

- N.B:**
1. Question No. 1 is Compulsory.
 2. Attempt **any three** from the remaining questions.
 3. Assume suitable data wherever necessary.
 4. Figure to right indicate full marks.

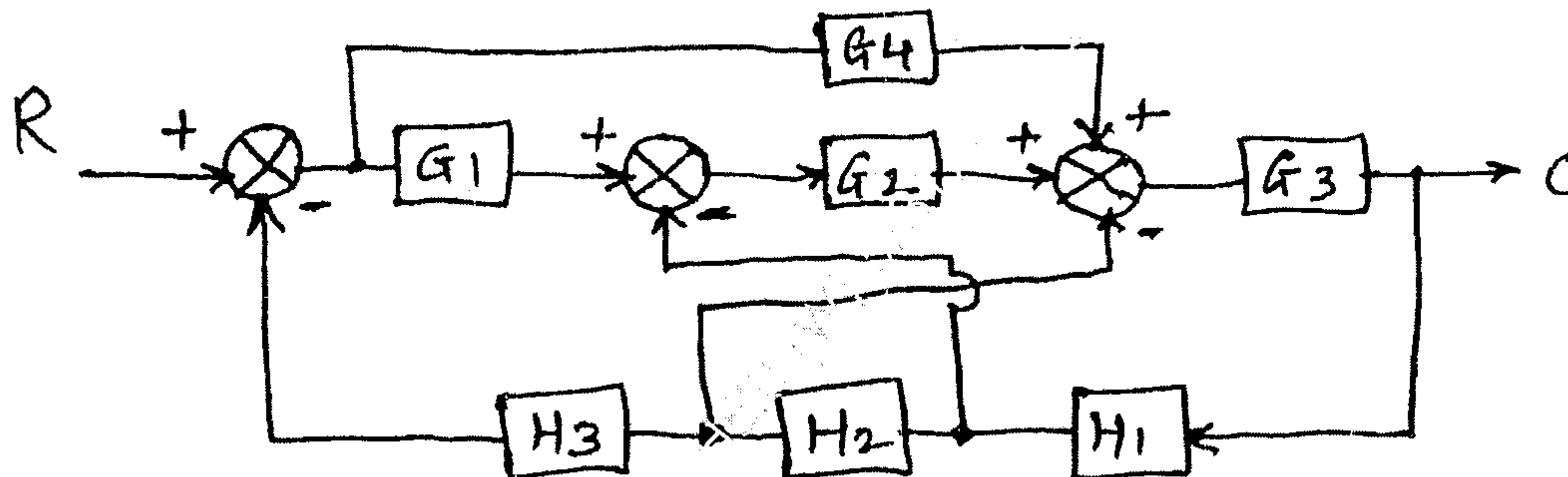
1. Attempt any four questions:- (20)

- a) Explain Adaptive control system.
- b) Explain lead and lag compensator.
- c) Explain Controllability and Observability with its necessity condition for stability.
- d) Determine whether the following systems are stable, marginally stable, and unstable

(i) $-2, 0$; (ii) $-2+j, -2-j$; (iii) $-2+j4, -2-j4, -2$; (iv) $x(t) = \cos\omega t$; (v) $x(t) = e^{-t} \sin 4t$.

e) Examine the stability of $s^5 + 2s^4 + 2s^3 + 4s^2 + 4s + 8 = 0$ using Routh's method.

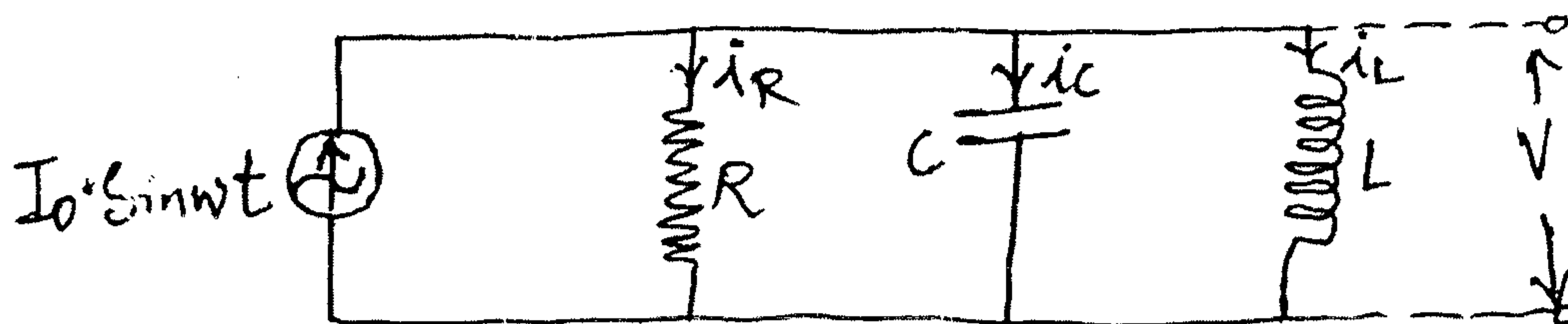
2. a) Obtain the overall transfer function from block diagram. (10)



b) Sketch the complete root locus for the system (10)

$$G(s)H(s) = [K(s+1)(s+2)] / [(s+0.1)(s-1)], \text{ where } K > 0.$$

3. a) Obtain the state variable model of the parallel RLC network. (10)



b) Explain P, PI and PID controller. (10)

TURN OVER

4. a) The state equation of a linear time-invariant system is given below: (10)

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

Where $u > 0$.

Determine the following:

- (i) The state transition matrix.
- (ii) Controllability of the system.

- b) Sketch the bode plot for the open loop transfer function given by: (10)

$$G(s) = [288 (s+4)] / [s(s+1) (s^2 + 4.8s + 144)] \text{ and } H(s) = 1.$$

5. a) Derive the expressions of Peak Overshoot when step input applied to the system. (05)

- b) Sketch the polar plot of $G(s) = 12 / [s(s+1)]$. (05)

- c) For $G(s)H(s) = 1+4s / [s^2 (1+s)(1+2s)]$, draw the Nyquist plot and examine the stability of the system. (10)

6. Attempt any two- (20)

- a) Write a short note on Robust control system.

- b) Construct the signal flow graphs for the following set of equations:

$$Y_2 = G_1 Y_1 - G_2 Y_4$$

$$Y_3 = G_3 Y_2 + G_4 Y_3$$

$$Y_4 = G_5 Y_1 + G_6 Y_3$$

where Y_4 is the output.

Using Mason's gain formula find the transfer function of the system.

- c) Explain the Correlations between time and frequency domain specifications of the system.