feedback Control Systems. QP Code :551100

(3 Hours) [Total Marks :80

N.B. : (1) Question no. **1** is **compulsory.**
(2) Answer any **three** out of the remaining **five** questions.
(3) **Assumptions** made should clearly stated.

1. Attempt any **four** :- 20
   (a) Compare open loop and closed system.
   (b) Explain principle of superposition and homogeneity.
   (c) Explain regenerative feedback.
   (d) Explain co-rrelation between time and frequency response.
   (e) What is the effect of adding a zero to a system.

2. (a) A unity feedback control system has an open loop transfer function 10

 $$G(s) = \frac{k}{s(s^2 + 4s + 13)}$$ sketch the root locus plot of the system. Find the

   value of k and frequency at which the root loci cross the jw axis.

   (b) Obtain the overall transfer function C/R from the signal flow graph shown 10
   in figure.
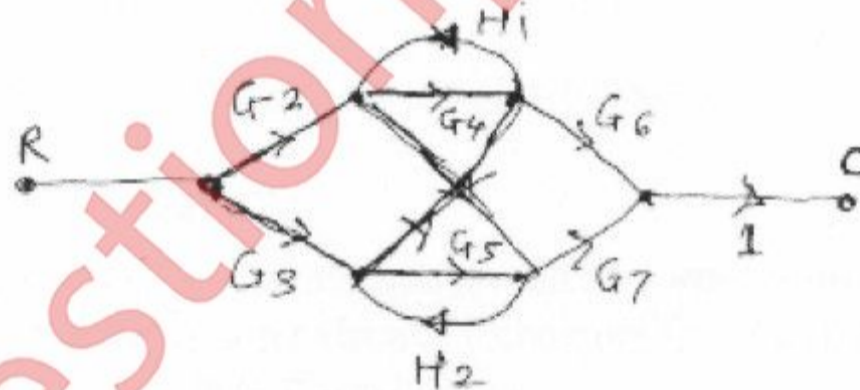
3. (a) Write the differential equations governing the behaviour of mechanical **10** system shown in figure. Also obtain an analogous electrical circuit based on force-current analogy
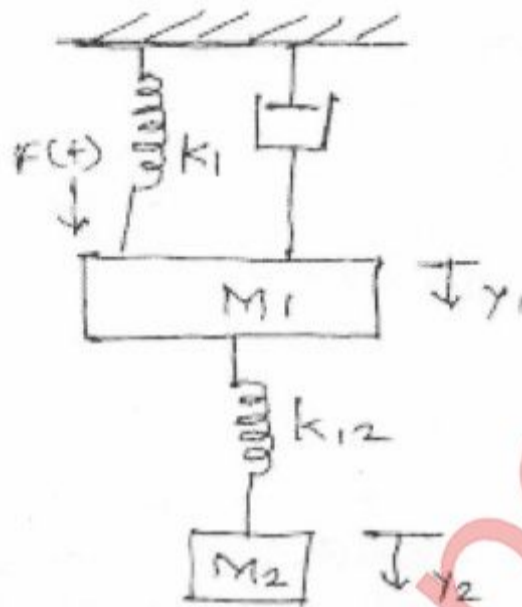

(b) Sketch the Bode plot and determine the gain cross over frequency for **10** the transfer function given below

$$G(s) = \frac{75(1 + 0.2s)}{s(s^2 + 16s + 100)}$$

4. (a) (i) Sketch the polar plot of transfer function given below **5**

$$G(s) = \frac{1}{(1 + s)(1 + 2s)}$$

(ii) Explain any one thermal system and also write its difference equation. **5**

(b) Using the block diagram reduction techniques find the closed loop transfer **10** function of the system given below
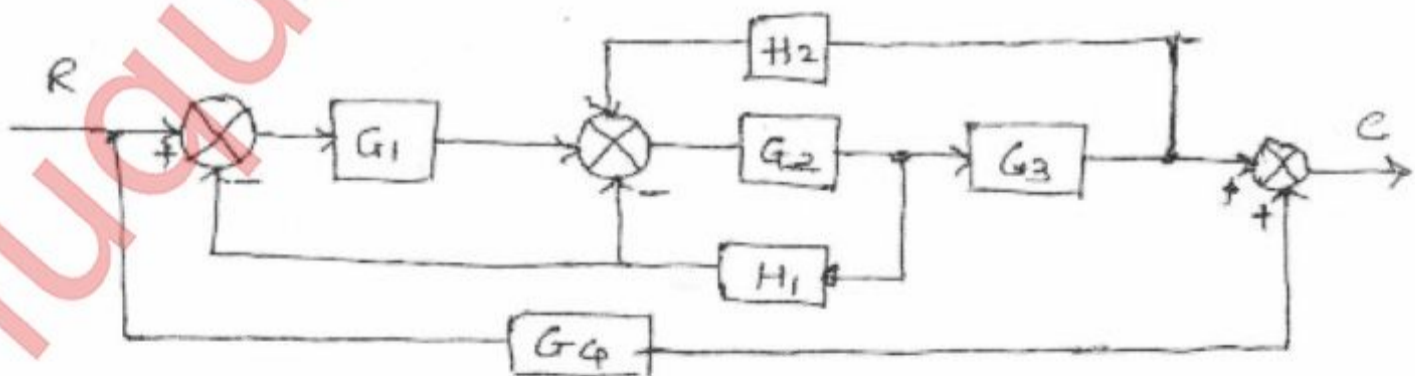
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5. (a) The characteristic equations for a certain feedback control system are **10** given below. Determine the range of k for system to be stable.

    (i) $s^3 + 2ks^2 + (2+k)s + 4 = 0$

    (ii) $s^4 + 20ks^3 + 5s^2 + 10s + 15 = 0$

  (b) The closed loop transfer function of the second order system is   **10**

$$\frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\omega_n \zeta n s + \omega_n^2}$$

obtain the equation of output response c(t) for the unit step input for underdamped condition.

6. (a) (i) Explain the dominent condition   **5**

    (ii) Explain Nquist stability criterion   **5**

  (b) For the system represented by the following equations find the transfer **10** function X(s)/ U(s) by signal flow graph technique.

$$x = x_1 + \beta_3 u$$
$$\dot{x}_1 = -a_1 x_1 + x_2 + \beta_2 u$$
$$\dot{x}_2 = -a_2 x_1 + \beta_1 u$$

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