

1) 一次進み要素と呼ばれる次の伝達関数  $G(j\omega) = K(1 + T_1 j\omega)$

$$G(s) = K(1 + T_1 s) \quad |G(j\omega)|_{dB} = 20 \log_{10} |K| + 20 \log_{10} |1 + T_1 j\omega| = 20 \log_{10} 10 + 20 \log_{10} \sqrt{1 + \omega^2} = 20 + 20 \log_{10} \sqrt{1 + \omega^2}$$

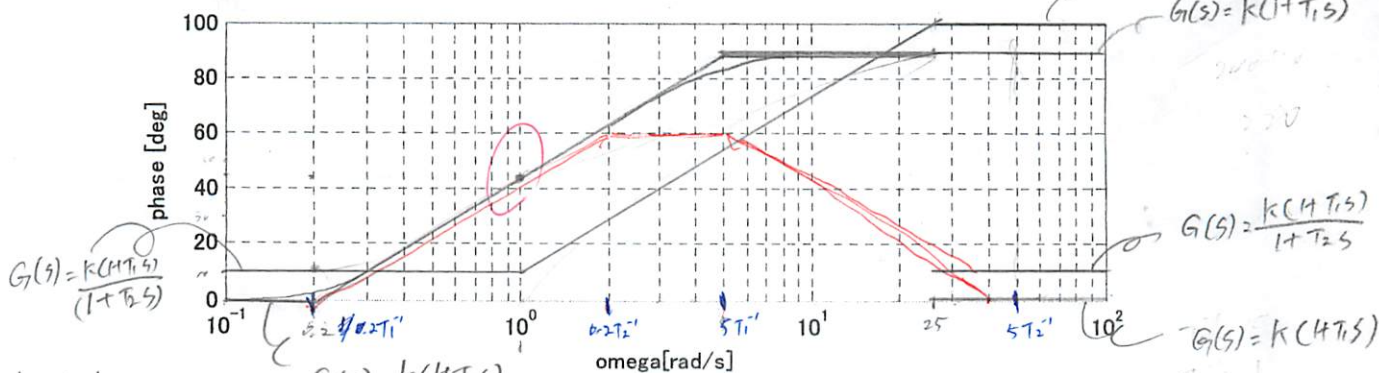
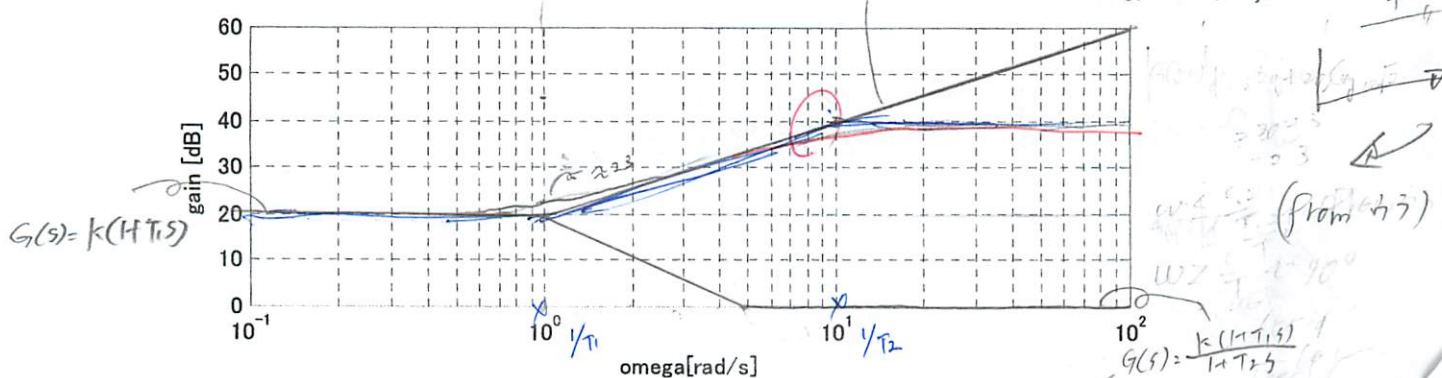
のボード線図を折れ線近似で描け。ただし  $K=10$ ,  $T_1=1$  とする。

$$\angle G(j\omega) = \angle K + \angle(1 + T_1 j\omega) = \tan^{-1} \frac{\omega}{0} + \tan^{-1} T_1 \omega = \tan^{-1} \omega$$

2) また  $G(s)$  に一次遅れが加えられた  $G(s) = \frac{K(1 + T_1 s)}{1 + T_2 s}$  について  $T_2=0.1$  として同様に示せ。

$$G(s) = K(1 + T_1 s) \quad \omega = T_1^{-1} \quad (\text{折れ点})$$

$$\angle G(j\omega) = \tan^{-1} T_1 \omega = \tan^{-1} 1 = \frac{\pi}{4}$$



$$\begin{aligned} (2) \quad g &= |G(j\omega)|_{dB} \\ &= 20 \log_{10} |G(j\omega)| \\ &= 20 \log_{10} |K| + 20 \log_{10} |1 + T_1 j\omega| - 20 \log_{10} |1 + T_2 j\omega| \\ &= 20 \log_{10} |K| + 20 \log_{10} \sqrt{1 + (\omega T_1)^2} - 20 \log_{10} \sqrt{1 + (\omega T_2)^2} \\ g &= 20 \log_{10} 10 + 20 \log_{10} \sqrt{1 + \omega^2} - 20 \log_{10} \sqrt{1 + 0.1^2 \omega^2} \\ g|_{T_1^{-1} \leq T_2^{-1}} &\approx 20 \left| \begin{array}{l} \omega \leq T_1^{-1} \rightarrow 20 \log_{10} \omega T_1 \\ T_1^{-1} \leq \omega \leq T_2^{-1} \rightarrow 20 - 20 \log_{10} T_2^{-1} T_1 \\ \omega \geq T_2^{-1} \rightarrow 20 - 20 \log_{10} T_2^{-1} T_1 - 20 \log_{10} \omega T_2 \end{array} \right. \end{aligned}$$

$$g|_{T_1^{-1} \leq T_2^{-1}} \approx 20 \left| \begin{array}{l} \omega \leq 1 \rightarrow 20 - 20 \log_{10} \omega \\ 1 \leq \omega \leq 10 \rightarrow 20 - 20 \log_{10} 10 \\ \omega \geq 10 \rightarrow 20 - 20 \log_{10} 10 - 20 \log_{10} \omega \end{array} \right.$$

$$= 20 \log_{10} 10 + 20 \log_{10} \sqrt{1 + \omega^2} - 20 \log_{10} \sqrt{1 + 0.1^2 \omega^2}$$

$$\begin{aligned} \phi &= \angle G(j\omega) \\ &= \angle K + \angle(1 + T_1 j\omega) - \angle(1 + T_2 j\omega) \\ &= 0 + \tan^{-1} T_1 \omega - \tan^{-1} T_2 \omega \\ \phi|_{T_1 \leq T_2} &\approx 0 \left| \begin{array}{l} \omega \leq 0.2 T_1^{-1} \rightarrow -64.3 \log_{10} \omega \\ 0.2 T_1^{-1} \leq \omega \leq 5 T_1^{-1} \rightarrow -90 \\ 5 T_1^{-1} \leq \omega \leq 5 T_2^{-1} \rightarrow -90 + 64.3 \log_{10} \omega \\ 5 T_2^{-1} \leq \omega \rightarrow -90 + 64.3 \log_{10} \omega - 64.3 \log_{10} \omega \end{array} \right. \\ \Rightarrow \phi|_{T_1 \leq T_2} &\approx 10 \left| \begin{array}{l} \omega \leq 0.2 \rightarrow -10 + 44.3 \log_{10} \omega \\ 0.2 \leq \omega \leq 5 \rightarrow 10 - 90 \\ 5 \leq \omega \leq 25 \rightarrow 10 - 90 + 10 + 44.3 \log_{10} \omega \\ \omega \geq 25 \rightarrow 10 \end{array} \right. \end{aligned}$$

(1.1.7)

$$\rho \approx 20 \log k \left| \frac{w_{\leq 1}}{w_{\leq 2}} + 20 \log(w_{\leq 2}) \right|$$

$$T^{-1} = 1 + \epsilon$$

$$\rho \approx 20 \log k \left| \frac{w_{\leq T-1}}{w_{\leq T}} + 20 \log(kw) \right|$$

$$\frac{20 \log k \left| \frac{w_{\leq T-1}}{w_{\leq T}} + 20 \log(kw) \right|}{20 \log k \left| \frac{w_{\leq T-1}}{w_{\leq T}} + 20 \log(kw) \right|}$$

$$20 \log k \left| \frac{w_{\leq T-1}}{w_{\leq T}} + 20 \log(kw) \right|$$

$$\rho \approx 20 \log k \left| \frac{w_{\leq T-1}}{w_{\leq T}} + 20 \log(kw) \right|$$