Register No : ___________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV/DEC 2025

Fifth Semester

Electrical and Electronics Engineering

EE3503 – Control Systems

(Use of Semi-log graph sheet and regular XY graph sheet may be permitted)

Regulations - 2021

Duration : 3 Hrs *Maximum : 100 Marks*

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	*Questions*	*BTL*	*CO*	*Marks*
1.	Differentiate between open loop and closed loop systems.	L2	1	2
2.	Extend the mathematical expression for Mason's gain formula.	L1	1	2
3.	Consider the unit step response of a unity feedback control system whose open loop transfer function is $G(s)=\frac{1}{s(s+1)}$. Find the maximum overshoot.	L3	2	2
4.	State the necessary and sufficient condition for Routh-Hurwitz stability criterion.	L2	2	2
5.	Construct an approximated polar plot of the system transfer function of order-2 and type-1.	L3	3	2
6.	Outline the Nyquist stability criterion.	L2	3	2
7.	List out the advantages of state space analysis.	L2	4	2
8.	Recall the condition for a system which is said to be controllable.	L2	4	2
9.	Distinguish between controller and compensator.	L4	5	2
10.	Sketch the process reaction curve and mark the process function parameters.	L2	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)*

Q.No		*Questions*	*BLT*	*CO*	*Marks*
11.	a	Write the differential equations governing the mechanical system shown in Fig-1.	L3	1	16

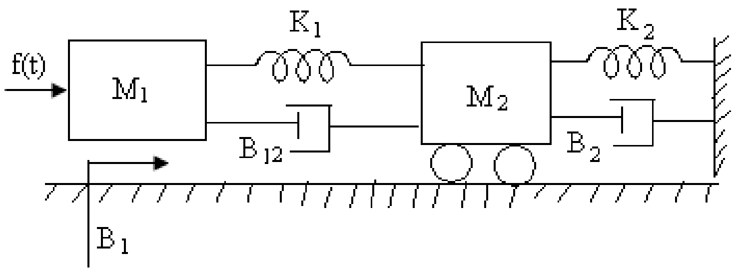

Fig-1

Or

	b	For the system represented by the block diagram shown in Fig-2, evaluate the closed loop transfer function when the input R is (i) at station-I ii) at station-II.	L3	1	16

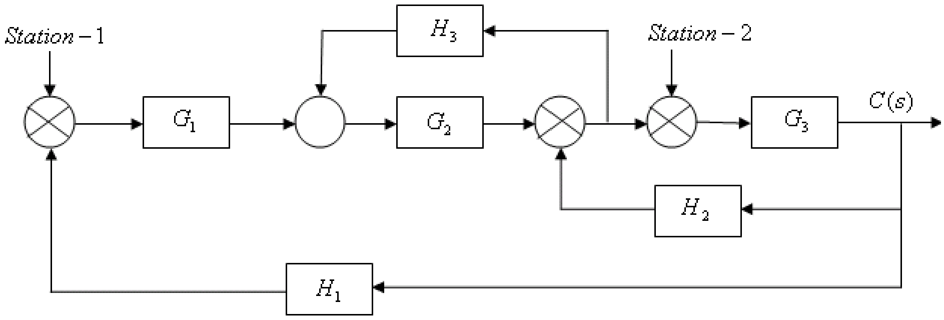

Fig-2

12.	a	The unity feedback system is characterized by an open loop transfer function $G(s)=\dfrac{K}{s(s+10)}$. Determine the gain K, so that the system will have a damping ratio of 0.5. For the value of K, determine peak time and overshoot for unit step input.	L3	2	16
		Or			
	b	Construct Routh array 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 and location of roots lying on right half of s-plane, left half of s-plane and on imaginary axis.	L3	2	16
13.	a	For a unity feedback system $G(s)=\dfrac{10}{s(s+1)(s+4)}$, analyze the gain margin and phase margin using bode plot.	L3	3	16
		Or			
	b	Draw the Nyquist plot for the system whose open loop transfer function is $G(s)=\dfrac{K}{s(s+2)(s+10)}$. Analyze the range of K for which closed loop system is stable.	L3	3	16
14.	a	Determine the canonical state model of the system whose transfer function is $G(s)=\dfrac{2(s+5)}{(s+2)(s+3)(s+4)}$. Determine the state model of the system in Jordan canonical form.	L3	4	16
		Or			
	b	The state model of a system is given by: $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 0 & 1\\ -2 & -3 & 0\\ 0 & 2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}0\\ 2\\ 0\end{bmatrix}[u]$; $y=[1\ \ 0\ \ 0]\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$ Check the condition of controllability and observability.	L3	4	16
15.	a	Obtain the transfer function of a lag compensator. Discuss the step-by-step procedure to design a lag compensator using Bode plot.	L2	5	16
		Or			
	b	Design the PID controller parameters K_P, T_I, T_D using Ziegler –Nichols Controller tuning method.	L2	5	16