R22 Regulation *Subject code:4E5DA*

TKR COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous, Accredited by NAAC with 'A+' Grade)

B.Tech V Semester Supplementary Examinations, May 2025

CONTROL SYSTEMS

(ECE)

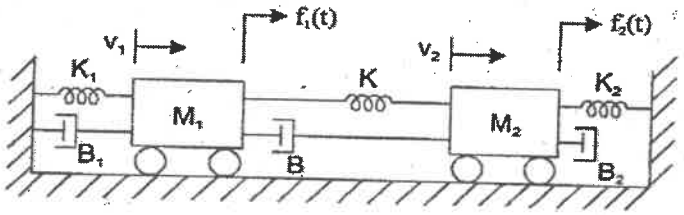
Maximum Marks: 60 Date: 17.06.2025 Duration: 3 hours

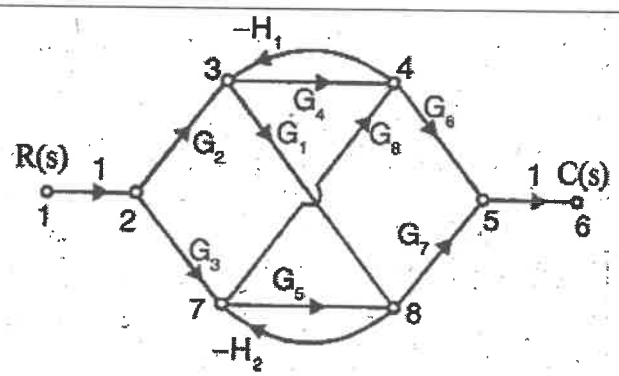
Note: **1.This question paper contains two parts A and B.**
2. Part A is compulsory which carries 20 marks. Answer all questions in Part A.
3. Part B consists of 5 Units. Answer any one full question from each unit.
4. Each question carries 10 marks and may have a, b, c, d as sub questions.

Part-A

All the following questions carry equal marks (10X1M=10 Marks)		Marks	CO	BTL
1	What are basic elements used for modelling mechanical translational system?	1M	1	L1
2	Write the Manson's gain formula?	1M	1	L1
3	Define steady state error.	1M	2	L1
4	Define type number and order of the system.	1M	2	L1
5	What are the limitations of Routh's stability?	1M	3	L1
6	Define gain and phase margins.	1M	3	L1
7	What is "Nyquist Contour"?	1M	4	L1
8	Why compensation is needed?	1M	4	L1
9	What are the properties of state transition matrix?	1M	5	L1
10	Define Observability.	1M	5	L1

Part-B

Answer All the following questions. (5X10M=50Marks)		Marks	CO	BTL
11	Write the differential equations governing the mechanical system shown in figure and also construct the force-voltage and force-current analogous circuits. 	10M	1	L2
	OR			
12	Find the transfer function of the following signal flow graph.	10M	1	L2

				
13	The system has G(s) = $\frac{K}{S(1+ST)}$, with unity feedback where K & T are constant. Determine the factor by which gain 'K' should be multiplied to reduce the overshot from 75% to 25%?	10M	2	L2
	OR			
14	The open loop transfer function of a system is $G(S) = \frac{K}{S(S+3)(S+5)}$, Calculate the steady error when input is $r(t)=10u(t)+10t+5t^2$	10M	2	L2
15	Using R-H Criteria, determine the locations of the roots of the following characteristic equations and comment on stability. $$s^5 + s^4 + 4s^3 + 24s^2 + 3s + 63 = 0$$	10M	3	L2
	OR			
16	Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies. $G(s) = \frac{10}{S(1+0.1S)(1+0.4S)}$.	10M	3	L2
17	Investigate closed loop stability of a system having G(s) H(s)=$\frac{K(s+4)}{s(s-2)}$ using Nyquist criterion. Determine the limiting value of 'K' for stability	10M	4	L2
	OR			
18	What is Controller and what are the types of controllers and its effects? Derive the transfer function of P-I Controller.	10M	4	L2
19	A linear time invariant system is representation by the state equation $X(t) = \begin{bmatrix} 0 & 3 \\ -1 & -4 \end{bmatrix}\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$ and $y = \begin{bmatrix} 1 & 1 \end{bmatrix}\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$ Find the characteristics equation, state transition matrix and stability of the system.	10M	5	L2
	OR			
20	A. Explain the concepts of state, state variables and state model. B. Derive State Transition Matrix using Laplace transform method.	5M 5M	5	L2