity error constant = 20 sec^{-1}, phase margin = 40°	**(14)**	**5**	**3**
	(OR)			
(b)	Elaborate the step by step procedure to design of Lag-Lead compensator and also draw the frequency response using Bode plot.	**(14)**	**5**	**3**

PART- C (1x 10=10Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	A system has open loop transfer function as $G(s)H(s)=\frac{10}{s(s+5)}$ Find the undamped natural frequency, the damping ratio, the damped naturalfrequency, rise time, peak time, peak overshoot and the settling time with 2 % of error.	**(10)**	**2**	**4**

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