CBCS SCHEME

USN | | | | | | | | | | |

21AE72

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
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. Discuss the concept of control system and briefly explain about the requirements of an ideal control system. **(10 Marks)**

b. Obtain the transfer function of the given electrical circuit.

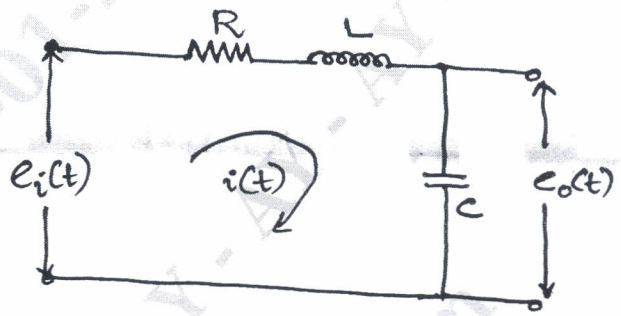

Fig Q1(b) **(10 Marks)**

OR

2 a. Differentiate open loop and closed loop control system. **(08 Marks)**

b. Obtain the differential equations for the mechanical system shown in Fig Q2(b), and draw the analogous electrical network based on :

i) Force – voltage analogy

ii) Force current analogy and verify by writing mesh and mole equation.

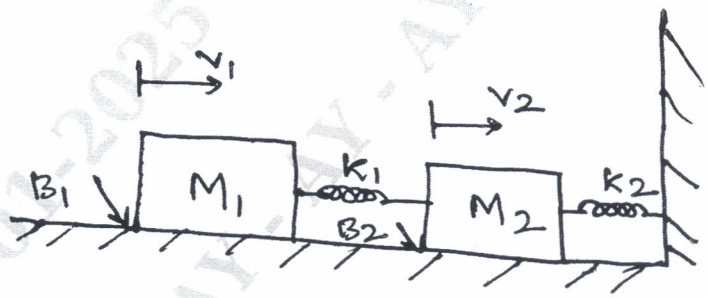

Fig 2(b) **(12 Marks)**

Module-2

3 a. Using block diagram reduction technique, find the closed loop transfer function of the system whose block diagram is shown in Fig Q3(a)

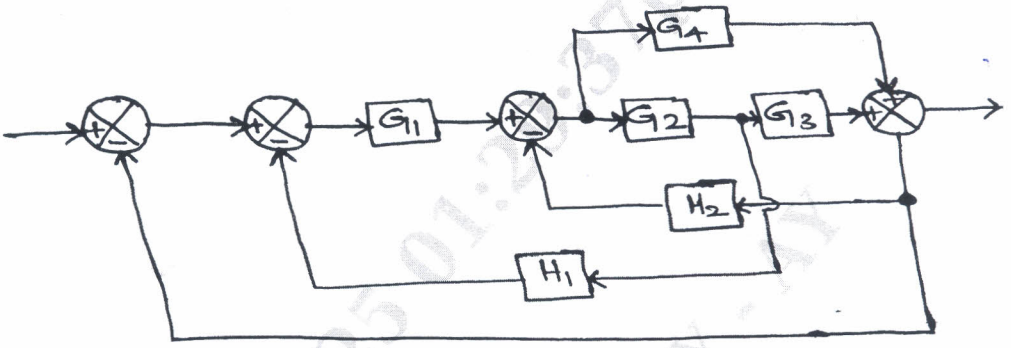

Fig Q3(a) **(10 Marks)**

b. Find the overall gain C(s)/R(s) for the signal flow graph shown in Fig Q3(b).

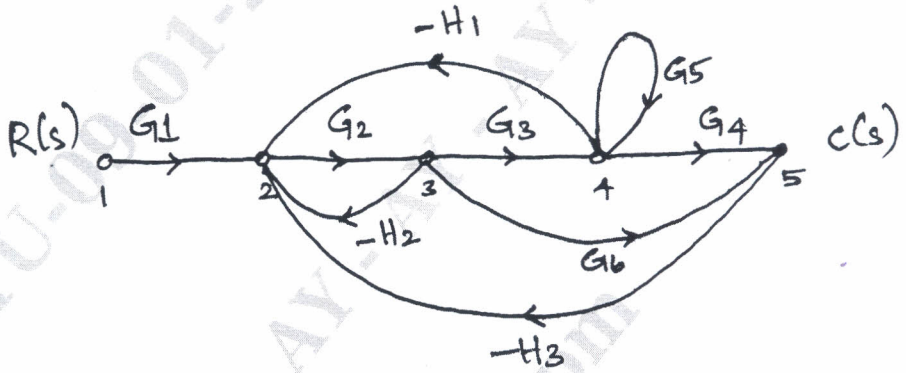

Fig Q3(b) **(10 Marks)**

OR

4 a. Derive the expression for the response of critically demand second order system for unit step input. **(12 Marks)**

b. A unity feedback system whose open loop transfer function is $G(s) = \frac{10}{s(s+2)}$. Find the damping ratio, rise time, percentage of overshoot and peak time. **(08 Marks)**

Module-3

5 a. Use the Routh stability criterion to determine the location of roots on the S-plane and stability for the system represented by the characteristics equation
$s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$. **(05 Marks)**

b. The open loop transfer function of a unity feedback system is given by
$G(s) = \frac{k(s+9)}{s(s^2+4s+11)}$. Sketch the root locus of the system. **(15 Marks)**

OR

6 Plot the Bode diagram for the following transfer function and obtain gain and phase cross over frequencies.
$G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$. **(20 Marks)**

Module-4

7 a. Describe about the frequency response specification with relevant expressions. **(10 Marks)**

b. The open loop transfer function for a unity feedback system is given by $G(s) = \frac{10}{s(1+s)(1+2s)}$. Sketch the polar plat and determine the gain margin and phase margin. **(10 Marks)**

OR

8 a. Draw the Nqyuist plot for the system whose open loop transfer function in $G(s)H(s) = \frac{K}{s(s+2)(s+10)}$. Determine the range of K for which closed loop system in stable. **(12 Marks)**

b. Derive the conditions of M and N circles. **(08 Marks)**

Module-5

9 a. What are the controllers? Explain briefly of all types of controller with their transfer function. **(10 Marks)**

b. Discuss about compensation methods. Derive their transfer functions of phase lead and phase lag network. **(10 Marks)**

OR

10 a. Write a note o the following terms :

i) State variables
ii) State equation
iii) State space
iv) State vector **(08 Marks)**

b. Consider the system with state representation.

$$\dot{x} = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix} x + \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix} u \quad \dot{y} = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix} x$$

Evaluate the state controllability and output controllability. **(12 Marks)**

* * * * *