

CBCS SCHEME

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18EE61

Sixth Semester B.E. Degree Examination, Dec.2023/Jan.2024 Control Systems

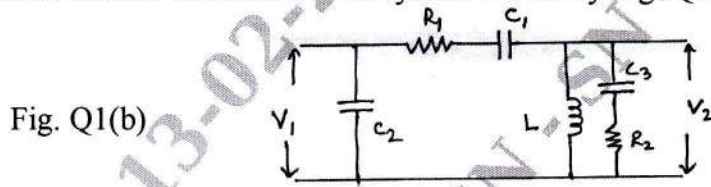
Time: 3 hrs.

Max. Marks: 100

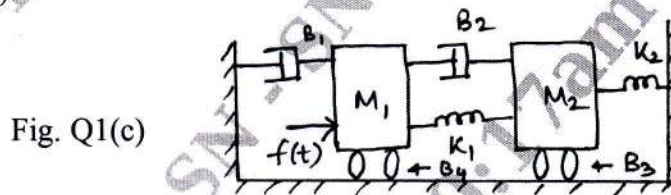
Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Distinguish between Open loop and Closed loop control system with an example for each. (06 Marks)
- b. Determine transfer function for the system shown by Fig. Q1(b).

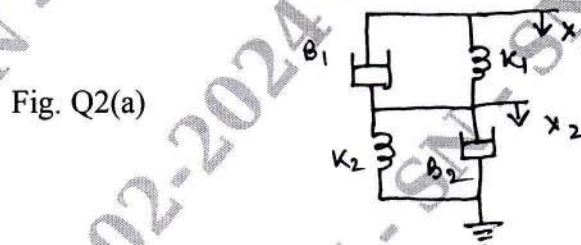


- c. Construct F.V. and F – I analogous electrical system for the mechanical system shown by Fig. Q1(c). (08 Marks)

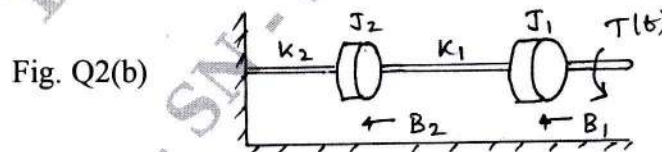


OR

- 2 a. Deduce transfer function for the mechanical translational system shown by Fig. Q2(a). Consider X_2 as output and X_1 as input. (06 Marks)



- b. Write the differential equations describing the mechanical rotational system shown in Fig. Q2(b) and obtain its T – V analogous electrical system. (08 Marks)



- c. Define Servomechanism. Explain AC servomotor and list its salient features. (06 Marks)

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 eg, 42+8 = 50, will be treated as malpractice.

Module-2

- 3 a. Obtain the overall transfer function for the system shown in Fig. Q3(a) using block diagram reduction technique. (10 Marks)

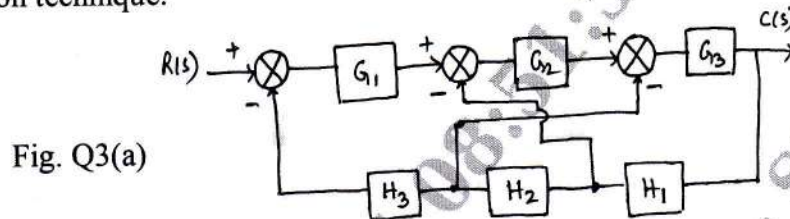


Fig. Q3(a)

- b. Use Mason's gain formula to find the transfer function for the system given by signal flow graph shown in Fig. Q3(b). (10 Marks)

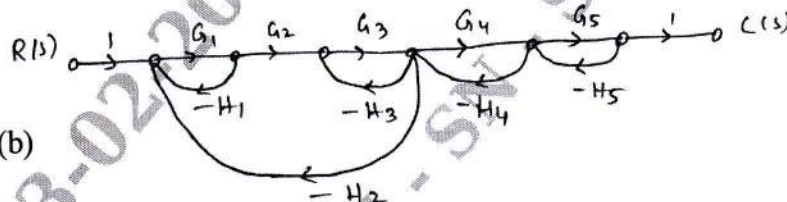


Fig. Q3(b)

OR

- 4 a. State Mason's gain formula. Construct the signal flow graph for the system expressed by the following set of equations.

$$X_2 = G_1 X_1 - H_1 X_2 - H_2 X_3 - X_6 X_6$$

$$X_3 = G_1 X_1 + G_2 X_2 - H_3 X_3$$

$$X_4 = G_2 X_2 + G_3 X_3 - H_4 X_5$$

$$X_5 = G_4 X_4 - H_5 X_6$$

$$X_6 = G_5 X_5$$

(10 Marks)

- b. For the block diagram, shown in Fig. Q4(b), determine the transfer function $\frac{C(s)}{R(s)}$.

(10 Marks)

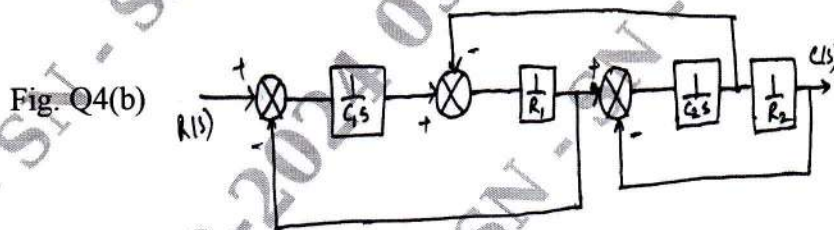


Fig. Q4(b)

Module-3

- 5 a. Considering the response of a second order system to a unit step input, find an expression of rise time and peak time. (07 Marks)

- b. An unity feedback system has $G(s) = \frac{20(1+s)}{s^2(2+s)(4+s)}$. Calculate its steady state error

coefficients and error when the applied input is $r(t) = 40 + 2t + 5t^2$. (07 Marks)

- c. The response of a servo mechanism is $C(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$, when subjected to a unit step input. Obtain an expression for closed loop transfer function. Determine undamped natural frequency and damping ratio. (06 Marks)

OR

- 6 a. State and explain Routh's stability criterion. (04 Marks)
- b. A unity feedback control system has $G(s) = \frac{K(s+13)}{S(s+3)(s+7)}$. Using Routh's stability criterion calculate the range of K for which the system is i) Stable ii) Has its closed loop poles more negative than -1. (10 Marks)
- c. Comment on the stability of a system using Routh's stability criterion whose characteristic equation is $S^4 + 2S^3 + 4S^2 + 6S + 8 = 0$. Find the number of poles in the right half of S plane. (06 Marks)

Module-4

- 7 a. Sketch the complete root locus of system having $G(s)H(s) = \frac{K}{S(s+1)(s+2)(s+3)}$. Comment on the stability of the system. (12 Marks)
- b. State and explain various frequency domain specifications. (08 Marks)

OR

- 8 a. Open loop transfer function of a system is given by $\frac{K}{S(s+3)(s^2+3s+11.25)}$. Find the valid breakaway point and angle of departure. (08 Marks)
- b. Given $G(s) = \frac{80000}{S(s+2)(s+50)(s+200)}$ for a unity feedback control system. Draw the Bode plot and hence determine phase margin and gain margin. (12 Marks)

Module-5

- 9 a. Explain the effect of PD controller on the performance of 2nd order system. (10 Marks)
- b. Sketch the nyquist plot for the system given by

$$G(s)H(s) = \frac{40}{(s+4)(s^2+2s+2)}$$

(10 Marks)

OR

- 10 a. State and explain Nyquist stability criterion. (04 Marks)
- b. List the effect of lag compensator and lead compensator. (08 Marks)
- c. Explain the steps to design lead compensator. (08 Marks)
