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B. TECH.
(SEM VI) THEORY EXAMINATION 2022-23
CONTROL SYSTEM

Time: 3 Hours ***Total Marks: 100***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

(a) Explain Eigen Vector.
(b) Define damping ratio.
(c) Differentiate between open loop system and closed loop system
(d) Explain resonant peak and resonant frequency
(e) Explain the Incremental Encoder
(f) What is servomechanism?
(g) Define transfer function.
(h) Explain static velocity error constant and static acceleration error constant
(i) What is characteristic equation?
(j) Explain characteristics of an ideal control system.

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

(a) Find the transfer function Y_8/Y_1 of the signal flow graph shown in Fig. 1

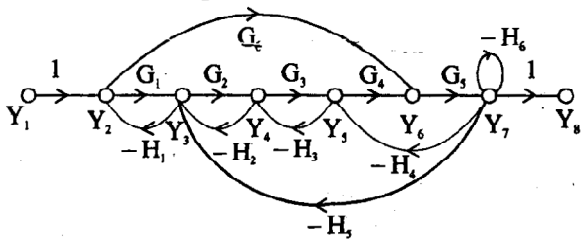

Fig. 1

(b) A linear time invariant system is characterized by the state variable model. Examine the controllability and observability of the system

$$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix}, \quad B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix}, \quad C = [0 \quad 0 \quad 1]$$

(c) Explain steady state error in detail. Derive its expression for step and ramp inputs in type 1 systems.
(d) Discuss the effect of adding a zero to the forward path in detail.
(e) Explain Routh Hurwitz stability criterion. Using this method check the stability of the system whose characteristic equation is $2s^5 + s^4 + 6s^3 + 3s^2 + s + 1 = 0$.

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a) Discuss the effect of feedback on following:
  (i) Stability
  (ii) Sensitivity
  (iii) Overall Gain.

(b) Determine the transfer function $Y_2(s)/F(s)$ of the system shown in Fig. 2

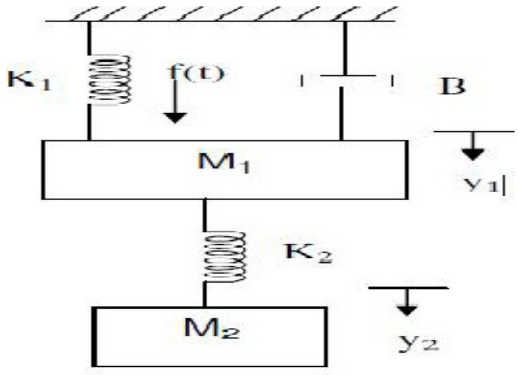

Fig. 2

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) Find the state transition matrix of a control system whose state equation is given by:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix};$$

(b) Construct the state model for a system characterized by the differential equation:

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y = 4$$

Give the block diagram representation of the state model

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) Derive the expressions for peak overshoot, rise time and peak time of a second order system subjected to unit step input.

(b) Derive the time response of a second order system subjected to unit step input.

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) Draw the Bode Plot for the transfer function G(s). From the bode plot determine-

(i) Phase crossover frequency
(ii) Gain crossover frequency
(iii) Gain Margin
(iv) Phase Margin

$$G(s) = \frac{36\,(1+0.2\,s)}{s^2(1+0.05s)(1+0.01s)}$$

(b) Sketch the polar plot for $G(s) = \frac{20}{s(s+1)(s+2)}$

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) Write a short note on

(i) Bounded input and bounded output stability
(ii) Zero input and asymptotic stability

(b) Sketch the root locus plot for $G(s) = \frac{K(s+1)}{s^2(s+3.6)}$ and $H(s) = 1$.