CBCS SCHEME

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18MT34

Third Semester B.E. Degree Examination, June/July 2024
Control System

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define closed loop control system and explain with neat diagram and list out its merits and demerits. **(10 Marks)**

b. Determine the transfer function $\frac{Y_2(s)}{F(s)}$ of the system shown in Fig. Q1 (b) **(10 Marks)**

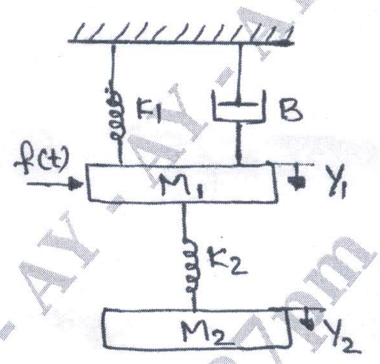

Fig. Q1 (b)

OR

2 a. Obtain the transfer function $\frac{E_0(s)}{E_i(s)}$ of the electrical circuit shown in Fig. Q2 (a). **(10 Marks)**

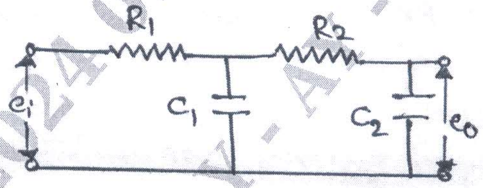

Fig.Q2 (a)

b. Determine the transfer function $\frac{C(s)}{R(s)}$ from the block diagram shown in the Fig. Q2 (b). **(10 Marks)**

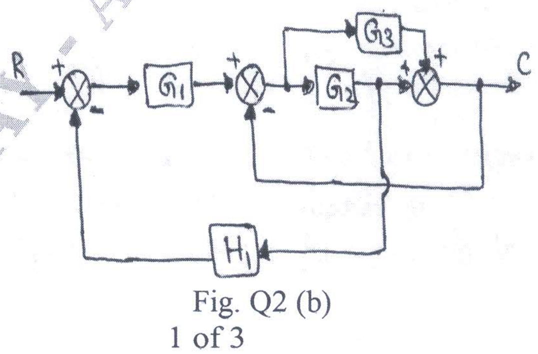

Fig. Q2 (b)

Module-2

3 a. What is signal flow graph representation? Briefly explain the properties of signal flow graph. **(10 Marks)**

b. Find $\frac{C(s)}{R(s)}$ for the following system using Mason's gain rule shown in Fig. Q3 (b).

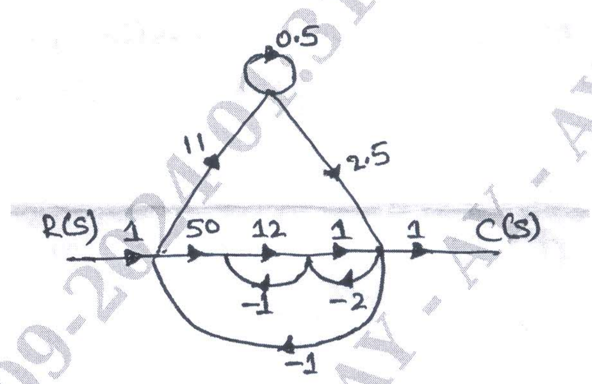

Fig. Q3 (b) **(10 Marks)**

OR

4 a. Derive an expression for the unit step response of first order system. **(10 Marks)**

b. A unity feedback control system has its forward path transfer function as, $G(s) = \frac{K}{s(1+sT)}$ the maximum overshoot in the unit step response of this system is to be reduced from 60% to 20%. Determine the change in factor K to achieve this reduction. **(10 Marks)**

Module-3

5 a. State and explain the Routh-Hurwitz criterion of stability. What are its limitations? **(10 Marks)**

b. Determine the stability of the system represented by the characteristic equation, $s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$ by means of the Routh criterion. Determine the number of roots lying in right half of s-plane. **(10 Marks)**

OR

6 a. Derive an expression for Resonant peak M_r and resonant frequency W_r for a standard second order system in terms of ξ and W_n. **(10 Marks)**

b. For a closed loop control system, $G(s) = \frac{100}{s(s+8)}$, $H(s) = 1$. Determine the resonant peak and resonant frequency. **(10 Marks)**

Module-4

7 a. Explain the following as applied to the root locus,
   (i) Centroid
   (ii) Angle of asymptotes
   (iii) Break away points. **(06 Marks)**

b. Sketch the complete root locus of system having, $G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$. **(14 Marks)**

OR

8 a. Define the terms gain margin and phase margin. Explain how these can be determined from Bode plots. **(06 Marks)**

b. Sketch the Bode plot for the transfer function, $G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$. Determine the value of K for the gain cross over frequency to be 5 rad/sec. **(14 Marks)**

Module-5

9 a. Define state variable. State vector, State space and State trajectory. **(08 Marks)**

b. Find the state model using physical variables for the network as shown in Fig. Q9 (b). **(12 Marks)**

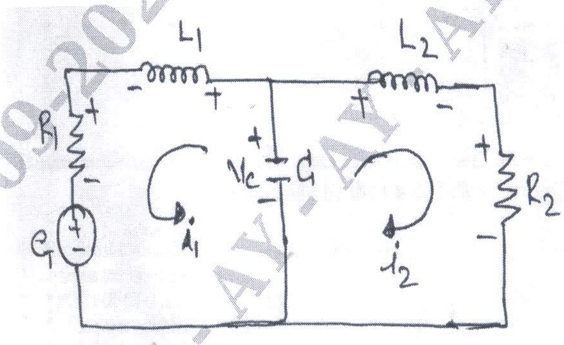

Fig. Q9 (b)

OR

10 a. Obtain the transfer function of the system,

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

(10 Marks)

b. A system is governed by the Differential Equation $\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 10y = 8u(t)$, where y is the output and u is the input of the system. Obtain a state space representation of the system. **(10 Marks)**

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