

- 4 a. A second order system has unity feedback and open loop transfer function :

$$G(s) = \frac{500}{s(s+15)}$$

- i) Draw the block diagram for closed loop system
 - ii) What is characteristic equation?
 - iii) What is damping ratio and natural frequency values?
 - iv) Calculate T_p (peak time), M_p (peak overshoot) and T_s (setting time) for the system output response when excited by unit step input. (10 Marks)
- b. For a system with characteristic equation :
 $F(s) = s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$, examine stability. (10 Marks)

PART – B

- 5 a. Define :

- i) polar plot
- ii) phase margin
- iii) gain margin
- iv) gain cross over frequency. (08 Marks)

- b. The open loop transfer function is $\frac{(s+2)(s+8)}{s^3}$. Is the closed loop system stable? if not, deduce the number of unstable poles. Use the Nyquist criterion to arrive at your answers. (12 Marks)

- 6 Draw the Bode magnitude and phase angle plots for the transfer function :

$$G(s) = \frac{2000(s+1)}{s(s+10)(s+40)}. \quad (20 \text{ Marks})$$

- 7 Sketch the complete root locus for the system having :

$$G(s)H(s) = \frac{k(s+5)}{(s^2+4s+20)}. \quad (20 \text{ Marks})$$

- 8 a. What is series and feedback compensation? Explain. (06 Marks)

- b. Consider the system with state equation :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$

- Estimate the state controllability by : i) Kalman's test and ii) Gilbert's test. (14 Marks)
