PDPM - INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, DESIGN & MANUFACTURING JABALPUR

EC 2006: Control Systems

Quiz Test-1

Full Marks 20 **Time 60 minutes**

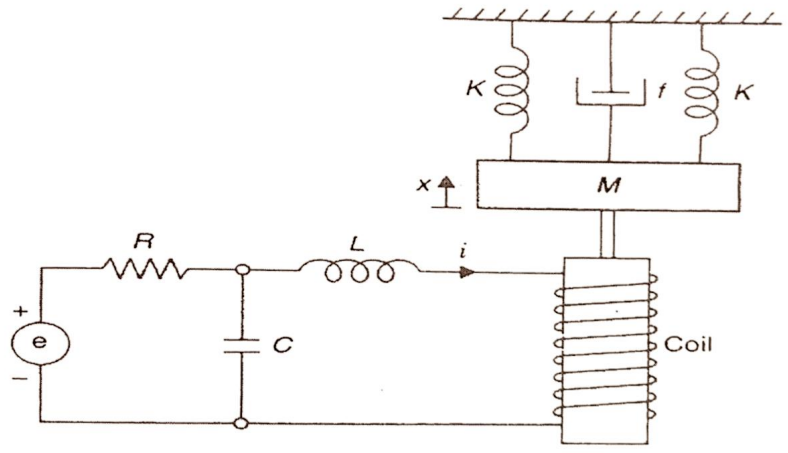
(Answer all)

Q1. Sketch the root locus plot of the system with open loop transfer function mentioning angle of asymptotes, Break Away points, Imaginary intersection.

$$GH(s) = \frac{K(s+4)}{(s+2)^2}$$ [8]

Q2. Determine the stability range of "K" for a system having characteristic equation $s^4 + 2s^3 + 10s^2 + (K-10)s + K = 0$ [5]

Q3. Find the transfer function $X(s)/E(s)$ of the electromechanical system shown below. (Assume that the coil has a back emf of $e_b = k_1\, dx/dt$ and the coil current i produces a force $F = k_2\, i$ on the mass M) [7]



Best of Luck

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PLP

EC-2006: Control Systems (End-Semester)

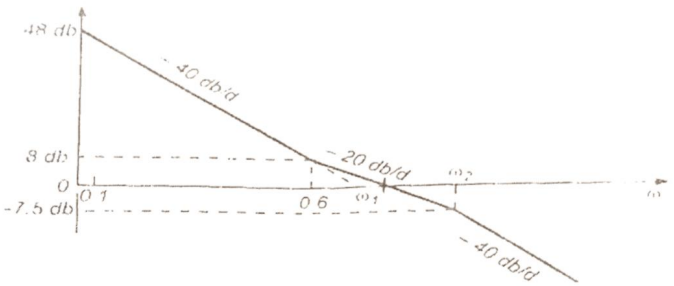
Full Marks 35 **Time 180 minutes**

1. For a system represented by state equation $\dot{X} = AX$, the state response is

$X(t) = \begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix}$ when $X(0) = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$ and $X(t) = \begin{bmatrix} e^{-t} \\ -e^{-t} \end{bmatrix}$ when $X(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$ [5+4]

Determine the system matrix A and state transition matrix.

2. Find out the open loop transfer function from the bode plot (asymptotic magnitude plot) shown below. [5]



[6]

3. Consider the system

$$\dot{X} = AX + Bu$$

where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

Determine the state feedback gain matrix K by using the state feedback control law $u = -KX$ so that the desired closed loop poles will be at $s = -2 \pm j4$ and $s = -10$.

4. Consider the discrete time unity-feedback control system (with sampling period 1 second) whose open loop pulse transfer function is given by

$$G(z) = \frac{K(0.3679z + 0.2642)}{(z - 0.3679)(z - 1)}$$

Determine the range of K for the stability of the system using Jury stability criteria. [8]

5. Find the equivalent discrete state model of the system given below [7]

$\dot{X} = AX + BU, \quad Y = CX$

$A = \begin{bmatrix} -0.01 & 0 \\ 0 & -0.02 \end{bmatrix}, B = \begin{bmatrix} 1 & 1 \\ -0.004 & -0.002 \end{bmatrix}, C = \begin{bmatrix} 0.01 & 0 \\ 0 & 1 \end{bmatrix},$

$U = \begin{bmatrix} 2 \\ 0 \end{bmatrix}, X(0) = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

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12/04/24

EC-2006: Control Systems

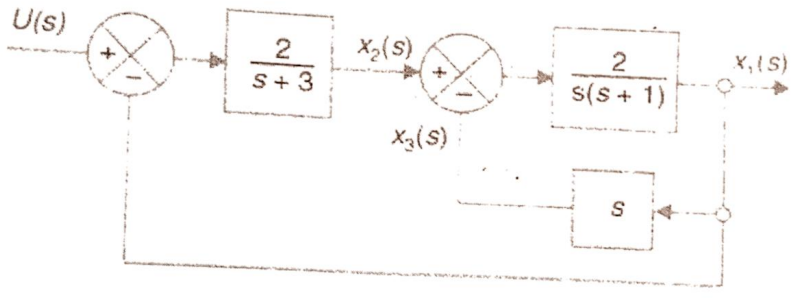
Full Marks 15 **Quiz Test-1I** **Time 60 minutes**

(Answer all)

Q1. Determine the time response of the system output having state model [5]

$$\dot{x}_1 = x_2 + u(t)$$
$$\dot{x}_2 = -2x_1 - 3x_2$$
$$u(t) = \begin{cases} e^{-t} & for\ t \geq 0 \\ 0 & for\ t < 0 \end{cases} \quad and\ x_1(0) = x_2(0) = 0$$
$$y(t) = x_1(t)$$

Q2. Write the equivalent state model of the system given below in controllable canonical form and diagonal canonical form. Also, check the controllability and Observability. [3+3+2+2]



Best of Luck