Course Code: 23EE4T06

BONAM VENKATA CHALAMAYYA INSTITUTE OF TECHNOLOGY & SCIENCE

(AUTONOMOUS)

II - B.Tech II-Semester Regular Examinations (BR23), Apr/May - 2025

CONTROL SYSTEMS (EEE)

Time: 3 hours | Max. Marks: 70

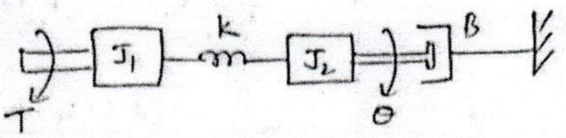
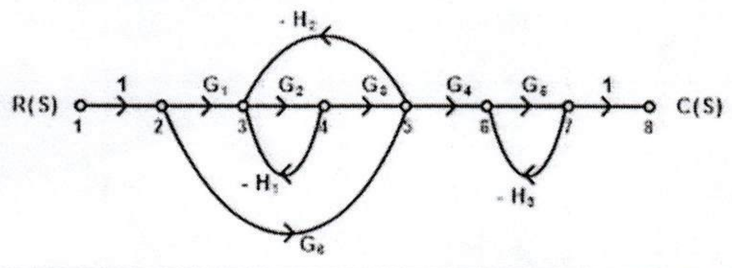
Question Paper consists of Part-A and Part-B

Answer ***ALL*** *the question in* ***Part-A and Part-B***

PART–A (10X2 = 20M)

		Marks	CO	BL
1. a)	Define transfer function.	(2M)	CO1	BL2
b)	Write the force balance equation of an ideal mass and dashpot elements.	(2M)	CO1	BL2
c)	Define BIBO stability.	(2M)	CO2	BL2
d)	Find steady state error for unit step input for type-2 system?	(2M)	CO2	BL3
e)	What are the frequency domain specifications.	(2M)	CO3	BL1
f)	Write advantages of polar plot.	(2M)	CO3	BL2
g)	Define the purpose of a lead compensator in control system.	(2M)	CO4	BL2
h)	What is the necessity of PI controller.	(2M)	CO4	BL2
i)	Define observability of a system.	(2M)	CO5	BL1
j)	State any two properties of State Transition Matrix.	(2M)	CO5	BL1

PART–B (5X10 = 50M)

2a.	Compare open-loop and closed loop control systems with example.	5(M)	CO1	BL2
b.	Obtain the transfer function $\frac{\theta(S)}{T(S)}$ for the given mechanical rotational system. 	5(M)	CO1	BL3
	(OR)			
3a.	Derive the transfer function for armature voltage controlled DC servomotor.	5(M)	CO1	BL2
b.	Obtain the transfer function C(S)/R(S) for the given SFG using Mason's gain rule. 	5(M)	CO1	BL3

4a.	Derive an expression for the step response of second order underdamped system.	5(M)	CO2	BL2
b.	A unit feedback system is characterized by the open loop transfer function, $$G(S)=\frac{1}{S(0.5S+1)(0.2S+1)}$$ Determine the steady state error for unit step, unit ramp and unit parabolic inputs.	5(M)	CO2	BL3

	(OR)			
5a.	Determine the stability of the system whose characteristic equation $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$ using R-H criteria.	5(M)	CO2	BL3
b.	Explore about the construction rules of Root Locus.	5(M)	CO2	BL2

6a.	Define Phase Margin, Gain Margin, Phase crossover frequency and Gain crossover frequency.	5(M)	CO3	BL2
b.	A second order system step response shows 25% overshoot. Determine its resonant peak in frequency response?	5(M)	CO3	BL3
	(OR)			
7a.	Obtain the Bode plot for the system with open loop transfer function $G(S)=\frac{2500}{S(S+5)(S+50)}$. Determine the Gain Margin and Phase Margin.	5(M)	CO3	BL3
b.	Draw the Nyquist plot for the system whose open loop transfer function is, $G(S)H(S)=\frac{k}{S(S+2)(S+10)}$. Determine the range of 'k' for which closed loop system is stable.	5(M)	CO3	BL3

8a.	What is lag-lead compensator. Draw the bode plot of lag-lead compensator.	5(M)	CO4	BL3
b.	Explain the procedure for design of lag compensator using Bode plot.	5(M)	CO4	BL2
	(OR)			
9.	Design a lead compensator for the unity feedback system with an OLTF $G(S)=\frac{K}{S(S+1)}$, to satisfy the following specifications. (i) The Phase margin of the system $\geq 45^0$. (ii) Steady state error for a unit ramp input $\leq 1/15$. (iii) The gain crossover frequency of the system must be lessthan 7.5 rad/sec.	10(M)	CO4	BL4

10a.	Obtain the state model of the system whose transfer function is given as: $$\frac{Y(s)}{U(s)} = \frac{10(s+5)}{(s^3+6s^2+7s+8)}$$	5(M)	CO5	BL3
b.	Obtain State Transition Matrix (STM) for the system matrix, $A=\begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$	5(M)	CO5	BL3
	(OR)			
11a.	Derive the solution for Homogeneous and Non-Homogeneous state equations.	5(M)	CO5	BL2
b.	Check the controllability and observability of the system described below. $$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} U$$ $$Y = \begin{bmatrix} 3 & 4 & 1 \end{bmatrix} X$$	5(M)	CO5	BL3

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