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

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

Fourth Semester

EC18404 – LINEAR CONTROL SYSTEMS

(Electronics and Communication Engineering)

(Regulation 2018A)

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

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Represent the mathematical model of control system.	3
CO 2	Determine the time domain characteristics of control system using various techniques.	4
CO 3	Determine the frequency domain characteristics of control system using various plots.	4
CO 4	Sketch the representation of control system is state space and their characteristics .	4
CO 5	Design compensators to satisfy the desired specifications of control system.	4

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Distinguish between open loop and closed loop system.	1	2
2.	In the signal flow graph of Fig 1. Obtain the gain Y/X	1	3

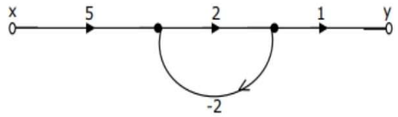

Fig 1

3.	How is type and order of a system defined?	2	2
4.	What is frequency response and List out the different frequency domain specifications?	2	2
5.	A second-order system has an un-damped natural frequency of 100 rad/s and a damping factor of 0.3. Calculate damping frequency and Delay time the system.	3	3
6.	What are the main advantages of Bode plot?	3	2
7.	Find stability of the following system given by using Routh-Hurwitz stability criterion $s^3 + 5s^2 + 10s + 3 = 0$	4	4
8.	What will be the minimum number of states required to describe the network shown below in Fig 2.	4	4

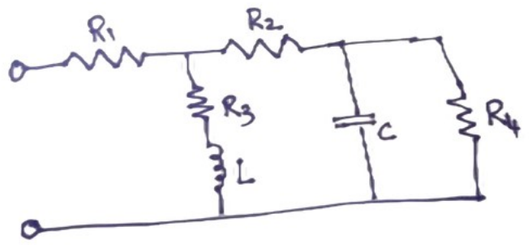

Fig 2

9.	What is the need for a controller? What are the different types of controllers?	5	2
10.	What is a compensator? List the types of compensators?	5	1

PART- B (5 x 14 = 70 Marks)

			Marks	CO	RBT LEVEL
11. (a)	**(i)**	Determine the transfer function of the system using Block Diagram Reduction method.	**(10)**	**1**	**4**

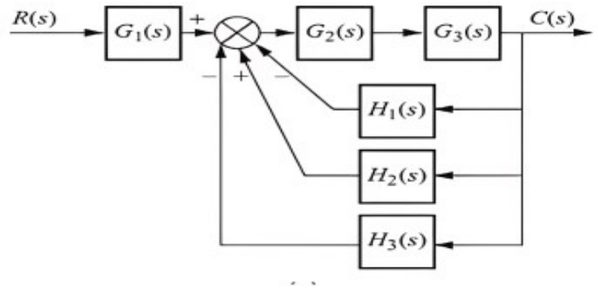

Fig 4

	(ii)	Explain the disadvantages and advantages of block diagram reduction process over signal flow graph?	**(4)**	**1**	**2**

(OR)

	(b)	Write the differential equations governing the mechanical system shown in Fig 4 and also determine the transfer function $\frac{x(t)}{f(t)}$?	**(14)**	**1**	**4**

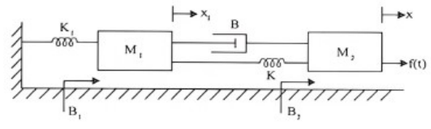

Fig 4

12. (a)	**(i)**	Derive the expression of the unit step response of a second order under-damped system. Use standard notations.	**(8)**	**2**	**3**

	(ii)	The unity feedback system is characterized by an open loop transfer function $\frac{K}{s(s+10)}$. Determine the gain K, so that the system will have a damping ratio of 0.5. For this value of K, determine settling time, peak overshoot and time to peak overshoot for a unit step input.	**(6)**	**2**	**3**
		(OR)			
(b)		For a unity feedback control system the open loop transfer function $G(s) = \frac{10(s+1)}{s^2(s+2)(s+10)}$ Find (a) The position, velocity and acceleration error constants. (b) The steady state error when the input is R(S) where $1 + 4s + \frac{s^2}{2}$	**(14)**	**2**	**3**
13. (a)		Sketch Bode plot for the following transfer function and determine the system gain K for the gain cross over frequency to be 5 rad/sec. $G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$	**(14)**	**3**	**5**
		(OR)			
(b)		The open loop transfer function of a unity feedback system is given by $G(s) = \frac{1}{s(1+s)(1+2s)}$ Sketch the polar plot and determine the gain and phase margin of the closed loop system. Also comment on the stability of the closed loop system.	**(14)**	**3**	**5**
14. (a)	**(i)**	Obtain the state model of the system described by the following transfer function $\frac{Y(s)}{u(s)} = \frac{5}{s^2+6s+7}$	**(7)**	**4**	**3**
	(ii)	Obtain the transfer function model for the following state space system. A= $\begin{bmatrix} 1 & 1 \\ -6 & -5 \end{bmatrix}$, B= $\begin{bmatrix} 1 \\ 0 \end{bmatrix}$, C= [1 0] D= [0]	**(7)**	**4**	**3**
		(OR)			
(b)	**(i)**	The transfer function of a system is : $G(s)H(s) = \frac{(s+1)(s+3)}{(s+5)(s+7)(s+9)}$ in the state space representation of the system, the minimum number state variables (integer) necessary is _____	**(2)**	**4**	**4**

	(ii)	A discrete time is described by the difference equation y(k+2)+5y(k+1)+6y(k)=u(k) ,y(0)=y(1)=0 ;T=1 sec, Determine (i) State model in canonical form. (ii) State transition matrix.	**(12)**	**4**	**3**
15. (a)		A unity feedback system has an open loop transfer function $G(s) = \frac{K}{s(1+2s)}$. Design a suitable lag compensator such that phase margin is $40^0$and steady state error for ramp input is 0.2.	**(14)**	**5**	**3**
		(OR)			
(b)		With suitable block diagrams and equations, explain the following types of controllers employed in control systems: a) Proportional controller, b) PI controller, c) PID controller.	**(14)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)
(Q.No.16 is compulsory)

			Marks	**CO**	**RBT LEVEL**
16.		Draw the root-locus of the unity feedback system whose open-loop transfer function is given by $G(s) = \frac{K(s+9)}{s(s^2+4s+11)}$ and calculate K. Comment on stability.	**(10)**	**3**	**4**

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