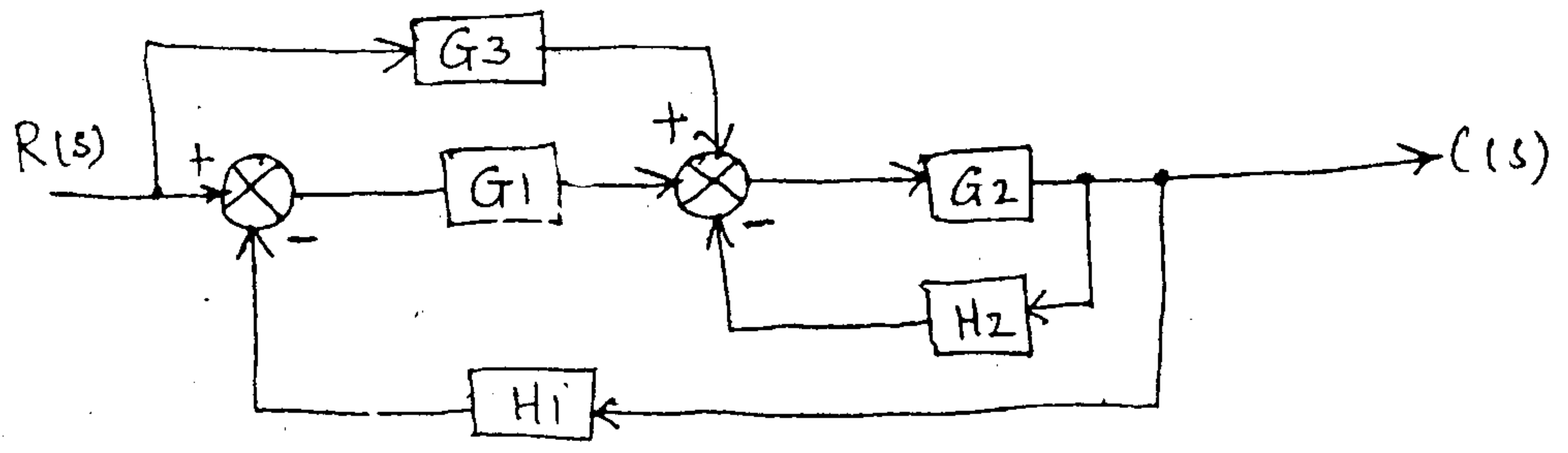


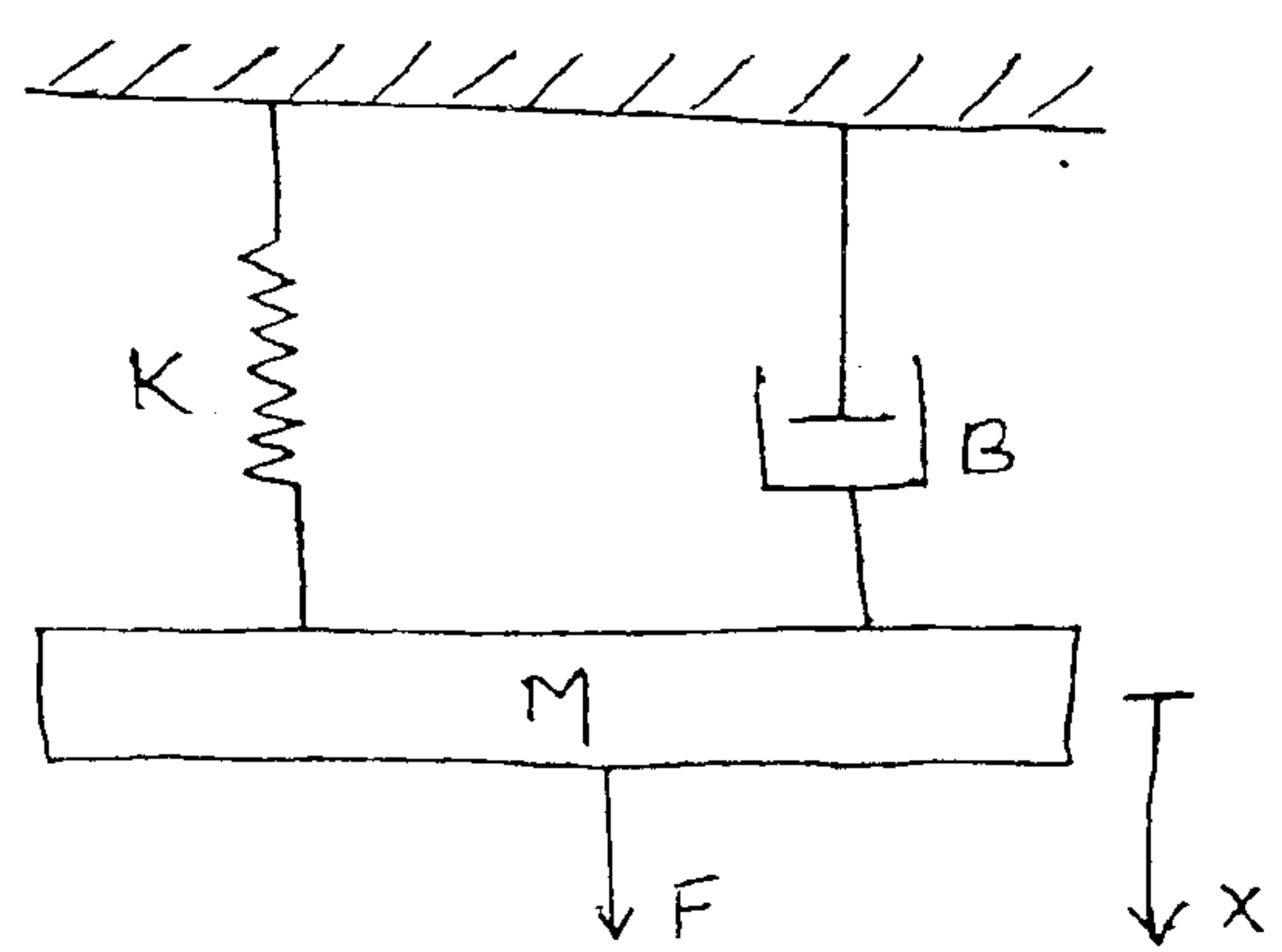
- N. B. : (1) Question No.1 is compulsory.
 (2) Attempt any **three** questions out of remaining **five** questions
 (3) Assume **suitable** data, if **necessary**.
 (4) Figure to the right indicated **full** marks.

1. Attempt any five : 20
- (a) Differentiate between open loop and closed loop control system.
 - (b) Explain the Mason's Gain formula with reference to signal Flow Graph Technique.
 - (c) Define and state the condition for controllability and observability for nth order MIMO system.
 - (d) The characteristic equation for certain feedback control system is given below. Determine the range of value of K for the system to be stable.

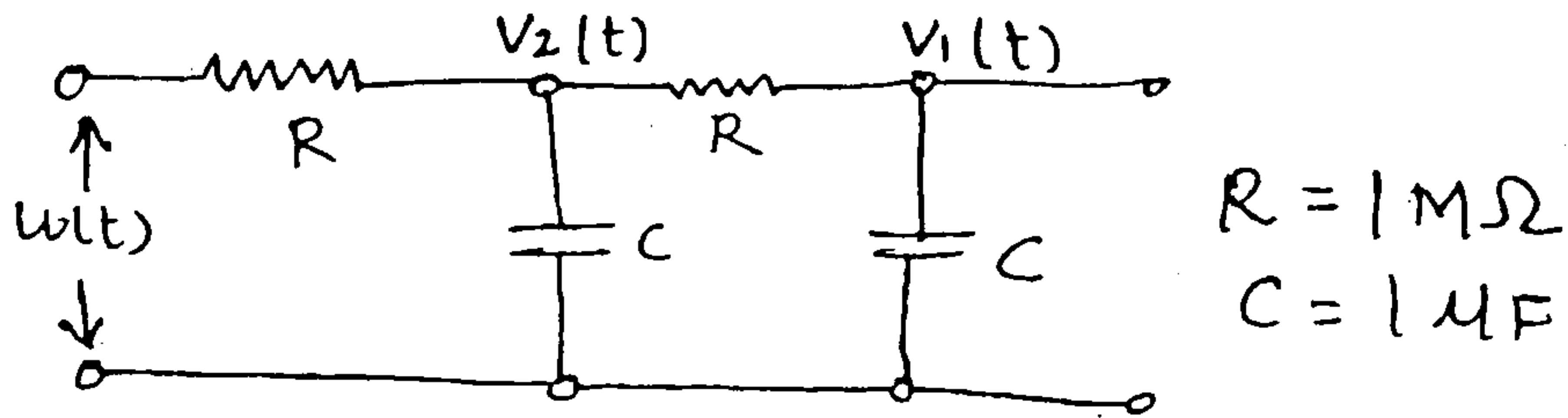
$$S^3 + 2ks^2 + (k + 2)s + 4 = 0$$
 - (e) Define gain and phase margin. Draw approximate Bode plot for a stable system showing gain and phase margin.
 - (f) Compare between Lead and Lay compensator.
2. (a) Derive the output response for second order underdamped control system subjected to unit step input. 10
- (b) Find the transfer function $\frac{C(S)}{R(S)}$ using Block diagram reduction Technique. 10



3. (a) Find the Transfer function for the system show below. 4



- (b) What are the properties of state transition matrix? 4
 (c) For the system shown below, chose $V_1(t)$ and $V_2(t)$ as state variables and write down the state equations satisfied by them. Bring these equations in the vector-matrix form. 12



4. (a) Examine the observability of the system given below using kalman's test. 8

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u = Ax + Bu$$

- (b) Derive the expression for Peak resonant of a standard second order control system. 8
 (c) Explain the concept of ON/OFF controller. 4
5. (a) For a unit feedback system the open loop transfer function is given by 10

$$G(S) = \frac{K}{S(S+2)(S^2 + 6S + 25)}$$

Sketch the root locus and find the value of K at which the system becomes unstable.

- (b) Explain Robust control and Adaptive control system. 10
6. (a) Find polar plot for the transfer function given below $G(S) = \frac{1}{(1+S)(1+4S)}$ 5
 (b) Write a short note on PID controller. 5
 (c) Determine the stability of a system shown by following open loop transfer 10

function using Nyquist criterion - $G(s)H(s) = \frac{(4s+1)}{s^2(s+1)(2s+1)}$