CBCS SCHEME

USN

15MT34

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

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. Define a control system. List merits and demerits of open-loop and closed loop control system. **(05 Marks)**

b. Draw the mechanical network. Write the differential equations of performance and also draw F-V analogous electrical circuit of the system shown in Fig.Q1(b).

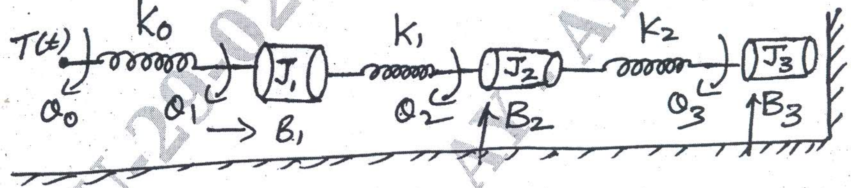

Fig.Q1(b) **(06 Marks)**

c. Illustrate how to perform the following in connection with block diagram reduction techniques:
i) Shifting a summing point ahead of a block and behind a block.
ii) Shifting a take off point after a summing point and before a summing point.
iii) Removing minor feedback loop. **(05 Marks)**

OR

2 a. List the requirements of a good control system. **(04 Marks)**

b. For the mechanical system shown in Fig.Q2(b). Draw the mechanical network. Write the differential equations of performance and also draw force-to-current analogous electric circuit.

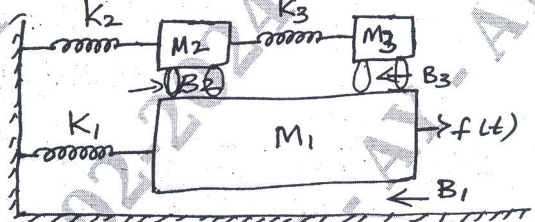

Fig.Q2(b) **(06 Marks)**

c. Find $\frac{C(s)}{R(s)}$ of the system shown in Fig.Q2(c) using block diagram reduction method.

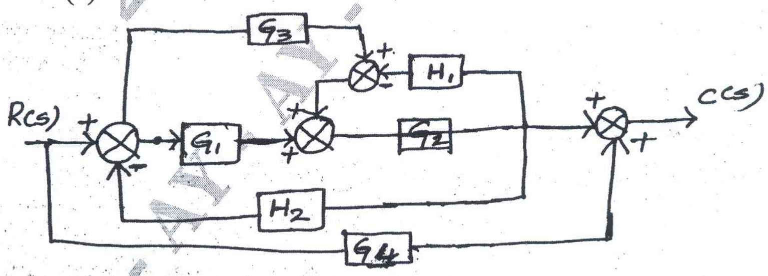

Fig.Q2(c) **(06 Marks)**

Module-2

3 a. State and explain Mason gain formula. **(08 Marks)**

b. Find the transfer function c(s)/R(s) for signal flow graph shown in Fig.Q3(b) below. **(08 Marks)**

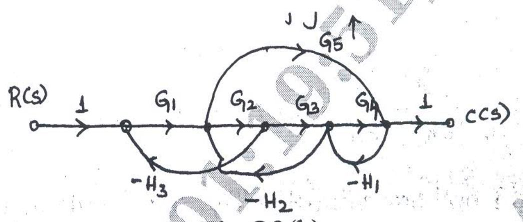

Fig.Q3(b)

OR

4 a. Define the following for second order system :
i) peak time ii) rise time iii) peak overshoot iv) settling time. **(08 Marks)**

b. A system has 30% overshoot and settling time of 5 seconds for an unit step input for second order system determine : i) transfer function ii) peak time (tp) iii) output response (Assume tolerance $e_{ss} = 2\%$). **(08 Marks)**

Module-3

5 a. Calculate the number of roots of the equation $s^6 + 4s^5 + 3s^4 - 6s^2 - 64s - 48 = 0$. Which have positive real part, zero real part and negative real part? **(08 Marks)**

b. Draw the compute root locus for the system with $G(s)H(s) = \dfrac{K}{s(s+3)(s^2+2s+2)}$. **(08 Marks)**

OR

6 a. Draw the root locus for the system with $G(s)H(s) = \dfrac{K}{s(s+3)(s+5)}$. Also find the rang of K. **(08 Marks)**

b. Comment on the stability of the system using Rouths method for a system with equation $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. **(08 Marks)**

Module-4

7 a. List the advantages of frequency domain approach. **(04 Marks)**

b. Define the terms "gain margin" and "phase margin". Explain how these can be determined from Bode plot. **(04 Marks)**

c. Investigate the stability of a negative feedback control system whose open loop transfer function is given by $G(s)H(s) = \dfrac{100}{(s+1)(s+2)(s+3)}$ using Nyquist stability criterion. **(08 Marks)**

OR

8 a. For a particular unity feedback system $G(s) = \dfrac{242(s+5)}{s(s+1)(s^2+5s+121)}$. Sketch the Bode plot. Find W_{gc}, W_{pc}, GM and PM. **(08 Marks)**

b. Draw a polar plot for a negative feedback control system having an open loop transfer function $G(s)H(s) = \dfrac{100}{s^2+10s+100}$. **(04 Marks)**

c. Explain Nyquist stability criterion. **(04 Marks)**

Module-5

9 a. Obtain the state model for an electrical system shown in Fig Q9(a), electrical system shown in Fig Q9(a). Choosing variables as $i_1(t)$, $i_2(t)$ and $V_c(t)$

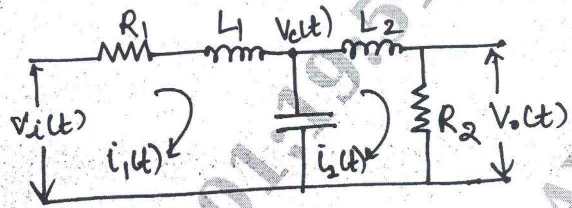

Fig Q9(a) **(08 Marks)**

b. Construct the state model using phase variables for a system defined by differential equations

$$\frac{d^3y(t)}{dt^3} + \frac{4d^2y(t)}{dt^2} + \frac{7dy(t)}{dt} + 2y(t) = 5u(t)$$ **(08 Marks)**

OR

10 a. List 8 properties of the state Transition matrix. **(08 Marks)**

b. Obtain the state transition matrix for the system.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$ **(08 Marks)**

* * * * *