تمرین سری پنجم کنترل خطی

سوال ۱:

$$G(S)=\frac{k(S+۳)}{S(S+1)(S+۲)}=\frac{۳k(\frac{S}{۳}+1)}{۲S(S+1)(\frac{S}{2}+1)}$$

بهره ثابت $G_1(j\omega)=\frac{3}{2}k=\frac{3}{2}$ صفر $\rightarrow G_2(j\omega)=\frac{S}{3}+1=\frac{j\omega}{3}+1$

قطب $G_3(j\omega)=\frac{1}{j\omega}$ $G_4(j\omega)=\frac{1}{1+j\omega}$ $G_5(j\omega)=\frac{1}{\frac{j\omega}{2}+1}$

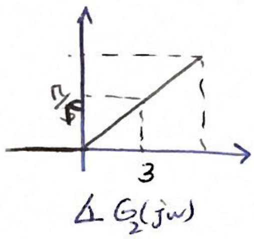
حال به محاسبه زاویه و اندازه هر یک می‌پردازیم:

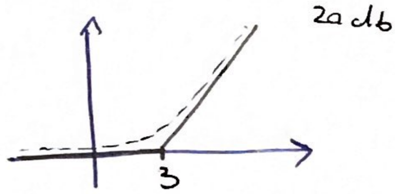
1) $\angle G_1(j\omega)=\tan^{-1}0=0$

$|G_1(j\omega)|=20\log\frac{3}{2}=2$

2) $|G_2(j\omega)|=20\log\sqrt{1+\frac{\omega^2}{9}}$ $\begin{cases}20\log\frac{\omega}{3} & \omega\gg 3\\ 0 & \omega\ll 3\end{cases}$

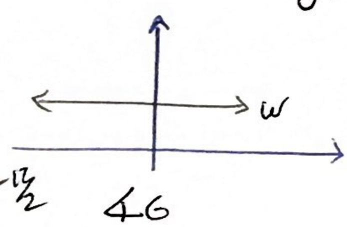
$\angle G_2(j\omega)=tg^{-1}\omega/3$

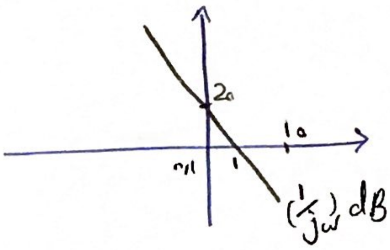




3) $\angle G_3(j\omega)=-tg^{-1}\frac{\omega}{0}=-\frac{\pi}{2}$

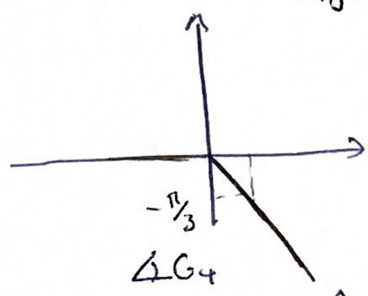
$|G_3(j\omega)|=20\log\left|\frac{1}{j\omega}\right|=-20\log\omega$

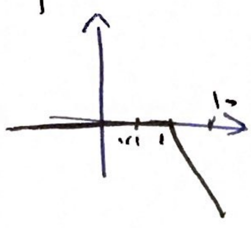




4) $\angle G_4=-tg^{-1}\omega$

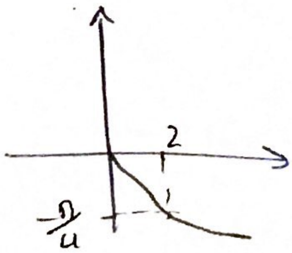
$|G_4|=20\log\left|\frac{1}{1+j\omega}\right|=\begin{cases}-20\log\omega & \omega\gg 1\\ 0 & \omega\ll 1\end{cases}$

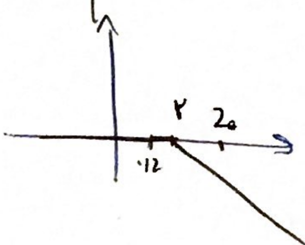




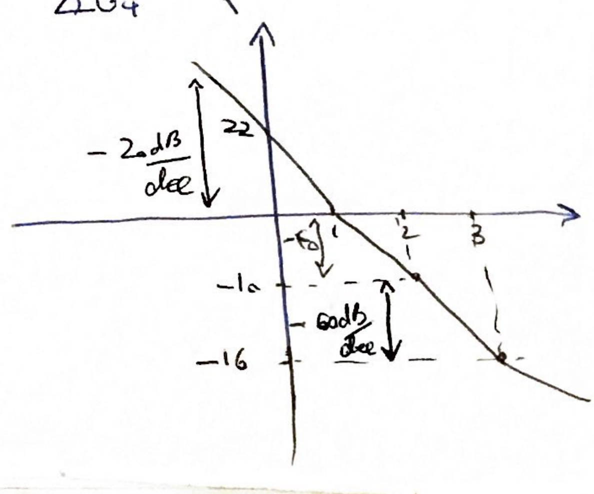
5) $\angle G_5(j\omega)=-tg^{-1}\omega/2$

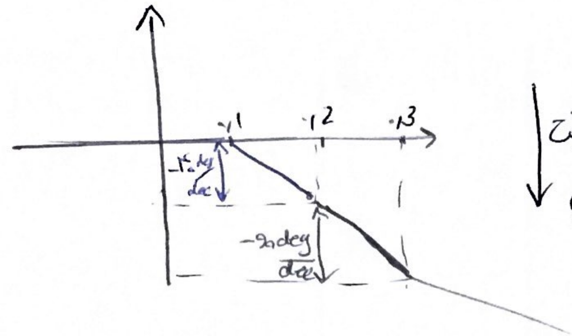
$|G_5(j\omega)|=-20\log\sqrt{1+\frac{\omega^2}{4}}=\begin{cases}-20\log\frac{\omega}{2} & \frac{\omega}{2}\gg 1\\ 0 & \frac{\omega}{2}\ll 1\end{cases}$





sum $\Longrightarrow$





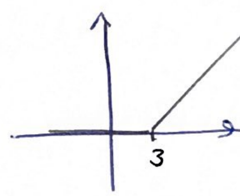
هم اندازه $\frac{\pi}{2}$ شیفت
به پایین می‌دهیم

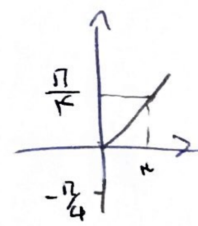
سوال 2)

$$G(S)=\frac{(S+3)}{(S+2)(S^2+2S+25)}=\frac{3(\frac{S}{3}+1)}{50(\frac{S}{2}+1)(\frac{S^2}{25}+\frac{2}{25}S+1)}$$

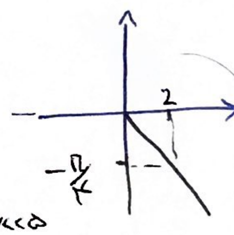
$$G_1(j\omega)=\frac{3}{50}\Rightarrow\begin{cases}|G_1|=20\log\frac{3}{50}\simeq-24\\ \angle G_1=0\end{cases}$$

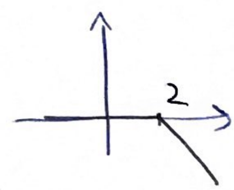
$$G_2(j\omega)=\frac{j\omega}{3}+1\Rightarrow\begin{cases}|G_2|=20\log\sqrt{1+\frac{\omega^2}{9}}=\begin{cases}20\log\frac{\omega}{3} & \omega\gg3\\ 0 & \omega\ll3\end{cases}\\ \angle G_2=tg^{-1}\frac{\omega}{3}\end{cases}$$



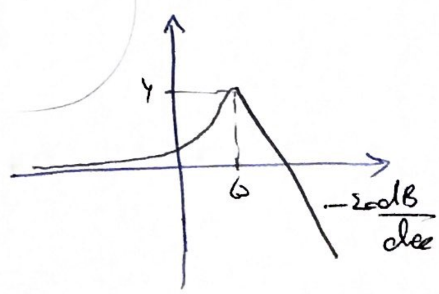


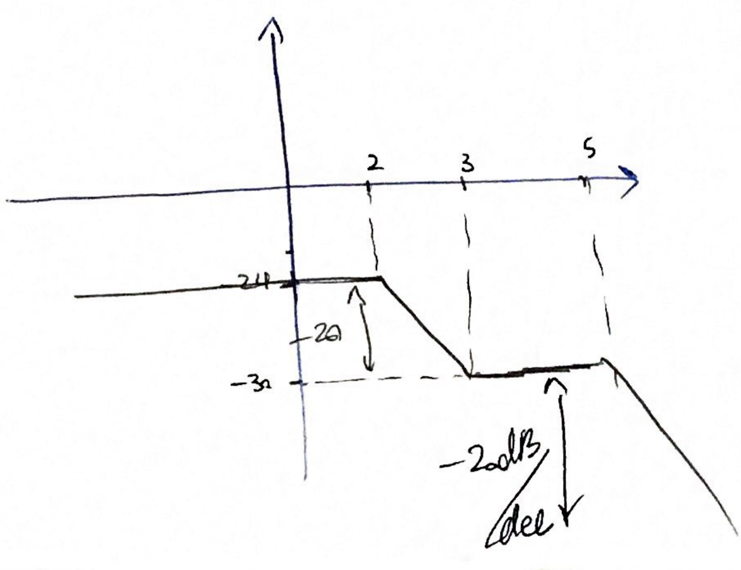
$$G_3(j\omega)=\frac{1}{\frac{j\omega}{2}+1}\Rightarrow\begin{cases}|G_3|=\begin{cases}-20\log\frac{\omega}{2} & \omega\gg2\\ 0 & \omega\ll2\end{cases}\\ \angle G_3=-tg^{-1}\frac{\omega}{2}\end{cases}$$





$$G_4(j\omega)=\frac{1}{\frac{(j\omega)^2}{25}+\frac{2}{25}j\omega+1}\Rightarrow\begin{cases}|G_4|=\begin{cases}0 & \omega\ll5\\ +6 & \omega=5\\ -40\log\frac{\omega}{5} & \omega\gg5\end{cases}\\ \angle G_4=tg^{-1}\dfrac{\frac{2}{25}\omega}{1-\frac{\omega^2}{25}}\end{cases}$$





سؤال سهل:

$$\text{شیب} = -20\frac{dB}{dec} \Rightarrow \text{نوع لحظ} \quad N=1$$

$$\omega=1: \quad 20\log k_v = 10 \Rightarrow k_v = \sqrt{10} \Rightarrow e_{ss} = \frac{1}{k_v} = \frac{\sqrt{10}}{10}$$