Example 8.8 :

$$K = -\frac{1}{G(s)H(s)} \quad\Rightarrow\quad K = -\frac{\sigma^3 + 11\sigma^2 + 10\sigma}{\sigma + 1,5}$$

$$G(s) = \frac{s+1,5}{s(s+1)(s+10)}$$

$$\frac{dK}{d\sigma} = -\frac{(3\sigma^2 + 22\sigma + 10)(\sigma + \frac{3}{2}) - \sigma^3 + 11\sigma^2 - 10\sigma}{(\sigma + \frac{3}{2})^2} = 0$$

$$\frac{dK}{d\sigma} = -\frac{3\sigma^3 + \frac{9}{2}\sigma^2 + 22\sigma^2 + 33\sigma + 10\sigma + 15 - \sigma^3 - 11\sigma^2 - 10\sigma}{(\sigma + \frac{3}{2})^2} = 0$$

$$\Rightarrow \quad 2\sigma^3 + \frac{31}{2}\sigma^2 + 33\sigma + 15 = 0$$

denklemin bir kökü $-4,4$ ise diğer iki kökünü bulunuz.

$$\boxed{\sigma_3 = -4,4}$$

$$
\begin{array}{l}
2\sigma^3 + 15,5\sigma^2 + 33\sigma + 15 \;\big|\; \sigma + 4,4 \\
\underline{-2\sigma^3 + 8,8\sigma^2} \quad\big|\; 2\sigma^2 + 6,7\sigma + 3,5 \\
\quad 6,7\sigma^2 + 33\sigma + 15 \\
\quad \underline{-6,7\sigma^2 + 29,5\sigma} \\
\qquad 3,5\sigma + 15 \\
\qquad \underline{-3,5\sigma + 15,4} \\
\qquad\qquad \boxed{-0,4} \approx 0 \;(\text{kalan } 0)
\end{array}
$$

$$\sigma_{1,2} = \frac{-6,7 \pm \sqrt{(6,7)^2 - 2\times 4\times 3,5}}{4}$$

$$\sigma_1 = \frac{-6,7 + 4,1}{4} = \underline{-0,65}$$

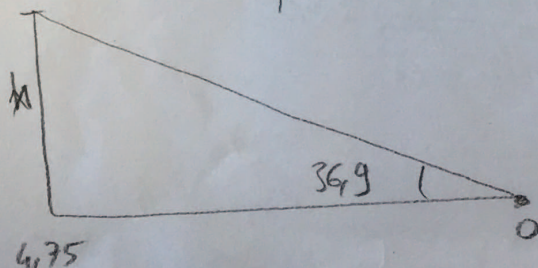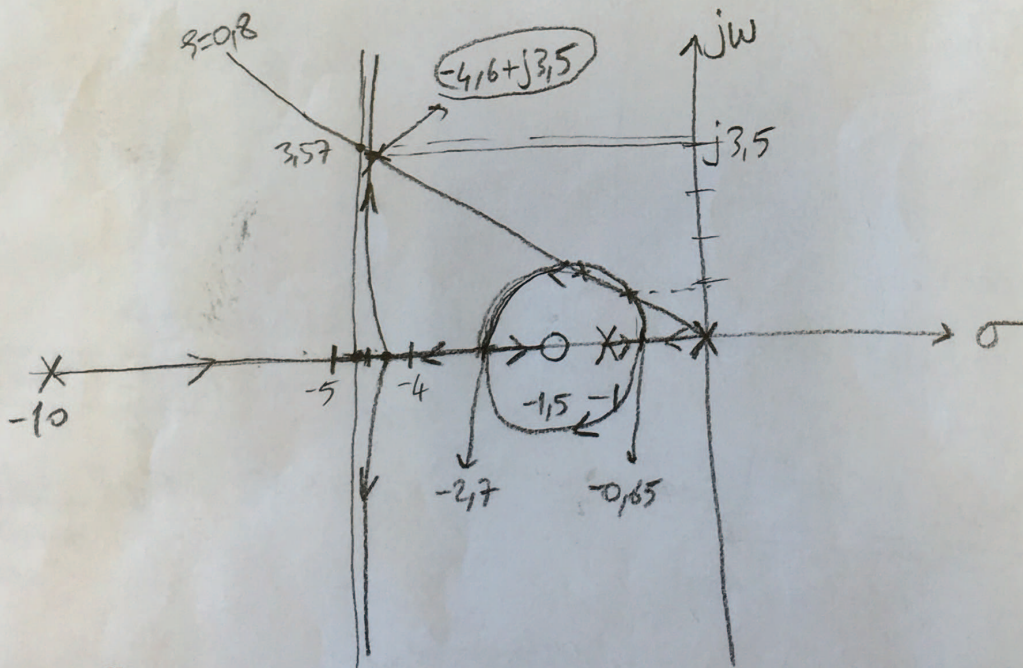$$\sigma_2 = \frac{-6,7 - 4,1}{4} = \underline{-2,7}$$

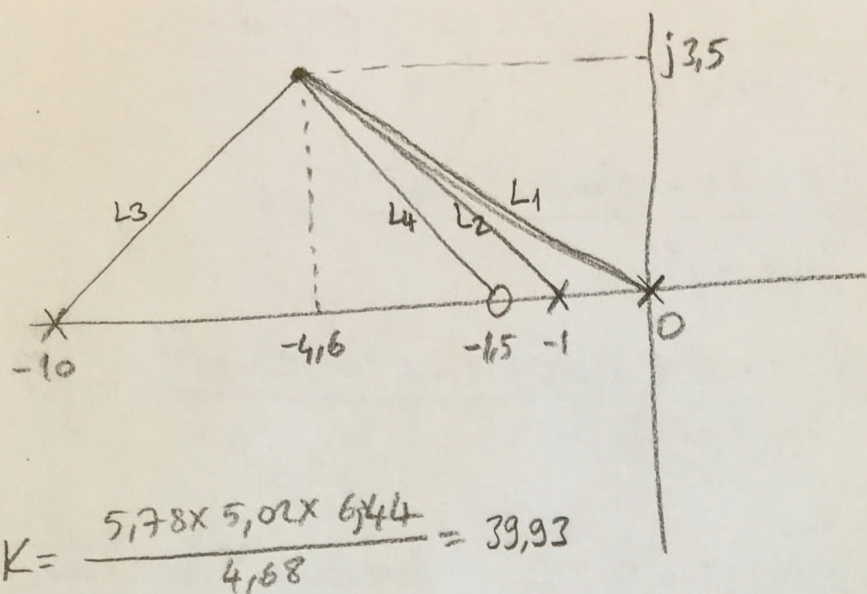$$\sigma_a = \frac{(-10-1) - (-1,5)}{3-1}$$

$$\sigma_a = -4,75$$

$$\theta_a = \frac{(2k+1)\pi}{3-1} = \begin{cases} \pi/2 \\ -\pi/2 \end{cases}$$

$$\zeta = 0,8$$

$$\cos^{-1}(0,8) \approx 36,9°$$

$$\tan 36,9 = \frac{h}{4,75} \Rightarrow h \approx 3,57$$

$$K = \frac{1}{|G|} = \frac{L_1 \times L_2 \times L_3}{L_4}$$

$$L_1 = \sqrt{4{,}6^2 + 3{,}5^2} = 5{,}78$$

$$L_2 = \sqrt{3{,}6^2 + 3{,}5^2} = 5{,}02$$

$$L_3 = \sqrt{5{,}4^2 + 3{,}5^2} = 6{,}44$$

$$L_4 = \sqrt{3{,}1^2 + 3{,}5^2} = 4{,}68$$

$$K = \frac{5{,}78 \times 5{,}02 \times 6{,}44}{4{,}68} = 39{,}93$$

Example 9.3

$$G(s) = \frac{K}{s(s+4)(s+6)}$$

$$\frac{dK}{d\sigma} = 3\sigma^2 + 20s + 24$$

%16 OS $\Rightarrow \varsigma = 0.504$

$$s^3 + 10s^2 + 24s$$

$$\sigma_{1,2} = \frac{-20 \pm \sqrt{400 - 12 \times 24}}{6}$$

$\varsigma = 0.504$

$\rightarrow -1.205 + j2.064$

$j2.064$

L_3 L_2 L_1

-6 -4 $\theta = 59.74°$

$$\sigma_{1,2} = \overbrace{-1.57}^{\text{ayrılma noktası}}$$
$$\sigma_{1,2} = -5.1$$

$$\sigma_a = \frac{-10}{3}, \quad \theta_a = \begin{cases} \pm \pi/3 \\ \pi \end{cases}$$

$$T_s = \frac{4}{\varsigma \omega_n} = \frac{4}{1.205} = 3.32$$

$$K = L_1 \times L_2 \times L_3$$
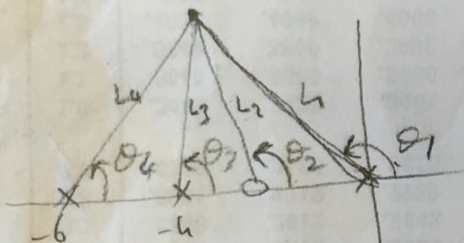$$= 2.39 \times 3.47 \times 5.22 = \underline{43.29}$$

Yerleşme zamanını 3 kat düşürecek bir PD tasarlayın.

$$T_{s_n} = \frac{3.32}{3} = 1.107 \quad \rightarrow \quad \sigma_n = \frac{4}{T_{s_n}} = \frac{4}{1.107} = 3.613$$

$$\omega_n = 3.613 \times \tan(59.74) = 6.193$$

$$-3.613 + j6.193$$
$$\downarrow$$

L_4 L_3 L_2 L_1

θ_4 θ_3 θ_2 θ_1

-6 -4

$$\theta_2 - \theta_1 - \theta_3 - \theta_4 = \pm 180°$$

$$\theta_2 = -180 + 120.26° + 86.42° + 68.92° = 95.6°$$
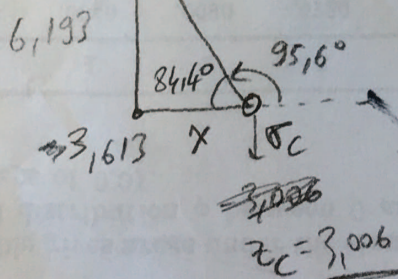
$$\theta_3 = 86.42°$$

$$\theta_4 = 68.92°$$

$$K = \frac{L_1 \times L_3 \times L_4}{L_2} = \frac{7.17 \times 6.2 \times 6.64}{6.22} = \boxed{47.46}$$

$$\tan 84.4 = \frac{6.193}{X}$$

$$X = \frac{6.193}{\tan(84.4)} = 0.607$$

6.193

$84.4°$ $95.6°$

3.613 X σ_c

$z_c = 3.006$

$$\frac{6.193}{3.613 - \sigma_c} = \tan(84.4)$$

$$\boxed{\sigma_c = 3.006}$$