

$$W(s) = \frac{K(s-8)}{s(s+0.5)}$$

$$K=1$$

$$W(s) = \frac{s-8}{s(s+0.5)}$$

Soluzione sviluppata da uno studente durante lo svolgimento del compito d'esame.

• $s-8 = -8(1-\frac{s}{8})$ termine binomio al numeratore

$$\omega_t = 8 \text{ rad/s}$$

$$+ 20 \text{ dB/dec } [8, +\infty]$$

$$- \frac{\pi}{4} \text{ rad/dec } [0.8, 80]$$

• s termine monomio al denominatore

$$- 20 \text{ dB/dec } [0, +\infty]$$

$$- \frac{\pi}{2} \text{ rad sfasamento globale}$$

• $s+0.5 = 0.5(1+\frac{s}{0.5})$ termine binomio al denominatore

$$\omega_t = 0.5$$

$$- 20 \text{ dB/dec } [0.5, +\infty]$$

$$- \frac{\pi}{4} \text{ rad/dec } [0.05, 5]$$

$$\tilde{W}(s) = \frac{-8(1-\frac{s}{8})}{0.5 \cdot s(1+\frac{s}{0.5})} = -\frac{8}{0.5} \frac{(1-\frac{s}{8})}{s(1+\frac{s}{0.5})} = -16 \frac{(1-\frac{s}{8})}{s(1+\frac{s}{0.5})}$$

$$K_W = -16$$

$$|K_W|_{\text{dB}} = 20 \log(16) \approx 24 \text{ dB}$$

$$\angle K_W = \pm \pi$$

il diagramma delle fasi parte da $-\frac{\pi}{2}$ per il termine monomio ma c'è uno sfasamento di $\pm \pi$

$$\Rightarrow +\pi - \frac{\pi}{2} = \frac{\pi}{2}$$

il diagramma dei moduli passa per il punto (1, 24 dB)

Attenzione:

vero se non ci fossero i due termini binomi

$$[0, 0.5) = -20 \text{ dB/dec}$$

$$[0.5, 8) = -20 \text{ dB/dec} - 20 \text{ dB/dec} = -40 \text{ dB/dec}$$

$$[8, +\infty) = -20 \text{ dB/dec} - 20 \text{ dB/dec} + 20 \text{ dB/dec} = -20 \text{ dB/dec}$$

$$[0, 0.05) = 0 \text{ rad/dec}$$

$$[0.05, 0.8) = -\frac{\pi}{4} \text{ rad/dec}$$

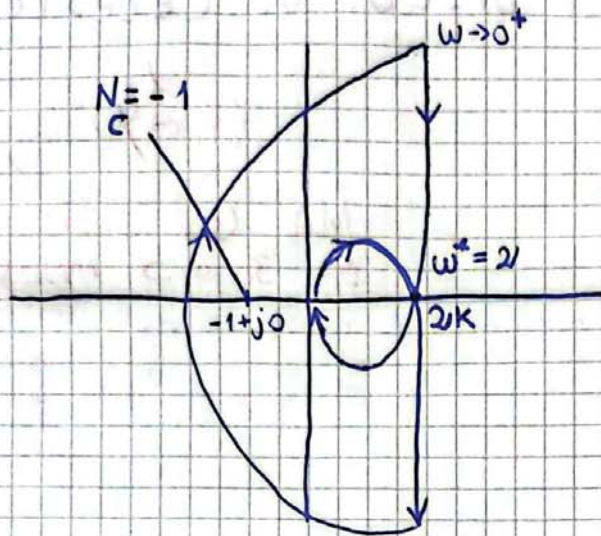
$$[0.8, 5) = -\frac{\pi}{4} \text{ rad/dec} - \frac{\pi}{4} \text{ rad/dec} = -\frac{\pi}{2} \text{ rad/dec}$$

$$[5, 80) = -\frac{\pi}{4} \text{ rad/dec}$$

$$[80, +\infty) = 0 \text{ rad/dec}$$

diagramma polare

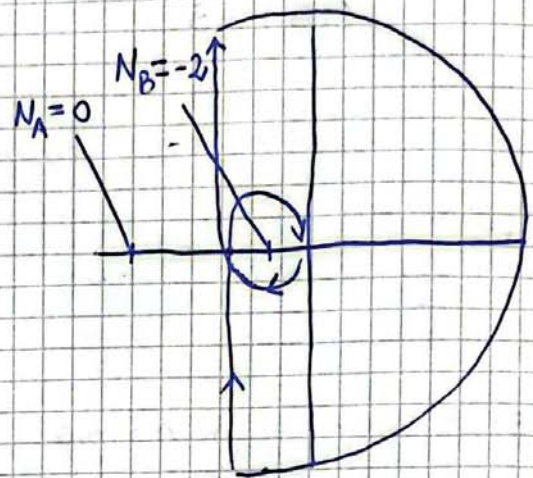
$K > 0$



$$W(j\omega) = \frac{j\omega}{j\omega(j\omega + 0.5)}$$

$$W(0) = \frac{-8}{0} \rightarrow \infty$$

$K < 0$



$$W_{CH}(s) = \frac{KW(s)}{1 + KW(s)}$$

$$d_{CH}(s) = KN(s) + D(s) = K(s-8) + s(s+0.5) = Ks - 8K + s^2 + 0.5s = s^2 + s(K+0.5) - 8K$$

ROUTH

2	1	-8K	
1	K+0.5	0	
0	-8K		
	-0.5	0	
1	+	+	+
K+0.5	-	+	+
-8K	+	+	-
	2V	0V	1V

$$K+0.5 > 0 \rightarrow K > -0.5$$

$$-8K > 0 \rightarrow -K > 0 \rightarrow K < 0$$

$K < -0.5$ ha 2 variazioni

$\Rightarrow$ instabilità

$-0.5 < K < 0$ ha 0 variazioni

$\Rightarrow$ stabilità

$K > 0$ ha 1 variazione

$\Rightarrow$ instabilità

$$P_{AP} = s(s+0.5) = 0 \begin{cases} s=0 \\ s=-0.5 \end{cases} \rightarrow \text{Re}(s)^+ = 0$$

Nyquist

$$m_{CH}^+ = P_{AP} - N$$

$K > 0$

$$m_{CH}^+ = 0 - (-1) = 1$$

$K < 0$

$$- \text{e in (A) se } -2 > -1 \quad m_{CH}^+ = 0 - 0 = 0$$

$$- \text{e in (B) se } -2 < -1 \quad m_{CH}^+ = 0 - (-2) = 2$$