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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)

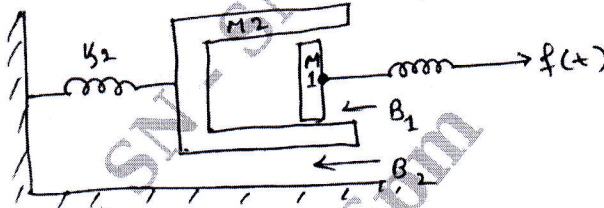


Fig. Q2 (a)

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

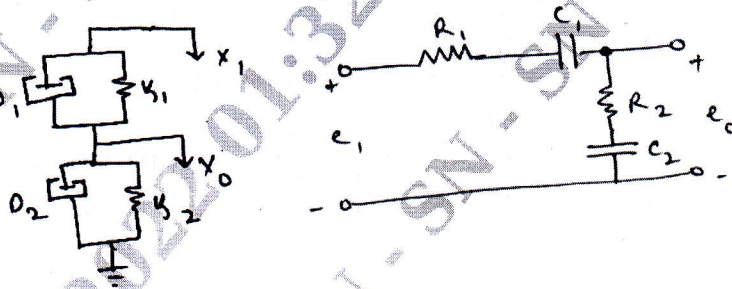


Fig. Q2 (b)

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)

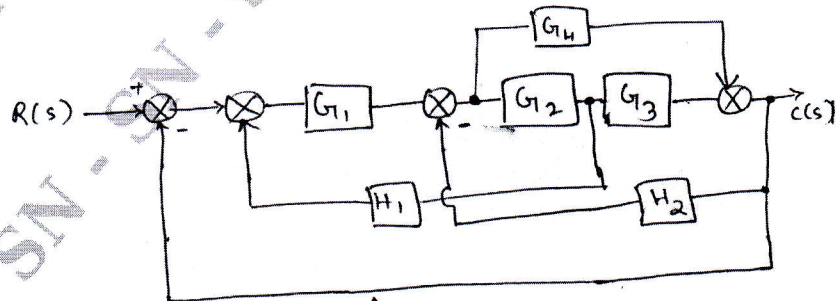


Fig. Q3 (a)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written e.g. 42+8 = 50, will be treated as malpractice.

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

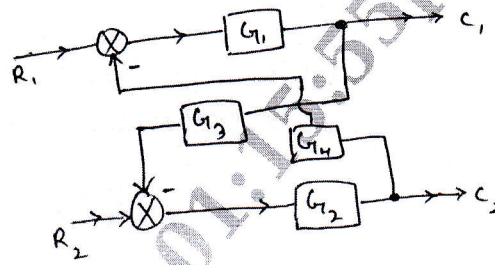


Fig. Q3 (b)

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
- Number of roots is left half of S-plane.
 - Number of roots is right half of S-plane.
 - 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 $G(s)H(s) = \frac{12}{s(s+1)(s+2)}$. 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.

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

- c. Verify the following system is observable or not.

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