

- N. B. : (1) Question No. 1 is **compulsory**.
 (2) Attempt any **four** out of remaining **six**.
 (3) Assume **suitable** data wherever **necessary**.
 (4) **Figures** to the **right** indicate marks.

1. Answer any **five** :—

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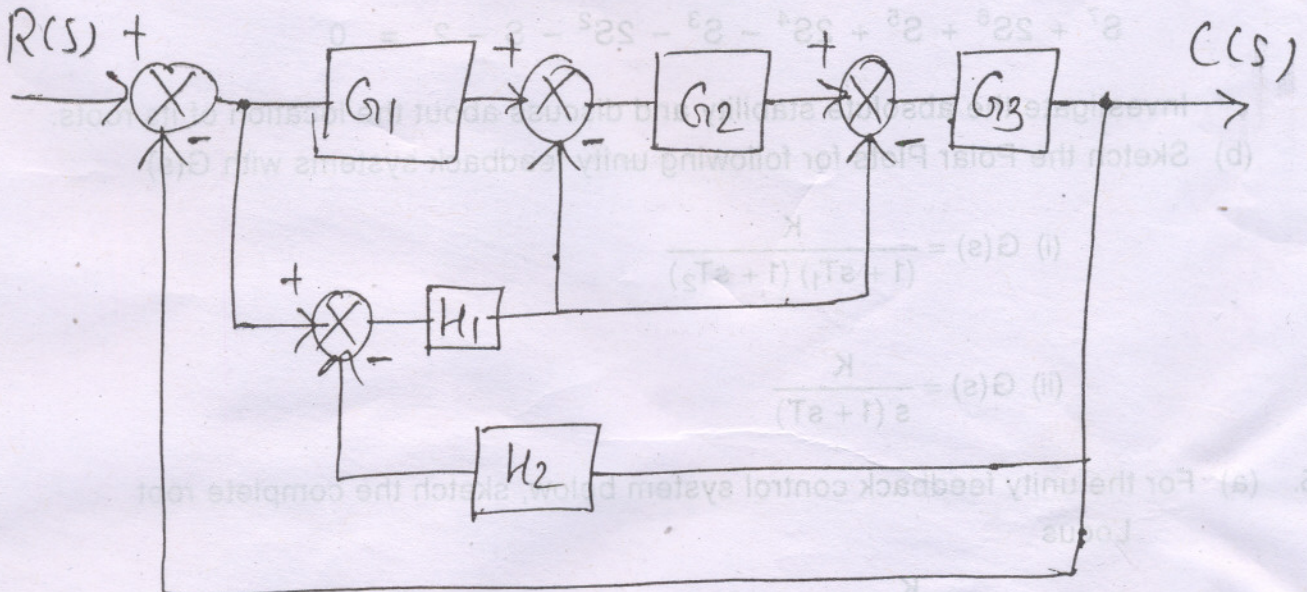
- (a) How do find Gain Margin and Phase Margin from Polar Plot.
 (b) Differentiate between Open Loop and Close Loop system.
 (c) Define Corner frequency and explain its significance.
 (d) Define Type and order of system. Hence determine Type and Order of a control system with

$$G(s) = \frac{10}{s^3 (s+2)^2 (s+3)} \quad \text{and} \quad H(s) = \frac{s}{10}$$

- (e) Draw the step responses of a standard second order undamped, underdamped and critically damped system. Also show pole locations of these systems.
 (f) State the two conditions on which Root Locus is based.

2. (a) Find the transfer function $\frac{C(s)}{R(s)}$ using Block diagram reduction Technique.

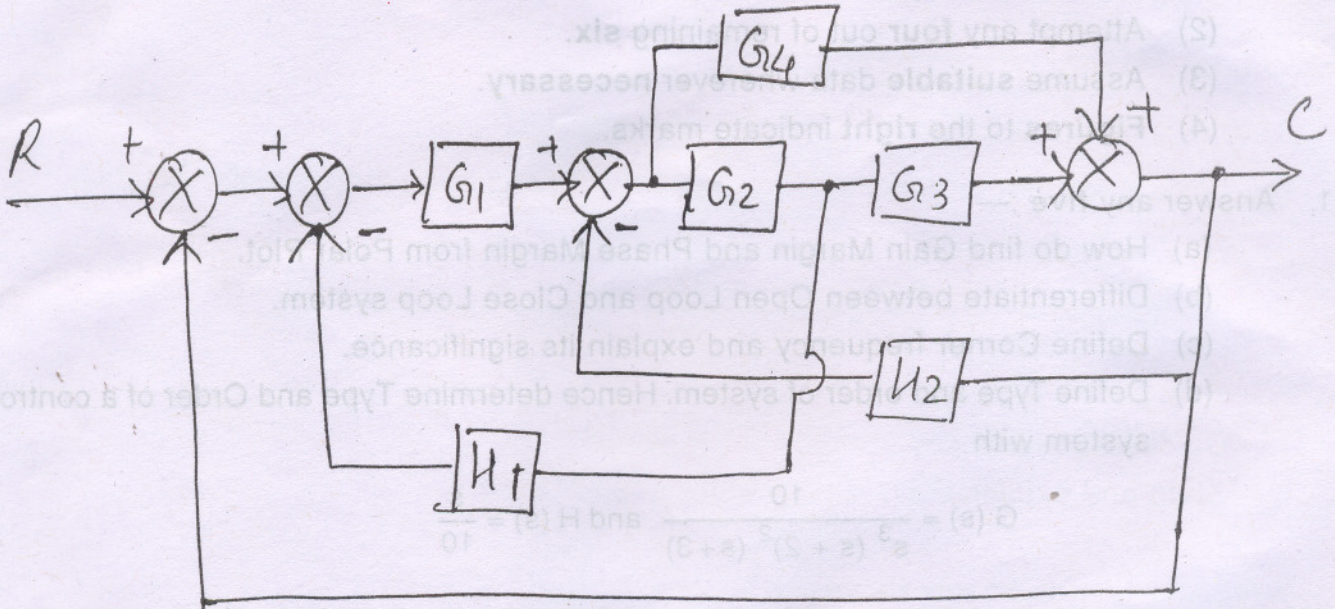
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(b) Derive the expression for output response of standard second order underdamped system.

3. (a) Draw the signal flow graph and find C/R for the system shown.

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- (b) The Close loop transfer function of a system is $\frac{10}{s^2 + 2s + 10}$ obtain the time response of the system when a step of 10 Volt is applied at the input terminals of the system. Sketch the response.

4. (a) For a Seventh Order System whose characteristic equation is

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$$s^7 + 2s^6 + s^5 + 2s^4 - s^3 - 2s^2 - s - 2 = 0$$

Investigate the absolute stability and discuss about the location of its roots.

- (b) Sketch the Polar Plots for following unity feedback systems with $G(s)$

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$$(i) G(s) = \frac{K}{(1 + sT_1)(1 + sT_2)}$$

$$(ii) G(s) = \frac{K}{s(1 + sT)}$$

5. (a) For the unity feedback control system below, sketch the complete root Locus

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$$G(s) = \frac{K}{s(s^2 + 4s + 13)}$$

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(b) Sketch the Nyquist plot of unity feedback system with

$$G(s) = \frac{K(1+s)}{s(1+0.2s)(1+0.5s)}$$

6. (a) Draw Bode plot for unity feedback system having open loop transfer function. 15

$$G(s) = \frac{64(s+2)}{s(s+0.5)(s^2+3.2s+64)}$$

Comment on stability and find Error at $w = 8$.

(b) State and explain Gain Margin and Phase Margin. 5

7. Write short notes on any **three** :— 20

(a) Potentiometer

(b) Synchros

(c) M and N Circle

(d) PI and PD Controllers.