CBCS SCHEME

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17AE71

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
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. Compare open loop and closed loop system. **(08 Marks)**

b. What are the requirements of an ideal control system? **(04 Marks)**

c. Find the transfer function of the given electrical network

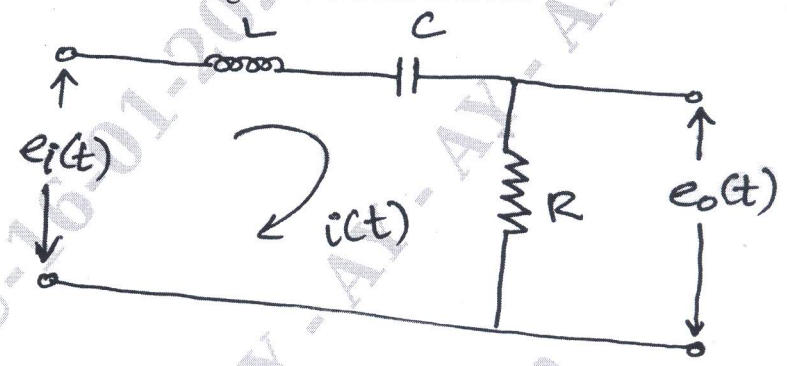

Fig Q1(c) **(08 Marks)**

OR

2 a. Explain the concept of transfer function and its properties. **(08 Marks)**

b. Write the differential equations governing the mechanical system shown in Fig Q2(b). Draw the Force – voltage and Force – current electrical analogous circuits and verify by writing mesh and node equations.

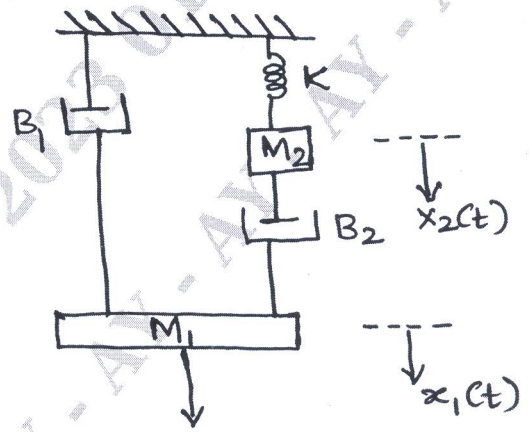

Fig Q2(b) **(12 Marks)**

Module-2

3 a. Determine the overall transfer function $\frac{C(s)}{R(s)}$ for the system shown in Fig Q3(a)

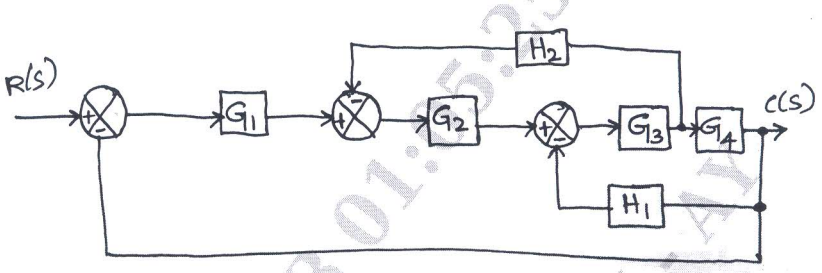

Fig Q3(a) **(10 Marks)**

b. The signal flow graph for a feedback control system is shown in Fig Q3(b). Determine the closed loop transfer function $\frac{C(s)}{R(s)}$.

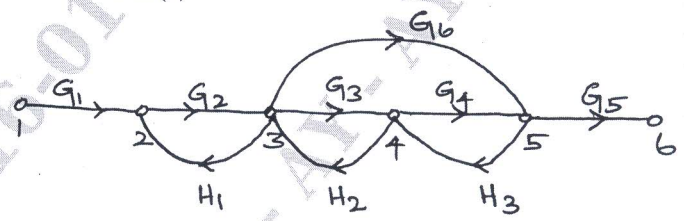

Fig Q3(b) **(10 Marks)**

OR

4 a. Find the response of first order system of unit step input. **(10 Marks)**

b. Obtain the response of unity feedback system whose open loop transfer function $G(s) = \frac{4}{s(s+5)}$ and when the input is unit step. **(10 Marks)**

Module-3

5 a. Use the Routh stability criterion to determine the location of roots on the s-plane and hence the stability for the system represented by the characteristics equations $s^7 + 9s^6 + 24s^5 + 24s^4 + 24s^3 + 24s^2 + 23s + 15 = 0$. **(08 Marks)**

b. Sketch the root locus of the system whose open loop transfer function is $G(s) = \frac{K}{s(s+2)(4+4)}$. Find the value of K. So that the damping ratio of the closed loop system is 0.5. **(12 Marks)**

OR

6 a. Write the procedure to determine Gain Margin and phase Margin from Bode plot. **(08 Marks)**

b. Sketch Bode Plot for the following transfer function and determine the system gain K for the gain cross over frequency to be 5 rad/sec. **(12 Marks)**

$$G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}.$$

Module-4

7 a. Define and find the expression for
   i) Rise time
   ii) Peak time
   iii) Maximum over shoot
   iv) Settling time. **(08 Marks)**

b. The open loop transfer function of a unity feedback system is given by $G(s) = \frac{1}{s(1+s)(1+2s)}$. Sketch the polar plot and determine the gain margin and phase margin. **(12 Marks)**

OR

8 Draw the Nyquist plot for the system whose open loop transfer function is $G(s)H(s) = \frac{K}{s(s+2)(s+10)}$. Determine the range of K for which closed loop system is stable. **(20 Marks)**

Module-5

9 a. Explain the following control action :
   i) Proportional plus Integral **(10 Marks)**
   ii) PID controller **(10 Marks)**

b. Discuss in detail about Lead and Lag compensator with expression.

OR

10 a. Write short note on state equations and state variable representation. **(10 Marks)**

b. Write short on controllability and observability. **(05 Marks)**

c. Find the controllability of the system described by the following equation. **(05 Marks)**

$$\dot{X} = \begin{bmatrix} -1 & -1 \\ +2 & -1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t).$$

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