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NOTES

Sheet 7

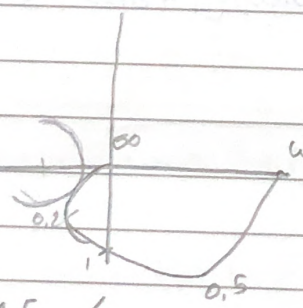
① $G(s) = \frac{K}{(1+S)^2}$ $\quad M_w = 1.4$

Using Polar plot:-

let $K = 1$ $\quad G(s) = \frac{1}{(1+s)^2}$

$|G(jw)| = \frac{1}{1+w^2}$ $\quad \angle G(jw) = -2\tan^{-1} w$

w	0	0.5	1	2	5	∞
|G|	1	0.8	0.5	0.2	0.04	0
∠G	0	-53	-90	-126	-157.4	-180



$\sin^{-1}(\frac{1}{M_m}) = \sin^{-1}(\frac{1}{1.4}) = 45.6$

$0a = 0.12$

$K = \frac{1}{0.12} = 8$

$\frac{1}{1+w^2} = 0.12 \Rightarrow w_m = 2.7$

Using Nichols Charts:

w	0	0.5	1	2	5	∞
20log|G|	0	-1.9	-6	-14	-28	∞
∠G	0	-53	-90	-126	-157.6	-180

NOTES.

Scale: $20^\circ = 1.6$ cm

$52^\circ = x$ cm $\Rightarrow x = 4$ cm

5 db = 1.5 cm

1.9 db = x $\Rightarrow$ x = 0.6 cm

$M_m = 1.4$

$K = 8.6$ $\quad 18.75 = 20 \log k$

$N = -6.625$

$|G| = 0.93 = \frac{1}{(1+\omega^2)}$

$\omega_m = 2.87$

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② $G(s) = \frac{K(1+4s)}{s(1+0.5s)(1+0.5s+s^2)}$ $\quad$ let $k = 1$

$$|G| = \frac{\sqrt{1+16\omega^2}}{\omega\sqrt{1+0.25\omega^2}\sqrt{(1-\omega^2)^2+0.25\omega^2}}$$

$$\angle G = \tan^{-1} 4\omega - 90 - \tan^{-1} 0.5\omega - \tan^{-1} \frac{0.5\omega}{1-\omega^2}$$

ω	0	0.5	1	2	5	∞
$\lvert G\rvert$	∞	5.5	7.4	0.9	0.86	0
$\angle G$	-90	-58.6	-130.6	-213.7	-245	-270
$20\log\lvert G\rvert$	∞	14.9	17.4	-0.9	-24.4	∞

$\phi = \sin^{-1} \frac{1}{M_m} = 45.6$

$\omega_a = 7.5$

$K = 1/4.5 = 0.133$

$\omega_b = 5.5$

$\omega = 1.15$ by trial & error

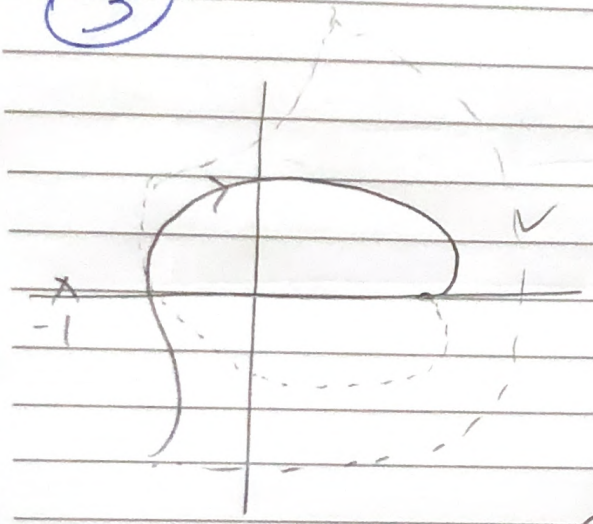
2)

$20 \log k = -18.43 \approx -9$ $\quad k = 0.12$ NOTES

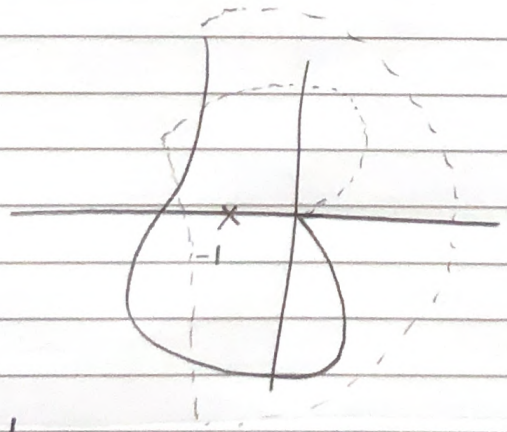
$20 \log k|G| = -4.10625 \Rightarrow |G| = 5.22$

$W \cong 1.15$

(3)



$N = Z = 0 \Longrightarrow$ Stable



$N = Z = 2 \Longrightarrow$ unstable