BTS (C) – VI – 06 – 021 (B)

B. Tech Degree VI Semester Examination, June 2006

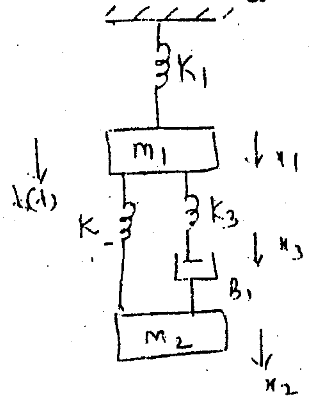
CS/EC/EB/EI 605 CONTROL SYSTEM ENGINEERING

(1999 Admissions onwards)

Time : 3 Hours | Maximum Marks : 100

I. (a) Compare open loop and closed loop control systems. (5)

(b) For the mechanical system given, obtain the differential equations. Also draw the electrical network based on force-voltage analogy and force-current analogy. (7)

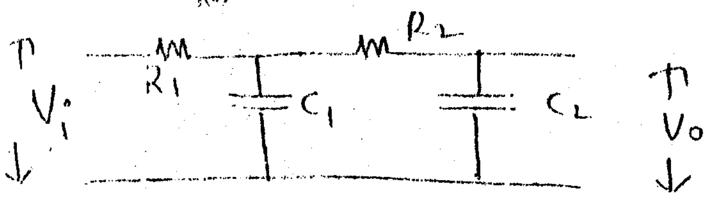


(c) Obtain the inverse Laplace atransform of

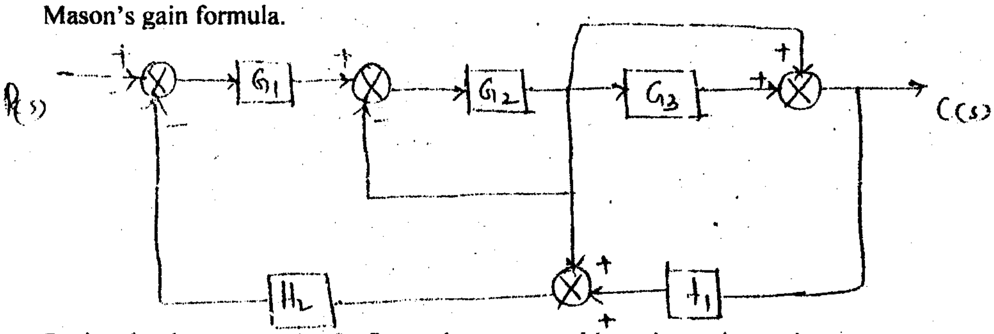
$$F(s) = \frac{5(s+2)}{s^2(s+1)(s+3)}.$$ (8)

OR

II. (a) Obtain the transfer function $\frac{V_{o(s)}}{V_{i(s)}}$ of the given network. (8)

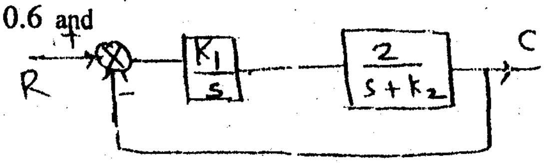


(b) Find $\frac{C(s)}{R(s)}$ using block diagram reduction techniques. Also verify the result using Mason's gain formula. (12)



III. (a) Derive the time response of a first order system subjected to unit step input. (4)

(b) For the system shown, for $\delta = 0.6$ and $w_d = 10$ rad/sec, find



(i) K_1 and K_2 (ii) Peak overshoot

(ii) Time required to stabilize the system output to stay within 2% tolerance band. (8)

(c) For a unity feedback system having

$$G(s) = \frac{10(s+1)}{s^2(s+2)(s+10)},$$ determine

(i) Static error coefficients

(ii) Steady state error for an input $1 + 4t + \frac{t^2}{2}$. (8)

(Turn Over)

OR

IV. (a) What are the effects of derivative controller on the system performance of a II order system? (4)

(b) Derive expressions for the rise time and peak time of a II order under damped system subjected to unit step input (8)

(c) The open loop transfer function of a negative unity feed back system is

$G(s) = \dfrac{K}{s(s+3)(s^2+s+1)}$. Determine the value of K that will cause sustained oscillations in the closed loop system. Also find the oscillation frequency. (8)

V. (a) Define gain margin and phase margin. How can you determine the phase margin, gain margin and hence stability of systems from polar plots? (8)

(b) Plot the bode diagrams for the open loop transfer functions of a unity feed back system having $G(s) = \dfrac{4}{(1+0.1s)^2(1+0.01s)}$. Determine gain margin and phase margin. Comment on the stability of the closed loop system. (12)

OR

VI. (a) Explain Nichol's chart. How will you get the various frequency domain specifications from it? (8)

(b) State Nyquist stability criterion - A certain control system is given by

$$G(s)\,H(s) = \frac{K}{s(1+s)(1+2s)(1+3s)}$$

Using Nyquist stability criterion, determine the critical value of K for stability of the closed loop system. (12)

VII. (a) Explain the necessity of compensators in control system. (4)

(b) The open loop transfer function of a system is given by

$G(s)\,H(s) = \dfrac{K}{s(s+3)(s^2+3s+3)}$. Sketch the root locus. (16)

OR

VIII. (a) Explain the various steps involved in the construction of root locus. (10)

(b) What are the steps to be followed to design a lag compensator by frequency response method? (10)

IX. (a) Explain the properties of state transition matrix. (4)

(b) Obtain the block diagram and state space model of the system with transfer function

$\dfrac{Y(s)}{U(s)} = \dfrac{2s^2+8s+7}{(s+2)^2(s+1)}$. (8)

(c) Consider a system having state model -

$$\begin{bmatrix} X_1' \\ X_2' \end{bmatrix} = \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 3 \\ 5 \end{bmatrix} U$$

$$Y = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

Obtain its transfer function. (8)

OR

X. (a) Obtain the complete time response of a system given by

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & 0 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

$$X(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \text{ and } Y = \begin{bmatrix} 1 & -1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}.$$ (8)

(b) Write notes on :

(i) a.c. Servomotor (ii) Rotating amplifiers. (12)

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