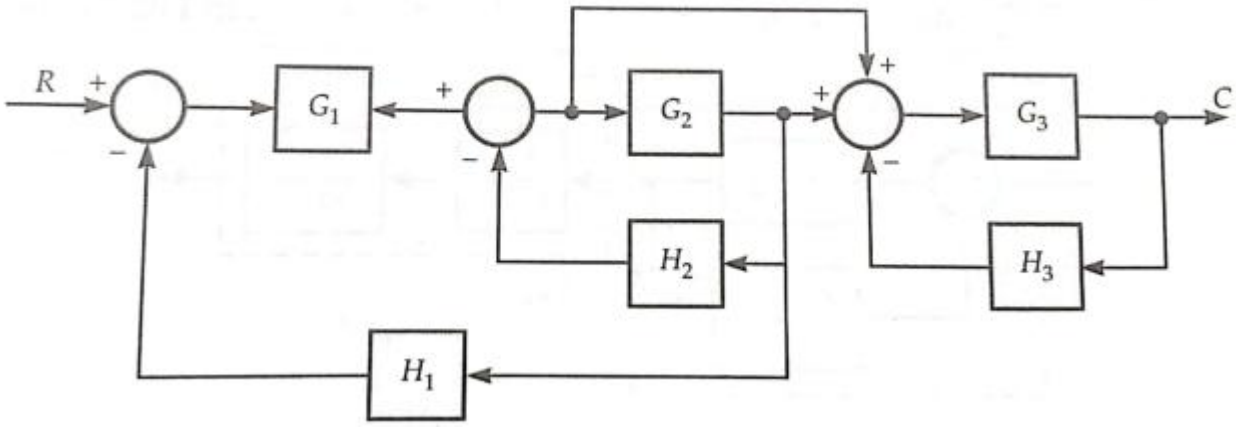
Time (3 Hours) **80 Marks**

Note: (1) Question no. 1 compulsory
(2) Attempt any 3 question out of remaining five questions.
(3) Draw neat diagram wherever necessary.

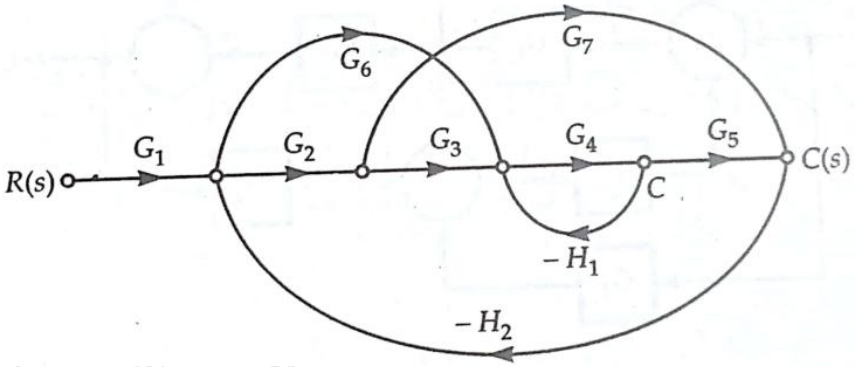
Q 1. Attempt any Four out of five questions

a. Consider an open loop system, G(s) H(s) = $\frac{k}{s^3 + 4s^2 + 8s}$. Check whether s = -1.33 + j 0.94 point lies on the root locus or not using angle condition in root locus.
b. Explain the stability conditions of Bode plot by using suitable diagrams.
c. Explain the general representation of state space model with example.
d. Explain the term damping ratio. Also explain the conditions for the damping ratio.
e. Explain force current analogy in mathematical modeling of control system.

Q 2. a. Obtain the transfer function for the following figure using Block Diagram Reduction method.



b. Obtain the transfer function C(s)/R(s)for the following figure using Mason's gain formula.



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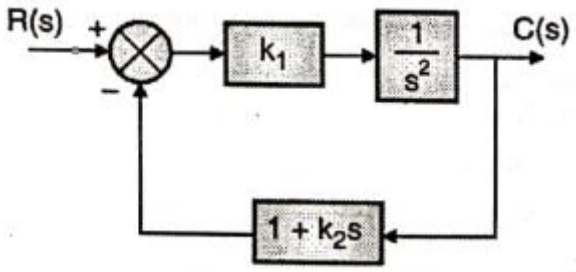
Q3. a. Given the unity feedback system that has the forward transfer function G(s) = $\frac{k(s+2)}{s\,(s^2+4s+13)}$. Sketch the complete root locus.

b. Determine the stability of a system having the characteristics equation using Routh-Hurwitz criteria: $s^6 + 5s^5 + 11s^4 + 25s^3 + 36s^2 + 30s + 36 = 0$ find the stability of the system using Routh Hurwitz criteria.

Q4. a. A feedback control system has G(s) H(s) =$\frac{k}{s(s+2)(s+10)}$Draw Bode plot and comment on stability.

b. For a control system, find the values of K_1 and K_2 so that Mp = 25% and Tp = 4 sec. Assume step input. Also find (1) Settling time (2) Rise time.



Q5. a. Explain the closed loop system. Also, compare the open loop and closed loop system for any control system.

b. Represent the following state space equation in phase variable form and also draw its state model $\frac{C(s)}{R(s)} = \frac{20\,(s+1)(s+3)}{(s+1)(s+5)(s+7)}$

Q 6 a. The control system having unity feedback has G(s) = = $\frac{20}{s\,(1+4s)\,(1+s)}$. Determine: (1) Type of system. (2) Static error constants. (3) Steady state error for the input r(t) = $2 + 4t + \frac{t^2}{2}$

b. Explain armature controlled DC servomotor and also draw the block diagram.

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