۱۵ آبان پنجشنبه ۱۹ ربیع‌الاول ۱۴۴۲ | 5 Nov./2020 Thursday

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HW11

1) $G(s) = \dfrac{1}{s^3 + 0.2s^2 + s + 1} \Rightarrow \boxed{G(jw) = \dfrac{1}{(1-0.2w^2) + j(w-w^3)}}$

$$G(jw) = \frac{1}{\sqrt{(1-0.2w^2)^2 + (w-w^3)^2}} \angle -\tan^{-1}\left(\frac{w-w^3}{1-0.2(w)^2}\right)$$

$$s^3 + 0.2s^2 + s + 1 = 0 \Rightarrow s = \begin{cases} s_1 \simeq -0.7245 \\ s_{2,3} \simeq 0.262 \pm 1.145i \end{cases}$$

	0^+	1^-	1^+	∞
اندازه	0	1.118	1.118	0
فاز	0^-	0^+	0^-	-90

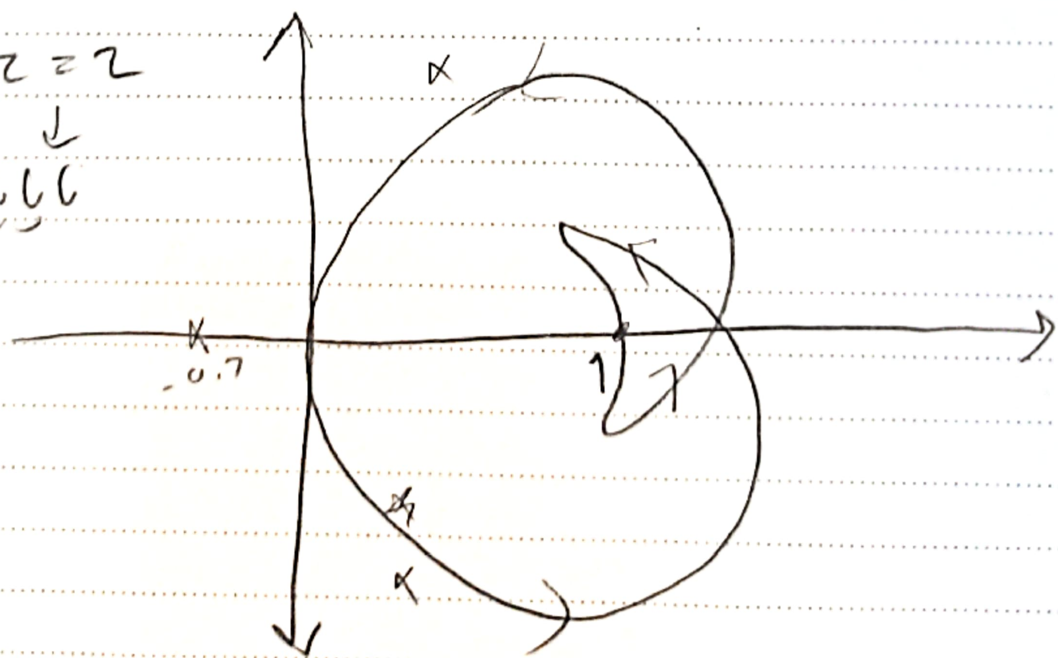
$P = 2$

$Z = 2$

$N = 0$

↓

ناپایدار



$$G(s) = \frac{s^2 + 2s + 1}{s^3 + 0.2s^2 + s + 1} \Rightarrow G(jw) = \frac{1 - w^2 + 2jw}{(1 - 0.2w^2) + j(w - w^3)}$$

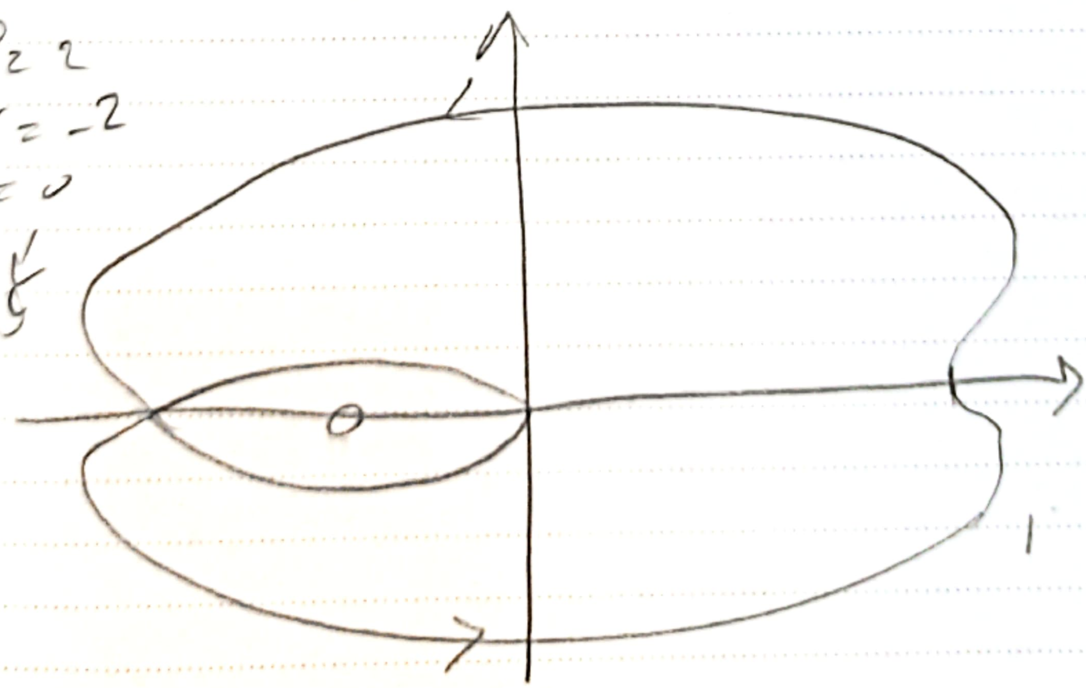
$$\Rightarrow G(jw) = \frac{\sqrt{(1-w^2)^2 + 4w^2}}{\sqrt{(1-0.2w^2)^2 + (w-w^3)^2}} \angle -\tan^{-1}\left(\frac{w-w^3}{1-0.2w^2}\right) + \tan^{-1}\left(\frac{2w}{\cancel{4}\,1-w^2}\right)$$

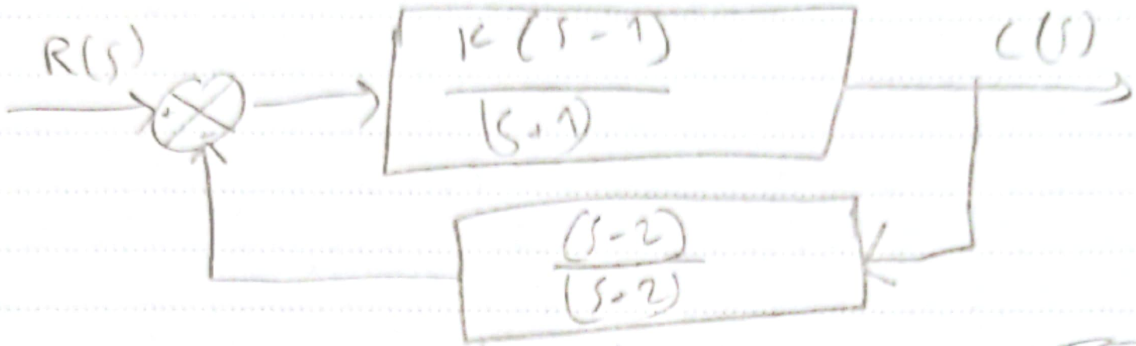
صفرها : $\left\{ z_{1,2} = -1 \right.$

قطبها $\left\{ \begin{array}{l} P_1 = -0.7245 \\ P_{2,3} = 0.262 \pm 1.145i \end{array} \right.$

	0^+	1^-	1^+	∞
اندازه	1	∞	∞	0
فاز	0	$\tan(\infty)$ $\cancel{+90}$ -270	$\tan(-\infty)$ -90	-90

$P = 2$
$N = -2$
$Z = 0$
پایدار





$$T(s) = G(s)H(s) = \frac{K(s-1)(s-2)}{(s+1)(s+2)} \Rightarrow \cancel{|K|<1}$$

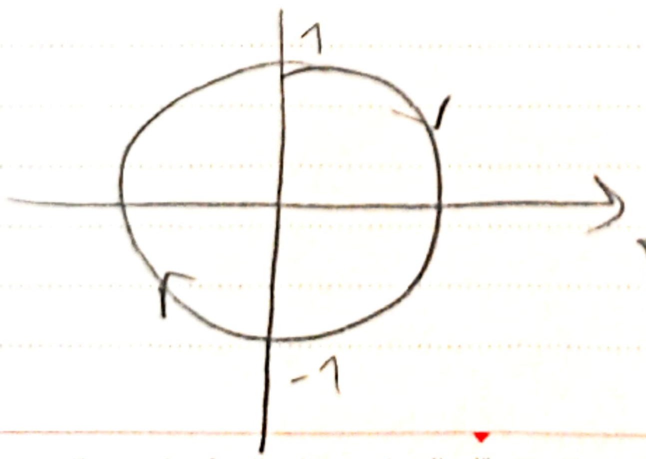
$$T(j\omega) = \frac{K(j\omega-1)(j\omega-2)}{(j\omega+1)(j\omega+2)}$$

$$T(j\omega) = \left|\frac{K\cancel{\sqrt{(\omega^2+1)(\omega^2+4)}}}{\cancel{\sqrt{(\omega^2+1)(\omega^2+4)}}}\right| \angle \tan^{-1}\left(\frac{-\omega}{1}\right) + \tan^{-1}\left(\frac{-\omega}{2}\right) - \tan^{-1}\left(\frac{\omega}{1}\right) - \tan^{-1}\left(\frac{\omega}{2}\right)$$

$$= -2\left(\tan^{-1}(\omega) + \tan^{-1}\left(\frac{\omega}{2}\right)\right)$$

$|K|$

	0^+	1^-	1^+	2^-	2^+	∞
اندازه	K	K	K	K	K	K
زاویه $\angle$	0	-143	-143	-216	-216	-360 = 0



$P=0$
$Z=0 \Rightarrow Z=0$

$\Rightarrow \cancel{|K|<1}$

$$\boxed{-1<K<1}$$

4) $\frac{(s+3)\,e^{-Ts}}{s^2+s} = \frac{(s+3)\,e^{-Ts}}{s(s+1)}$

رسم نایکوئیست

$G(s)=\frac{(s+3)}{s(s+1)} \Rightarrow G(j\omega)=\frac{j\omega+3}{j\omega(j\omega+1)}=\frac{\sqrt{(\omega^2+9)}}{\omega\sqrt{(\omega^2+1)}}\angle -\frac{\pi}{2}-\tan^{-1}(\omega)+\tan^{-1}\left(\frac{\omega}{3}\right)$

فرکانس قطع بهره

$|G(j\omega_g)|=1 \Rightarrow \sqrt{\omega_g^2+9}=\omega_g\sqrt{\omega_g^2+1} \Rightarrow \cancel{\omega^2}+9=\omega^4+\cancel{\omega^2}$

$\boxed{\omega_g=\sqrt{3}}$

$\measuredangle G(j\omega)=-180^\circ+t_d\,\omega_g$

$-90-\tan(\sqrt{3})+\tan\left(\frac{\sqrt{3}}{3}\right)=-180+\sqrt{3}\,t_d\,\frac{180}{\pi}$

$-90-60+30=-180+\sqrt{3}\,t_d\,\frac{180}{\pi}$

$60=\sqrt{3}\,t_d\,\frac{180}{\pi} \Rightarrow \frac{\pi}{3\sqrt{3}}=t_d$

$\Rightarrow \boxed{t_d=0.6046}$

امکان همین رو (۱،۱) پده

$e^{-Ts}=\frac{1-\frac{T}{2}s}{1+\frac{T}{2}s} \Rightarrow G(s)=\frac{(s+3)}{s(s+1)}\frac{(1-\frac{T}{2}s)}{(1+\frac{T}{2}s)} \overset{j\omega}{\Rightarrow} G(j\omega)=\frac{(\omega j+3)\,(1-\frac{T}{2}j\omega)}{j\omega(\omega j+1)(1+\frac{T}{2}j\omega)}$

$\Rightarrow G(j\omega)=\frac{\sqrt{(\omega^2+9)(1+\frac{T^2}{4}\omega^2)}}{\omega\sqrt{(\omega^2+1)(1+\frac{T^2}{4}\omega^2)}}\angle -90^\circ-\tan(\omega)-\tan\left(\frac{\omega T}{2}\right)+\tan\left(\frac{\omega}{3}\right)+\tan\left(\frac{-\omega T}{2}\right)$

$|G(j\omega)|=1 \Rightarrow \omega_g=\sqrt{3}$

$\measuredangle G=-90-\tan^{-1}(\sqrt{3})+\tan^{-1}\left(\frac{\sqrt{3}}{3}\right)-2\tan^{-1}\left(\frac{t_d\sqrt{3}}{2}\right)=-180$

$$-2\tan^{-1}\left(\frac{\sqrt{3}\,t_d}{2}\right) = -60$$

$$\tan^{-1}\left(\frac{\sqrt{3}\,t_d}{2}\right) = 30$$

$$\frac{\cancel{\sqrt{3}}}{3} = \frac{\cancel{\sqrt{3}}}{2}\,t_d \Longrightarrow \boxed{t_d = \frac{2}{3} = 0.\overline{6}}$$