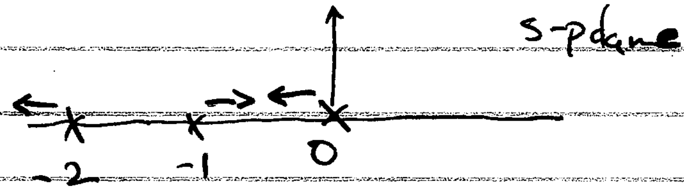
1°

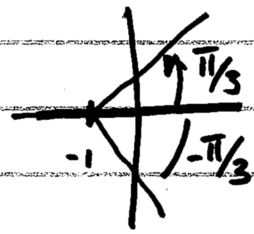
$$\frac{Y}{X} = \frac{GH}{1+GH} \qquad GH = \frac{K}{s(s+1)(s+2)}$$

(a)



(b) $\sigma = \frac{-2-1-[0]}{+3} = -1$

$\measuredangle \; \frac{\pm(2n+1)\pi}{3-0} = \left\{ \pm\frac{\pi}{3} \, ; \, \pi \right.$



(c)

$1+GH=0 \Rightarrow s(s+1)(s+2)+K=0 \; | \; s^3+3s^2+2s+k=0$

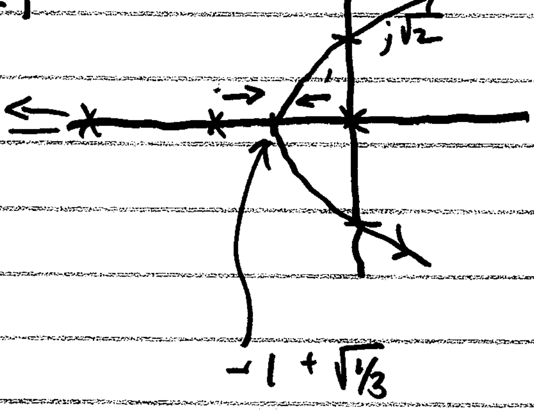
s^3	1	2
s^2	3	K
s^1	$\frac{6-K}{3}$	
	K	

$3s^2+k=0$; $\rightarrow k=6$ } $\Rightarrow s^2=-2 \Rightarrow$ $\boxed{s=\pm j\sqrt{2}}$

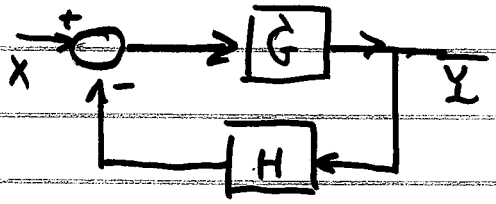
(d) $k=-[s^3+3s^2+2s] \Rightarrow \frac{dk}{ds}=0=-[3s^2+6s+2]=0$

$s=\frac{-3\pm\sqrt{3}}{3}=-1\pm\sqrt{\frac{1}{3}}$ $\quad \boxed{s=-1+\sqrt{\frac{1}{3}}}$ $\quad \boxed{K=\frac{2}{3^{3/2}}}$

(e)



2 (a)



$G = \frac{1}{s^2}$

$H = \frac{Ks+4}{s+4}$

(b)

$1 + GH = 0 \Rightarrow \frac{(Ks+4)}{s+4}\frac{1}{s^2} + 1 = 0$

$s^2(s+4) + (Ks+4) = 0 \Rightarrow s^3 + 4s^2 + Ks + 4 = 0$

(c)

s^3	1	K
s^2	4	4
s^1	$\frac{4K-4}{4}$	
s^0	4	

$\Rightarrow K - 1 > 0$ $\boxed{K \geq 1}$

(d)

$\boxed{K = 4}$ $4s^2 + 4 = 0$ $\boxed{s = \pm j}$ $= \pm j\omega$

$\omega = \frac{1}{2\pi}$ $\boxed{\omega = 1}$

3

(a) $1+G=0$

$s[s^2+6s+6]+k=0 \Rightarrow \boxed{s^3+6s^2+6s+k=0}$

(b)

given $s = -\frac{1}{2}[1 \pm i\sqrt{3}] \Rightarrow \boxed{s^2+s+1}$ → a factor of $1+G$

$$\frac{s^3+6s^2+6s+k}{s^2+s+1}$$

$$s^2+s+1 \;\overline{)\; s^3+6s^2+6s+k}$$

$$s+5$$

$$s^3+s^2+s$$

$$5s^2+5s+k$$

$$5s^2+5s+5$$

$$k = 5$$