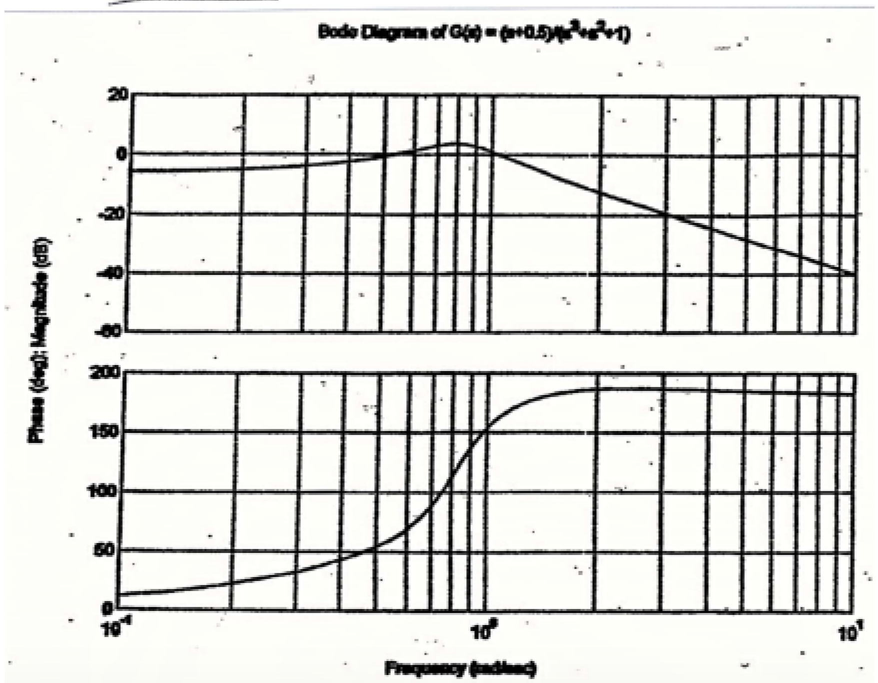
Question 1:

1)

$$G(s) = \frac{s+0.5}{s^3+s^2+1} \Rightarrow \text{open-loop poles} \begin{cases} s = -1.4656 \\ s = 0.2328 + j0.7926 \\ s = 0.2328 - j0.7926 \end{cases}$$

$\Rightarrow$ nonminimum



Question 2:

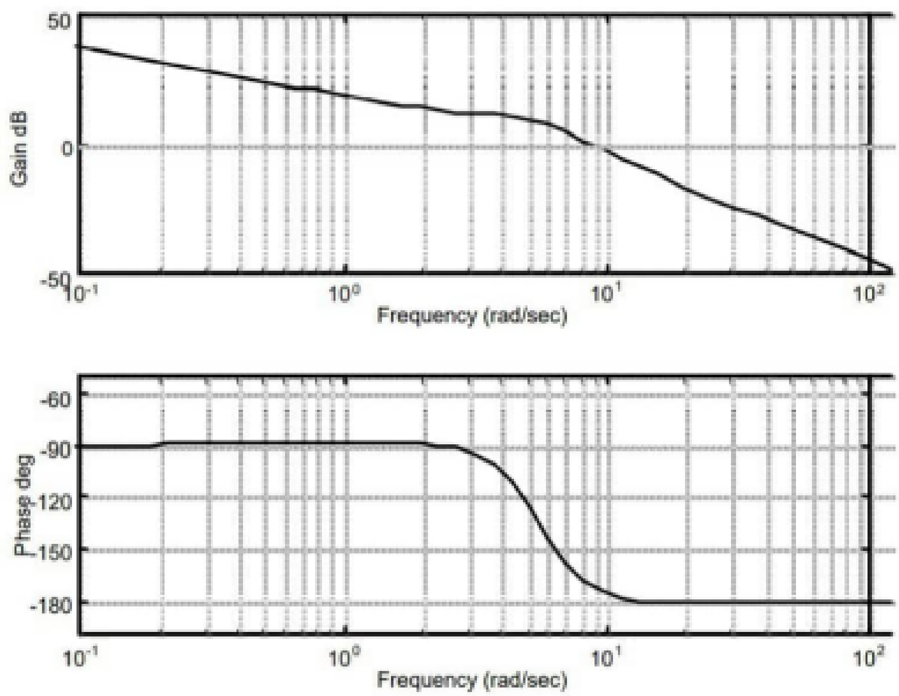
2

$N=1,\ -40\,dB \rightsquigarrow 5.3\ \frac{rad}{s} \Rightarrow G(s) = \frac{K}{s(s+5.3)}$

$|G(j0.01)| = 67 \rightsquigarrow 20\log K = 27 \Rightarrow K/5.3 = 22.38 \Rightarrow \boxed{K \approx 118}$

$$\Rightarrow \boxed{G(s) = \frac{118}{s(s+5.3)}}$$

$k_p = \lim_{s\to 0} G(s) = \infty \Rightarrow \boxed{e_{ss} = 0}$, $k_v = \lim_{s\to 0} s\,G(s) = 22.38 \Rightarrow \boxed{e_{ss} = 0.045}$



Question 3:

3

I

bode از روی $\Rightarrow$ phase margin $= 7 \Rightarrow \eta \approx \frac{PM}{100} \Rightarrow \boxed{\eta = 0.07}$

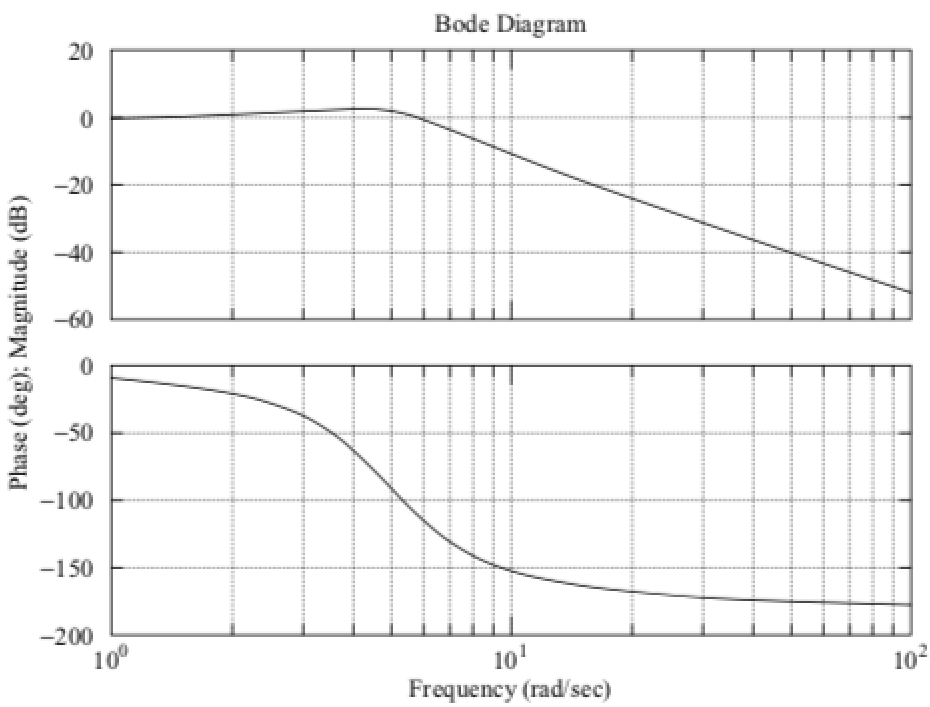
$$\text{overshoot} = \exp\left(\frac{-\eta\pi}{\sqrt{1-\eta^2}}\right) = -\exp\left(\frac{-0.07\pi}{\sqrt{1-0.0049}}\right) \Rightarrow \boxed{OS = 0.802 = 80.2\%}$$

II

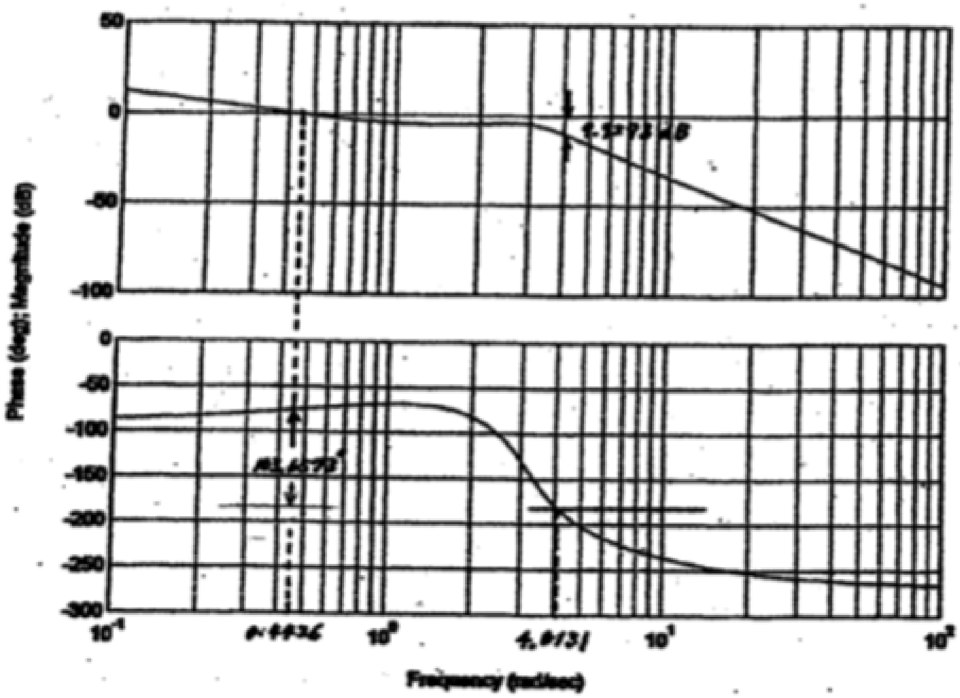
تعیین مرتبه دوم $\Rightarrow \tilde{G}(s) = \frac{1}{s^2 + as + b} \Rightarrow \frac{G(s)\,G(-s)}{\tilde{G}(s)\,\tilde{G}(-s)} = 1 \Rightarrow \tilde{G}(s) = \ldots\ldots$

به فرم $\frac{\omega_n^2}{s^2 + 2\omega_n \eta + \omega_n^2}$ در می‌آید.

Question 4:



Question 5:



Question 6:

B-7-29. Referring to Figure 7-9 and examining the Bode diagram of Figure 7-164, we find the damping ratio ζ and undamped natural frequency ω_n of the quadratic term to be

$$\zeta = 0.1, \qquad \omega_n = 2 \text{ rad/sec}$$

Noting that there is another corner frequency at $\omega = 0.5$ rad/sec and the slope of the magnitude curve in the low-frequency range is -40 dB/decade, $G(j\omega)$ can be tentatively determined as follows:

$$G(j\omega) = \frac{K\left(\frac{j\omega}{0.5} + 1\right)}{(j\omega)^2\left[\left(\frac{j\omega}{2}\right)^2 + 0.1(j\omega) + 1\right]}$$

Since, from Figure 7-164, we find $|G(j0.1)| = 40$ dB, the gain value K can be determined to be unity. Also, the calculated phase curve, $\angle G(j\omega)$ versus ω, agrees with the given phase curve. Hence, the transfer function G(s) can be determined to be

$$G(s) = \frac{4(2s+1)}{s^2(s^2 + 0.4s + 4)}$$