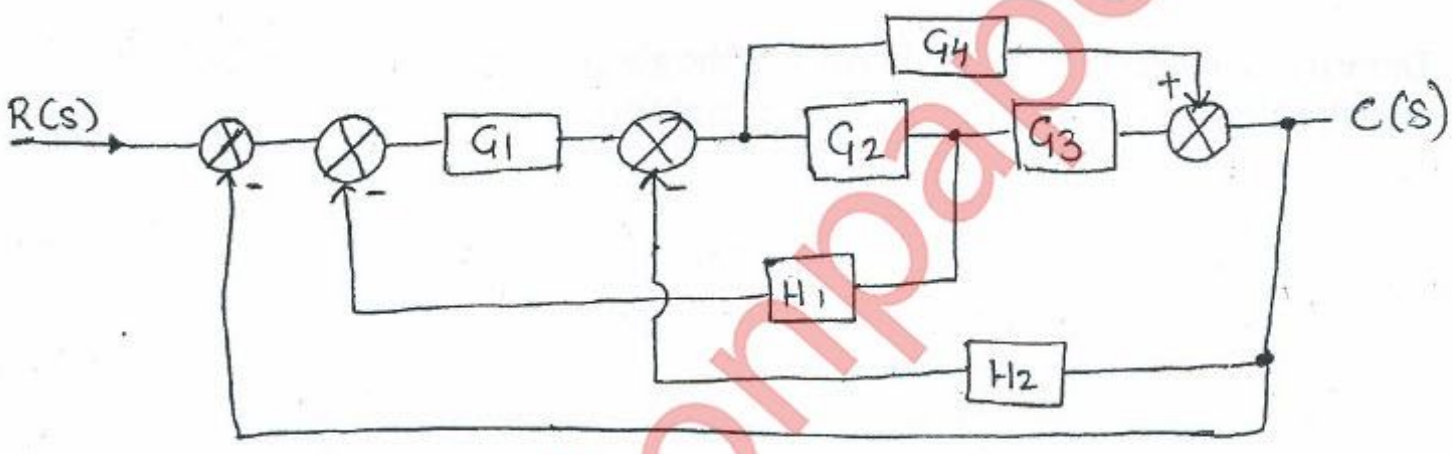
QP Code : 24265

[3 Hours] [Total Marks : 80]

N.B : 1. Question No. 1 is **compulsory.**
2. Solve any **three** questions from remaining questions.
3. Figures to the right indicate full marks.

1. Attempt any **five**. **20**
   (a) Explain the advantages and disadvantages of Routh's criteria.
   (b) Explain the effect of zeta on the second order system performance.
   (c) Compare open and closed loop system.
   (d) Explain the stability criteria on polar plot.
   (e) Compare time domain and frequency domain systems.
   (f) Explain how adding a pole to a function affects the root locus and its stability.

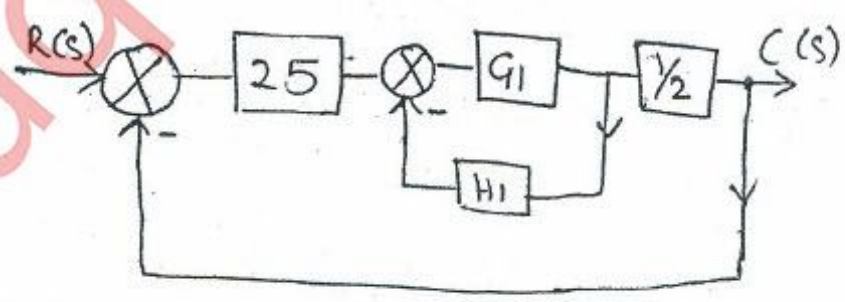
2. Answer the following **10**
   (a) Use block diagram reduction technique to obtain the transfer function of the following system.



(b) For a system show determine type of the system, error coefficients and the error for the following inputs. **10**

(i) $r(t) = 10$, (ii) $r(t) = 5t$, (iii) $r(t) = 10 + 5t + \frac{6}{2}t^2$ and

$$G1 = \frac{20}{(S+4)(S+10)}, \quad H1 = 10S$$



[TURN OVER

3. Answer the following.

(a) Draw the root locus of the system whose characteristic equation is given by **10**

$S^3 + 9S^2 + Ks + K = 0$

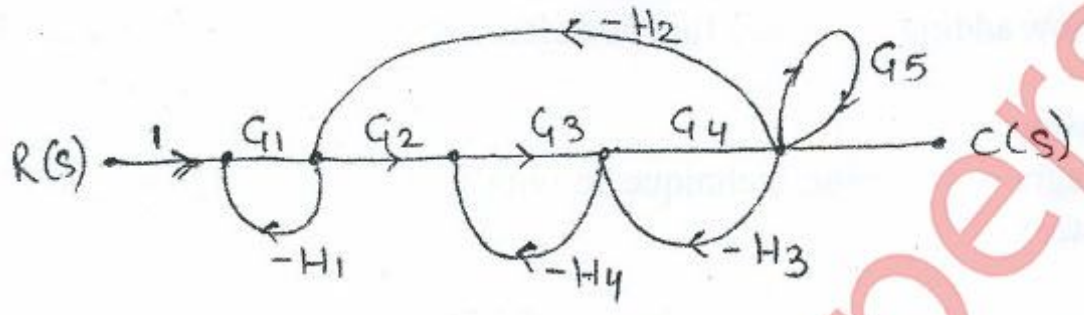
Comment on the stability.

(b) The open loop transfer function of a unity feed back system is $G(s) = \frac{K}{S(1+TS)}$. **10**

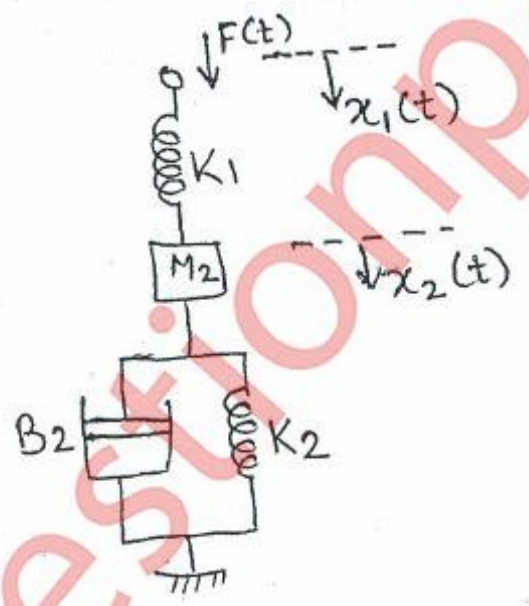
For the system overshoot reduces from 0·6 to 0·2 due to change in K only. Show that $\frac{Tk_1 - 1}{Tk_2 - 1} = 43{\cdot}33$ where k_1 and k_2 values of K for 0·6 to 0·2.

4. Answer the following :

(a) Use Mason's gain formula to obtain of the system shown below. **10**

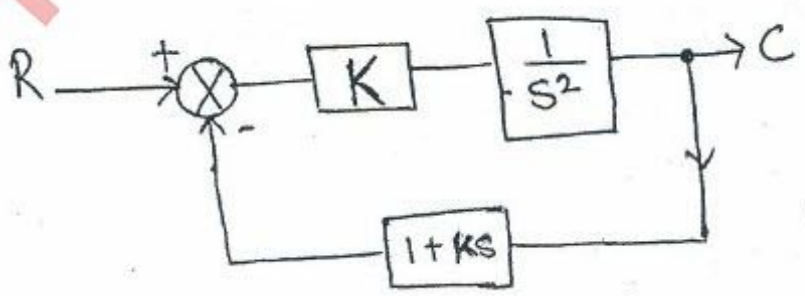


(b) Draw the equivalent mechanical system of the given system, write the equilibrium equations and obtain electrical analogous circuits using F-V and F-1 analogy. **10**



5. Answer the following :

(a) For the servomechanism shown below, determine the values of K and k, so that maximum overshoot for unit step input is 25% and peak time is 2 seconds. **10**



[TURN OVER

(b) Draw Bode lot for a unity feedback system with $G(s) = \frac{K\,(S+0{\cdot}3)}{(S+4)\left(S^2+30s+20\right)}$ *where* $K = 2000$. Determine GM, PM, w_{pc}. Comment on stability. Determine the value of 'K' to obtain P.M. of 30. **10**

6. Answer the following :

(a) The closed loop transfer function of an antenna control system is given by- **10**

$$T(s) = \frac{K}{S^4 + 6S^3 + 30S^2 + 60S + K}$$

(i) determine the range in which K must lie for the system to be stable.

(ii) What should be the upper limit on K if all the poles of T(s) are required to be on the left of the line $\sigma = -1$.

(b) Draw the Nyquist plot and discuss the stability of the system with $G(s)\,H(s) = \frac{10}{2-S}$. **10**
