# CBCS SCHEME

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17AE71

## Seventh Semester B.E. Degree Examination, Feb./Mar.2022
## Control Engineering

Time: 3 hrs. Max. Marks: 100

**Note:** ***Answer any FIVE full questions, choosing ONE full question from each module.***



### Module-1

1 a. With neat labeled diagram explain missile launching system with feedback control. **(10 Marks)**

b. Define the following :
(i) System (ii) Control system (iii) Controller
(iv) Disturbances (v) Plant **(10 Marks)**

**OR**

2 a. Write the differential equations for the mechanical system shown in Fig.Q2 (a) and obtain F-V and F-I analogous electrical networks. **(10 Marks)**

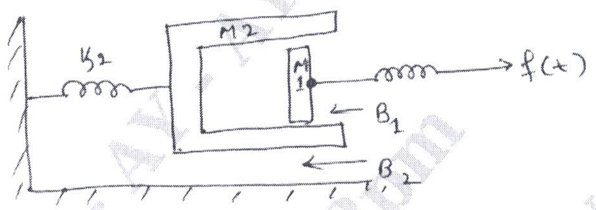


Fig. Q2 (a)

b. Obtain transfer functions for the systems shown in Fig. Q2 (b). Show that they are analogous. **(10 Marks)**

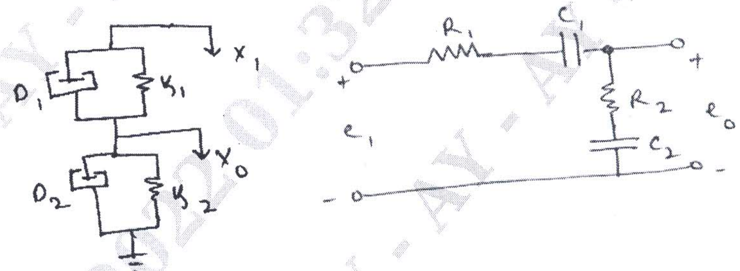


Fig. Q2 (b)

### Module-2

3 a. Draw the signal flow graph and hence determine the overall transfer function of the block diagram, shown using Mason's gain formula. **(10 Marks)**

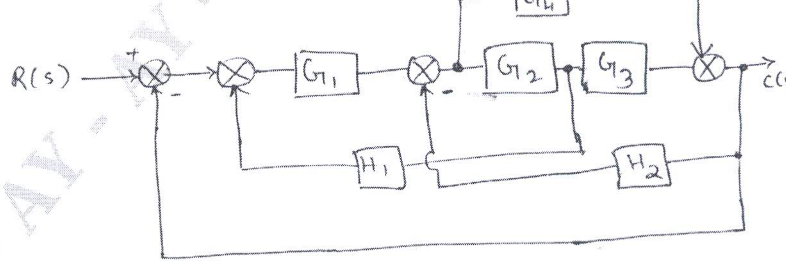


Fig. Q3 (a)

b. Obtain the expression for $C_1$ and $C_2$ for the given multiple input multiple output system. (Refer Fig. Q3 (b)). **(10 Marks)**

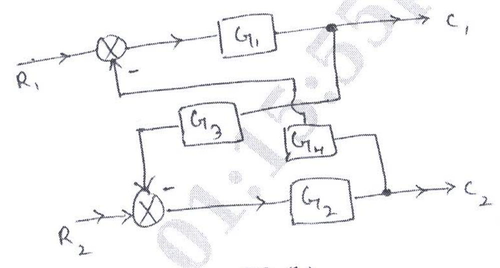


Fig. Q3 (b)

**OR**

4 a. The response of a system subjected to a unit step input is $C(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$. Obtain the expression for the closed loop transfer function. Also determine the undamped natural frequency and damping ratio of the system. **(10 Marks)**

b. Find the open loop transfer function of an equivalent prototype, single loop unity feedback, system having second order, whose step response is as shown in Fig. Q4 (b). **(10 Marks)**

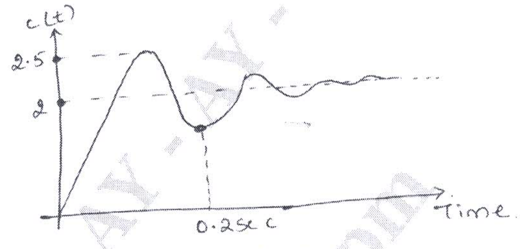


Fig. Q4 (b)

## Module-3

5 a. Use Routh Hurwitz criterion and determine
   (i) Number of roots is left half of S-plane.
   (ii) Number of roots is right half of S-plane.
   (iii) Number of roots on imaginary axis.

$$s^4 + 2s^2 + 1 = 0$$ **(10 Marks)**

b. Using RH criterion determine the stability of the system having the characteristics equation,

$$S^6 + 2S^5 + 5S^4 + 8S^3 + 8S^2 + 8S + 4 = 0$$ **(10 Marks)**

**OR**

6 A feed back control system has open loop transfer function,

$$G(s)H(s) = \frac{K}{s(s+4)(s^2+4s+20)}.$$

Plot the root locus for K = 0 to ∞. Indicate all the points on it. **(20 Marks)**

## Module-4

7 a. Sketch the polar plot of the system having open loop transfer function,

$$G(s)H(s) = \frac{10s}{(1+4s)}$$ **(10 Marks)**

b. For a certain control system,

$$G(s)H(s) = \frac{K}{s(s+2)(s+10)}$$

Sketch the Nyquist plot and hence calculate the range of values of K for stability. **(10 Marks)**

**OR**

8 a. Given $G(s)H(s) = \dfrac{12}{s(s+1)(s+2)}$. Draw the polar plot and hence determine if system is stable and its gain margin and phase margin. **(12 Marks)**

b. Show that Loci of constant phase angles are circles. **(08 Marks)**

**Module-5**

9 a. With neat diagram, explain PID controllers. **(10 Marks)**

b. What is the necessity of system compensation? Draw the block diagram for series and feedback compensation and explain. **(10 Marks)**

**OR**

10 a. Explain matrix representation of state equations. **(07 Marks)**

b. Verify the following system are controllable or not.

$$\begin{Bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{Bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} + \begin{Bmatrix} 0 \\ 1 \end{Bmatrix} u \text{ and } C = \{1 \quad 1\} x$$ **(06 Marks)**

c. Verify the following system is observable or not.

$$\begin{Bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{Bmatrix} = \begin{bmatrix} -5 & 4 \\ -6 & 5 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} + \begin{Bmatrix} 1 \\ 1 \end{Bmatrix} u \text{ and } Y = \{-2 \quad 3\} x$$ **(07 Marks)**

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