Reg. No.: | | | | | | | | | | |

Question PaperCode:95B03

B.E./ B.Tech. DEGREE EXAMINATION, NOV 2024

Fifth Semester

Biomedical Engineering

19UBM503–BIO CONTROL SYSTEM

(Regulations 2019)

Duration: Three hours Maximum:100 Marks

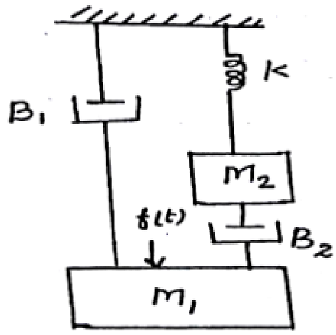
Answer ALL Questions

PARTA-(10 x2=20Marks)

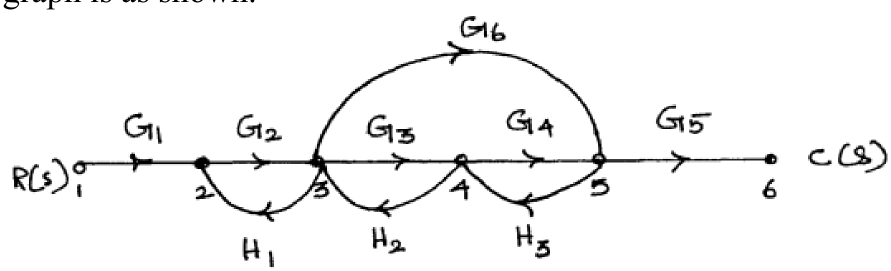
1.	Define transfer function.	CO1-U
2.	Compare open loop and closed loop system.	CO1-U
3.	Define maximum peak overshoot.	CO1-U
4.	State any two limitations of Routh stability criterion.	CO1-U
5.	Define Gain margin and phase margin.	CO1-U
6.	State Nyquist stability criterion.	CO1-U
7.	List the advantages of state space approach.	CO1-U
8.	Write the homogeneous and non-homogeneous state equation.	CO1-U
9.	What is the need of physiological modeling?	CO1-U
10.	Diagrammatically represents series & parallel combinations of resistance & compliance property in mechanical system.	CO1-U

PART– B(5X 16= 80Marks)

11. (a) (i) Draw the force-voltage analogy and force current analogy for themechanical system shown in figure. CO2-App (8)

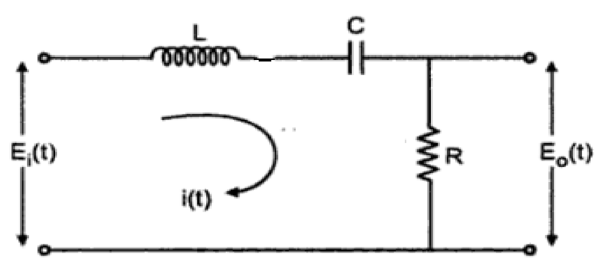


(ii) Determine the overall gain of the system whose signal flow graph is as shown. CO2-App (8)

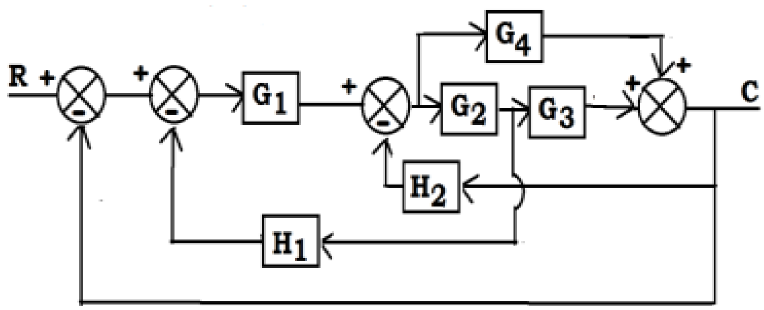


Or

(b) (i) Examine the given electrical network and deduce the transfe function. CO2-App (8)



(ii) Draw the signal flow graph and find C/R for the system shown in fig. CO2-App (8)



12 (a) (i) A second order system is given by $\frac{C(s)}{R(s)} = \frac{25}{s^2+6s+25}$. Find all the time domain coefficients. CO1-U (8)

(ii) Using Routh Hurwitz criterion determine the stability of asystem representing the characteristic equations $s^6 + s^5 + 3s^4 + 3s^3 + 3s^2 + 2s + 1 = 0$and comment onlocation of the roots of the characteristic equation. CO3-Ana (8)

Or

(b) (i) Explain briefly about the steps to be followed to construct aroot locus plot of a given transfer function. CO1-U (8)

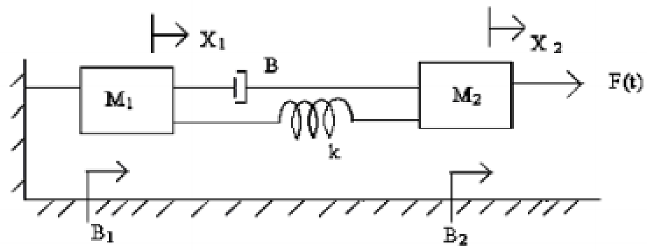
(ii) A unity feedback system has the forward transfer function $G(s) = \frac{K_1(2s+1)}{s(5s+1)(1+s)^2}$. The input $r(t) = 1 + 6t$ is applied to the system. Determine the minimum value of K_1 if the steady state error is to be less than 0.1. CO3-Ana (8)

13 (a) The open loop transfer function of a unity feedback system is given by G(s) $= \frac{80}{s(s+2)(s+20)}$. Draw the Bode plot and find the gain margin, phase margin, gain cross over frequency and phase cross over frequency. CO4-E (16)

Or

(b) Draw the Nyquist plot and comment on the range of K for stability of the system with G(s)H(s) $= \frac{K}{s(1+s)(1+2s)(1+3s)}$. CO4-E (16)

14 (a) (i) Obtain the state model of the mechanical system shown in fig. CO5-App (8)



(ii) Obtain the solution of state equation for the following state space model. $\dot{X} = \begin{bmatrix} -1 & 2 \\ 1 & 1 \end{bmatrix} X + \begin{bmatrix} 1 \\ 1 \end{bmatrix} U(t)$;Subjected to the initial conditions $X(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$. CO5-App (8)

Or

(b) (i) A system is represented by the state equation = AX+BU; Y=CX where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & -1 & 1 \\ 0 & -1 & -10 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 0 \\ 10 \end{bmatrix}$ and $C = [1 \quad 0 \quad 0]$ .Determine the transfer function of the system. CO5-App (8)

(ii) Test the controllability and observability of the system with state equation. CO5-App (8)

$$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} u ; \quad Y = [1 \quad 0 \quad 0] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

15 (a) (i) Explain with suitable examples the need for modeling in physiological system. CO1-U (8)

(ii) Analyze the various properties of generalized biological system and explain how to create models with combinations of system elements. CO1-U (8)

Or

(b) (i) With a neat diagram explain the linear model of any one physiological system. CO1-U (8)

(ii) Differentiate physiological control system with an engineering control system. CO1-U (8)