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Question Paper Code:95B03

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

Fifth Semester

Biomedical Engineering

19UBM503–BIO CONTROL SYSTEM

(Regulation2019)

Duration:3.00hours Maximum:100Marks

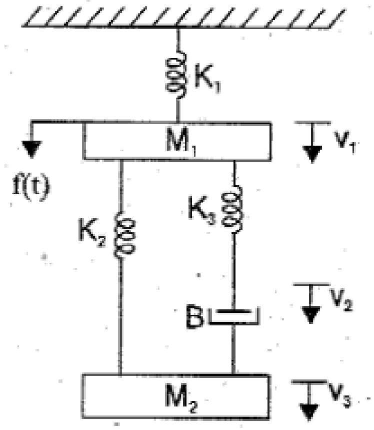
Answer ALL Questions

PARTA-(10 x2=20Marks)

1.	Distinguish between open loop and closed loop system.	CO1-U
2.	Why negative feedback is invariably preferred in closed loop control system?	CO1-U
3.	Define settling time.	CO1-U
4.	How the roots of characteristic equation are related to stability?	CO1-U
5.	List out the different frequency domain specifications.	CO1-U
6.	Define phase margin.	CO1-U
7.	Compare transfer function approach and state variable approach.	CO1-U
8.	Define Controllability of a system.	CO1-U
9.	What is the need of physiological modeling?	CO1-U
10.	Write the examples of physiological control system.	CO1-U

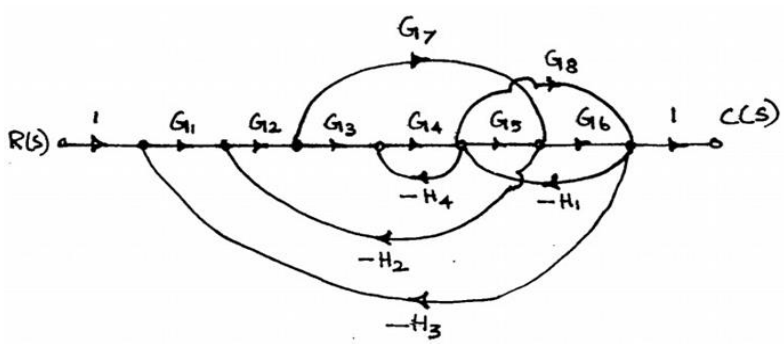
PART– B(5X 16= 80 Marks)

11.	(a)	For the mechanical system shown in Fig, draw the force voltage and force current electrical analogous circuits. Also verify the differential equations governing the electrical systems derived by Kirchhoff's laws with the differential equations governing the mechanical system derived by Newton's second law of motion.	CO2-App	(16)



(OR)

(b) Estimate the C(s)/R(s) for the Signal flow graph shown below using Mason's gain formula. CO2-App (16)



12. (a) i) The open loop transfer function of a unity feedback system is given by G(s)= $\frac{20}{(s^2+5s+6)}$. Determine the damping ratio, maximum overshoot, peak time, settling time and rise time for unit step input. CO3-Ana (8)

ii) The open loop transfer function of unity feedback system is given by $G(s)=\frac{10}{s(s+1)(s+2)}$. Determine the steady state error of the system for the input $r(t)=1+2t+1.5t^2$. CO3-Ana (8)

(OR)

(b) Construct the root locus of the system whose open loop transfer function $G(S) = \frac{K}{s(s+2)(s+4)}$. Determine the value of K so that the damping ratio of the closed loop system is 0.5. CO3-Ana (16)

13. (a) Sketch Bode log-magnitude and phase plot for the following transfer function CO4-Ana (16)

$$G(s)H(s) = \frac{40}{s(s+2)(s+5)}$$

From the Bode plot, evaluate the gain cross over frequency, phase cross over frequency, gain margin and phase margin. Comment on stability.

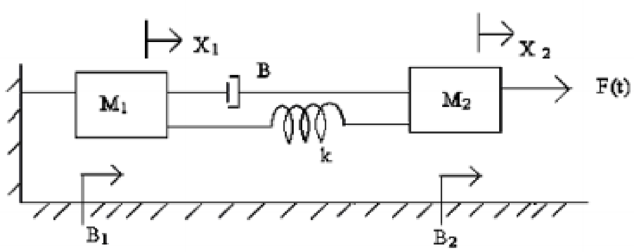
(OR)

(b) Sketch polar plot for the given system whose open loop transfer function is CO4-Ana (16)

$$G(s) = \frac{1}{s(s+10)(s+50)}$$

Determine gain margin and phase margin of the system and analyze the system stability.

14. (a) i) Obtain the state model of the mechanical system shown in fig. CO2-App (8)



ii) Test the controllability of the system whose state space representation is given as CO2-App (8)

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 0 & 1\\ -2 & -3 & 1\\ 0 & 2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 2\\ 0\end{bmatrix}u \quad \text{and}$$

$$y = \begin{bmatrix}1 & 0 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}.$$

(OR)

(b) i) Obtain the transfer function model for the following state space system. CO2-App (8)

$$A = \begin{bmatrix}0 & 1\\ -6 & -5\end{bmatrix};\ B = \begin{bmatrix}1\\ 0\end{bmatrix};\ C = \begin{bmatrix}1 & 0\end{bmatrix};\ D = [0]\ .$$

ii) The state equation and initial condition vector of a linear time invariant system are given below. Determine the solution of state equation. CO2-App (8)

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}\ ; \quad X_0 = \begin{bmatrix}1\\ 0\end{bmatrix}$$

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

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

(OR)

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

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