Code No: 155AR

R18

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, August - 2022

CONTROL SYSTEMS

(Common to ECE, EIE)

Time: 3 Hours **Max. Marks: 75**

Answer any five questions

All questions carry equal marks

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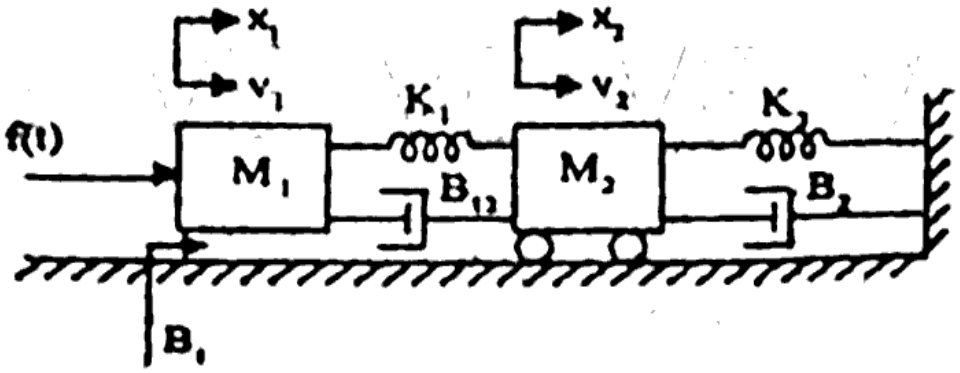
1.a) Explain the difference between open loop and closed loop system.

b) Define transfer function and derive an expression for the transfer function of a closed loop system with a unity feedback. [7+8]

2.a) Determine transfer function $\frac{X_2(s)}{f(s)}$ for a given mechanical system shown below:



b) What is the effect of feedback? [10+5]

3.a) An experiment conducted on a servo mechanism shows the error response to be $c(t) = 1.4\, e^{-4t} \sin(2.86t + 43^0)$
Where the input is a sudden unit displacement. Determine the natural frequency, damping ratio and damped angular frequency of the system.

b) Construct Routh Array and determine the stability of the system whose characteristic equation is $S^6+2S^5+8S^4+12S^3+20S^2+16S+16=0$. Also determine the number of roots lying on right half of s-Plane, left half of s-plane and on imaginary axis. [7+8]

4. What is break away and break in points? A unity feedback system has on open loop transfer function $U(s) = \frac{K}{s(s^2+6s+10)}$. Find its break away and break in points. [15]

5. Plot the bode diagram for the fallowing Transfer function and obtain the gain and phase crossover frequencies. [15]

$$G(S) = \frac{10}{S(1+0.1S)(1+0.2s)}$$

6.a) Define gain margin and phase margin.

b) Explain relation between time and frequency response analysis. [5+10]

7. What is compensation? What are the different types of compensators? Explain in brief. [15]

8.a) Obtain the state transition matrix for the state model whose matrix A is given by

$$A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$$

b) Consider the system $\dot{X} = AX + Bu$, $Y = CX$

Where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ $C = [1 \quad 0 \quad 0]$

Test for controllability and observability. [7+8]

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