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15AE71

Seventh Semester B.E. Degree Examination, July/August 2022  
**Control Engineering**

Time: 3 hrs.

Max. Marks: 80

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

**Module-1**

- 1 a. Define Control System. Compare open loop and closed loop control system. (08 Marks)
- b. Explain the various requirements of an ideal control system. (08 Marks)

OR

- 2 a. Determine the transfer function of the system. (08 Marks)

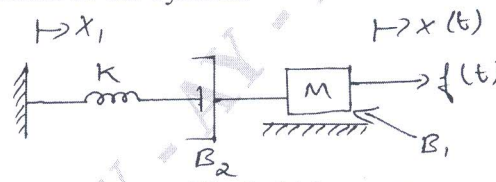


Fig.Q.2(a)

- b. Draw the torque-voltage and torque-current electrical analogous circuits and verify by writing mesh and node equations. (08 Marks)

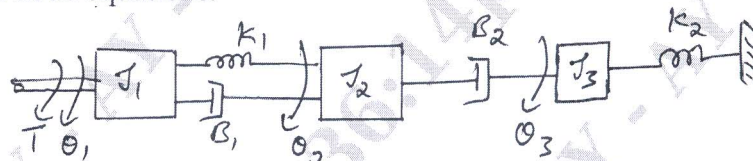


Fig.Q.2(b)

**Module-2**

- 3 a. Convert the given block diagram to signal flow graph and determine C(S)/R(S). (08 Marks)

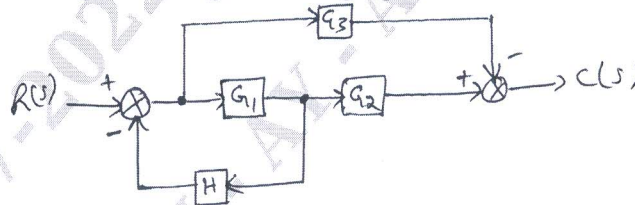


Fig.Q.3(a)

- b. Find the overall gain C(S)/R(S) for the signal flow graph. (08 Marks)

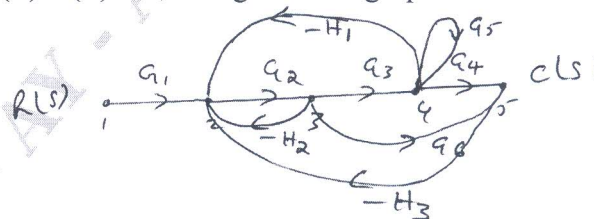


Fig.Q.3(b)

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.

OR

- 4 a. Find  $K_p$ ,  $K_v$ ,  $K_a$  and steady state error for a system with open loop transfer:

$$G(S)H(S) = \frac{10(s+2)(s+3)}{s(s+1)(s+5)(s+4)} \quad ; \text{ where the input is } r(t) = 3 + t + t^2. \quad (10 \text{ Marks})$$

- b. Assuming  $r(t) = 0.1t$  and it is desired that  $e_{ss} \leq 0.005$ , find the range of values of  $K$  for error to be within specified limit for given system. (06 Marks)

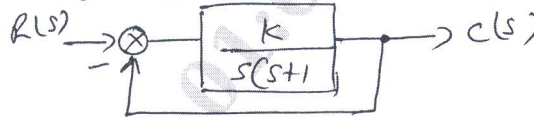


Fig.Q.4(b)

Module-3

- 5 Sketch the root locus for a unity feedback control system given as  $G(S) = \frac{K}{S(S^2 + 4S + 13)}$ . (16 Marks)

OR

- 6 The open loop T.F of an unity feedback system is:  $G(S) = \frac{K}{S(1+0.1S)(1+S)}$ . Determine the value of 'K' so that gain margin is +30db. What is the corresponding phase margin? (16 Marks)

Module-4

- 7 Sketch the polar plot for the given system  $G(S)H(S) = \frac{1}{1+0.1S}$ . (16 Marks)

OR

- 8 Explain the Nyquist criterion and the procedure for using the Nyquist criterion. (16 Marks)

Module-5

- 9 Explain the below controllers:

- PI Controller
- PID Controller.

(16 Marks)

OR

- 10 Consider the system with state equation:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$

Estimate the controllability by

- Kalman's test
- Gilberts test.

(16 Marks)

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