Course Code: 23EE4T06

BONAM VENKATA CHALAMAYYA INSTITUTE OF TECHNOLOGY & SCIENCE

(AUTONOMOUS)

II - B. Tech II-Semester Supplementary Examinations (BR23), Aug - 2025

CONTROL SYSTEMS (EEE)

Time: 3 hours Max. Marks: 70

Question Paper consists of Part-A and Part-B

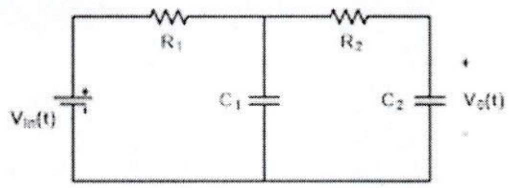
Answer ***ALL*** *the question in* ***Part-A and Part-B***

PART–A (10X2 = 20M)

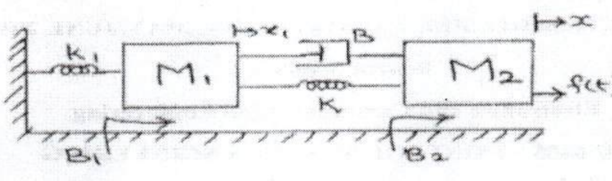
		Marks	CO	BL
1. a)	Write Masons Gain formula.	(2M)	CO1	BL1
b)	Define closed loop control system.	(2M)	CO1	BL2
c)	What is the necessary condition for stability?	(2M)	CO2	BL2
d)	Define delay time and rise time.	(2M)	CO2	BL2
e)	Define phase margin and gain margin.	(2M)	CO3	BL2
f)	Write advantages of bode plot.	(2M)	CO3	BL2
g)	What is the main effect of a lag compensator on the bode magnitude plot.	(2M)	CO4	BL2
h)	Give the transfer function of the lead compensator.	(2M)	CO4	BL2
i)	What is state variable and state vector.	(2M)	CO5	BL1
j)	What is the solution for non-homogeneous state equation.	(2M)	CO5	BL2

PART–B (5X10 = 50M)

2a. Obtain the Transfer Function for the given electrical network. 5(M) CO1 BL3

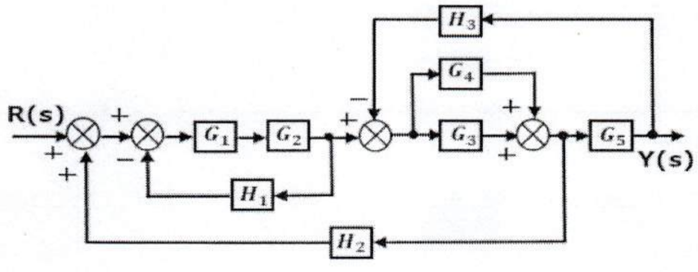


b. Determine the transfer function $\frac{X(S)}{F(S)}$ for the given mechanical system. 5(M) CO1 BL3

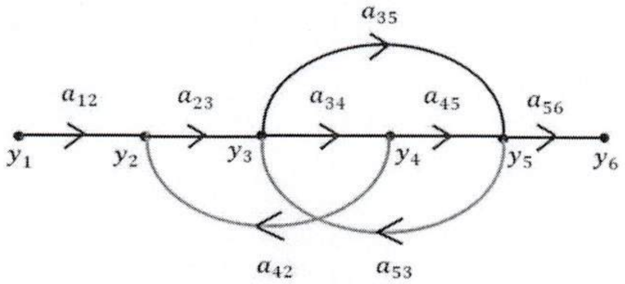


(OR)

3a. Simplify the block diagrams of the systems given by block diagram reduction techniques and determine the transfer functions. 5(M) CO1 BL2



b. Obtain the transfer function $y6/y1$ for the given SFG using Mason's gain rule. 5(M) CO1 BL3



4a. Compute rise time, peak time, maximum peak overshoot and settling time for unit step response of a unity feedback system whose open loop transfer function is 5(M) CO2 BL3

$$G(S) = \frac{1}{S(S+1)}$$

b. Effect of PI and PD controllers in control System. 5(M) CO2 BL2

(OR)

5a. What is the procedure for applying the Routh-Hurwitz stability criterion in a case where a row in the Routh array becomes all zeroes? 5(M) CO2 BL2

b. Sketch the root locus for the unity feedback system with following transfer function. 5(M) CO2 BL3

$$G(S) = \frac{K}{S(S^2+4S+20)(S+4)}$$

6a. Derive the expressions for frequency domain specifications of a second order system. 5(M) CO3 BL2

b. The open loop transfer function of a unity feedback system is given by $G(S) = \frac{1}{S(1+S)(1+2S)}$. Draw the polar plot. 5(M) CO3 BL3

(OR)

7a. Sketch the bode plot for the following system and find gain & phase margin. 5(M) CO3 BL3

$$G(S) = \frac{10}{S(1+0.4S)(1+0.1S)}$$

b. Draw Nyquist diagram and determine the stability of a closed loop control system with open-loop transfer function 5(M) CO3 BL3

$$G(S)H(S) = \frac{3}{S(S+1)^2}$$

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 lead compensator using Bode plot. 5(M) CO4 BL2

(OR)

9. A unity feedback system has an open loop transfer function, $G(S) = \frac{K}{S(1+2S)}$. 10(M) CO4 BL4

Design a suitable lag compensator so that phase margin is 400 and the steady state error for ramp input is less than or equal to 0.2.

10a. Obtain the state model of the system whose transfer function is given as: 5(M) CO5 BL3

$$\frac{Y(s)}{U(s)} = \frac{10(s+5)}{(s^3+6s^2+7s+8)}$$

b. Find transfer function Y(S)/U(S) for the state model. 5(M) CO5 BL2

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

$$Y = \begin{bmatrix} 3 & 4 \end{bmatrix} X$$

(OR)

11a. State and prove the properties of State Transition Matrix (STM). 5(M) CO5 BL2

b. Investigate the controllability of the following state model. 5(M) CO5 BL3

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} U$$

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