Register Number:……………..

KUMARAGURU college of technology
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B.E. DEGREE EXAMINATIONS: NOV/DEC 2023
(Regulation 2018)
Fifth Semester
ELECTRICAL AND ELECTRONICS ENGINEERING
U18EEI5203**:** Control Systems

COURSE OUTCOMES

CO1: Derive the transfer function model of electromechanical systems.
CO2: Analyse the system response in time and frequency domains.
CO3: Analyse system stability in time and frequency domain.
CO4: Construct the state space model of Linear systems.
CO5: Identify and measure Electrical and Non-Electrical quantities using appropriate instruments.

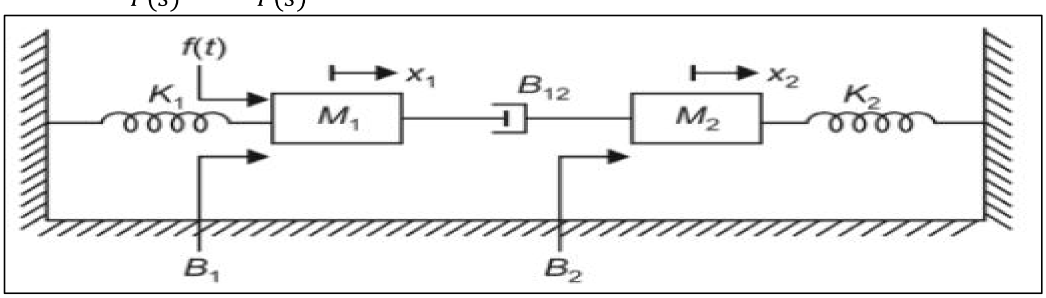
Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	List some real time applications of Closed Loop System.	CO1	[K_1]
2.	Demonstrate the Force-Voltage analogous of a mechanical spring and dash pot.	CO1	[K_1]
3.	Recall the standard test signals used in time domain analysis.	CO2	[K_1]
4.	A unity feedback system has an open loop transfer function of $G(s) = \frac{25(s+4)}{s(s+0.5)(s+2)}$. Determine the steady state error for unit ramp input.	CO2	[K_3]
5.	Define gain crossover frequency and phase crossover frequency.	CO2	[K_1]
6.	What will be the initial slope of the Bode Magnitude plot for a system having no poles at the origin?	CO2	[K_4]
7.	Define BIBO stability.	CO3	[K_1]
8.	State Nyquist stability criterion.	CO3	[K_1]
9.	Outline the merits of State Space Analysis.	CO4	[K_1]
10.	A linear system is described by the following state equation: $\dot{X}(t) = AX(t) + BU(t), A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$ Form the State Transition Matrix of the system.	CO4	[K_3]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11\. a) Write the differential equations governing the below system and find the transfer function: $\frac{X_1(s)}{F(s)}$ and $\frac{X_2(s)}{F(s)}$ — 10 — CO1 — [K_2]



b) Derive the mathematical model of Field Controlled DC Servo Motor. 6 CO1 [K_2]

12. a) A system is given by differential equation, $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 8y = 8x$, where y = output and x = input. Find the Transfer Function $\frac{Y(s)}{X(s)}$ and determine all time domain specifications for unit step input. 10 CO2 [K_3]

b) Derive the time response of a first order system for unit step input. 6 CO2 [K_2]

13. The open loop transfer function of a unity feedback system is given by, 16 CO2 [K_3]

$$G(s) = \frac{1}{s(1+s)(1+2s)}$$

Sketch the Polar Plot and determine the Gain Margin and Phase Margin.

14. a) Sketch the Root Locus of the system whose open transfer function is, 10 CO3 [K_3]

$$G(s) = \frac{K}{s(s+1)(s+3)}$$

b) Comment on the stability of a system represented by the Characteristic Equation, 6 CO3 [K_3]

$$s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$$

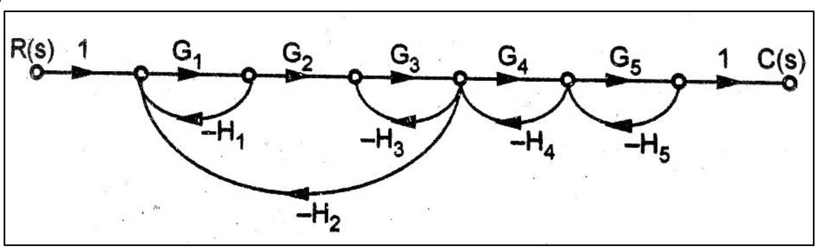
15. a) Check for Controllability and Observability of a system having following coefficient matrices. 10 CO4 [K_3]

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}; B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}; \; C^T = \begin{bmatrix} 10 \\ 5 \\ 1 \end{bmatrix}$$

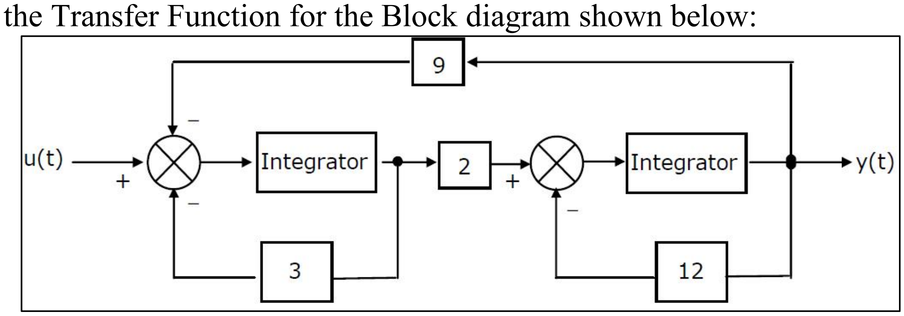
b) Develop the state model of a system, whose transfer function is given as 6 CO4 [K_3]

$$\frac{Y(s)}{U(s)} = \frac{10}{s^3 + 4s^2 + 2s + 1}$$

16. a) Find $\frac{C(s)}{R(s)}$ for the Signal Flow Graph shown below: 10 CO1 [K_2]



b) Find the Transfer Function for the Block diagram shown below: 6 CO1 [K_2]



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