CBCS SCHEME

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15AE71

Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020
Control Engineering

Time: 3 hrs. Max. Marks: 80

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

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-1

1 a. Explain closed loop control system with an example. What are the advantages and disadvantages of closed loop control system? **(10 Marks)**

b. Determine the transfer function $Y_2(s)/F(s)$ of the system shown in Fig.Q.1(b). **(06 Marks)**

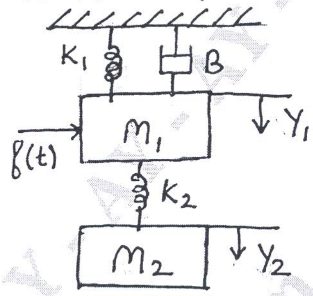

Fig.Q.1(b)

OR

2 a. Obtain the differential equations for the torsional system shown in Fig.Q.2(a). By using appropriate analogy obtain and draw the analogous force-voltage electrical network. **(10 Marks)**

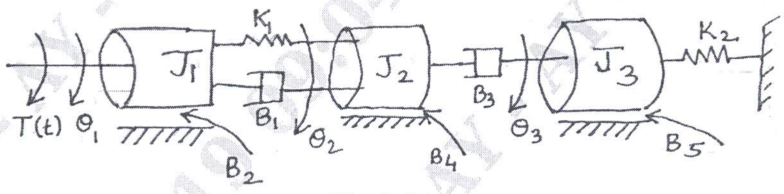

Fig.Q.2(a)

b. Derive the transfer function of an armature controlled dc motor. **(06 Marks)**

Module-2

3 a. Determine the transfer function C(S)/R(S) from the block diagram shown in the Fig.Q.3(a). **(08 Marks)**

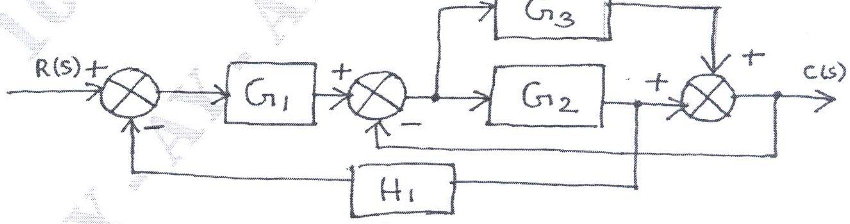

Fig.Q.3(a)

b. Find the transfer function of the system shown in Fig.Q.3(b). (08 Marks)

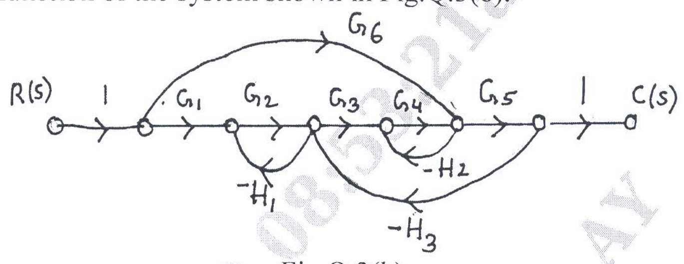

Fig.Q.3(b)

OR

4 a. Obtain an expression for time response of the first order system subjected to unit step input. (08 Marks)

b. A unity feedback system is characterized by an open loop transfer function $G(S) = \frac{10}{S^2 + 2S + 6}$. Determine the following when the system is subjected to a unit step input. i) Undamped natural frequency ii) Damping ratio iii) Peak overshoot iv) Peak time v) Settling time. (08 Marks)

Module-3

5 Draw the complete root locus diagram for the system with open-loop transfer function $G(S)H(S) = \frac{K(s+1)}{s^2(s+3)(s+5)}$. Determine the range of variation of K over which the system remain stable. (16 Marks)

OR

6 Sketch the Bode plot for $G(S)H(S) = \frac{2}{s(1+s)(1+0.2s)}$. Also obtain Gain Margin and Phase Margin and cross over frequencies. (16 Marks)

Module-4

7 a. Plot the polar diagram for the open loop transfer function $G(S)H(S) = \frac{12}{s(s+1)(s+2)}$. (10 Marks)

b. How to find gain and phase margin from polar and Nyquist plot? (06 Marks)

OR

8 Using Nyquist criteria, investigate the stability of a system whose open loop transfer function is $G(S)H(S) = \frac{K}{(s+1)(s+2)(s+3)}$. (16 Marks)

Module-5

9 a. Briefly explain proportional integral and proportional – derivative controller with block diagram and mathematical equations. (10 Marks)

b. Discuss various methods of compensation in feed back control system. (06 Marks)

OR

10 a. List the advantages and disadvantages of state variable analysis. **(04 Marks)**

b. Derive the state variable model for the system show in the Fig.Q.10(b).

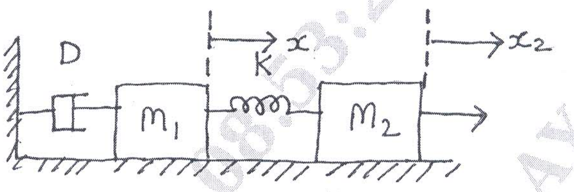

Fig.Q.10(b) **(06 Marks)**

c. Determine the state controllability and observability of the system described by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 10 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$ using Kalman Test. **(06 Marks)**

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