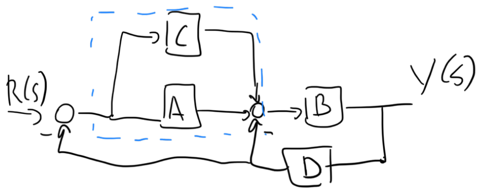
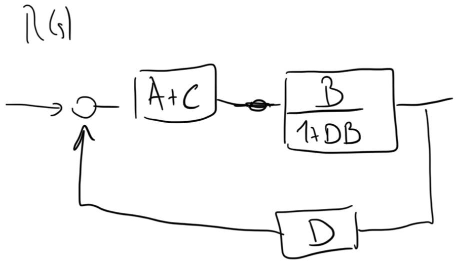
FILA A

ES 1, $F(s) = \frac{Y(s)}{R(s)}$





$$F(s) = \frac{\frac{(A+C)B}{1+BD}}{1+D\frac{(A+C)B}{1+BD}} = \frac{(A+C)B}{1+BD+DAB+DCB}$$

$A = \frac{3}{s}$ $B = \frac{1}{s+2}$ $C = 2$ $D = \alpha$

$$F(s) = \frac{\left(\frac{3}{s}+2\right)\frac{1}{s+2}}{1+\frac{\alpha}{s+2}+\frac{\alpha}{s(s+2)}+\frac{2\alpha}{s+2}} =$$

$$= \frac{\frac{3+2s}{s\,\cancel{(s+2)}}}{\frac{s(s+2)+s\alpha+\alpha+2\alpha s}{s\,\cancel{(s+2)}}} =$$

$$= \frac{3+2s}{s^2+2s+\alpha s+\alpha+2\alpha s} =$$

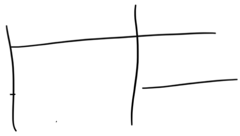
$$= \frac{3+2s}{s^2+(2+3\alpha)s+\alpha}$$

$$\begin{cases} 2+3\alpha > 0 \\ \alpha > 0 \end{cases}$$

$\alpha > -2$

$a > \frac{1}{3}$ $\qquad -\frac{2}{3}$ $\qquad 2$

$\alpha > 0$



$\alpha > 0$

Es 2 $\qquad G(s) = \dfrac{100(s-10)}{(s+1)^2\,(s^2+100)}$

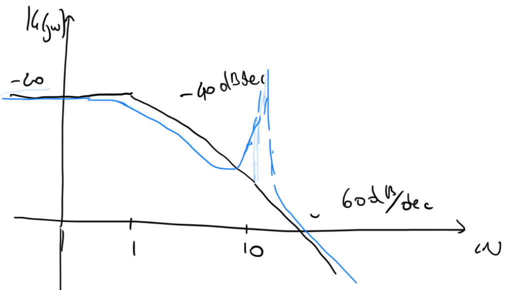
Forma di Bode

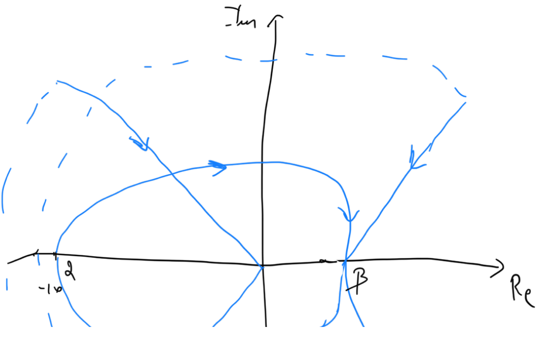
$$\frac{-\cancel{1000}\left(1-\frac{s}{10}\right)}{\cancel{100}(s+1)^2\left(\frac{s^2}{100}+1\right)} \qquad K_B = -10$$

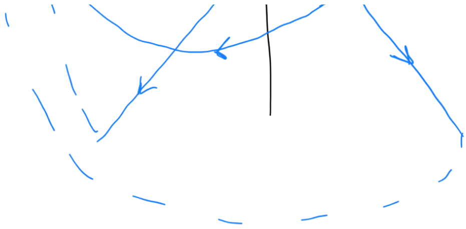
Zeri $\quad$ 1 zero instabile in $\omega = 10$

Poli $\quad$ 2 poli ~~[illegible]~~ $\omega = 1$

$\qquad$ 2 poli puramente immaginari in $\omega = 10$







$K>0$ $|K|>\frac{1}{2}$ 3 PD

$|K|<\frac{1}{2}$ 2 PD

$K<0$ $|K|>\frac{1}{8}$ 2 PD

$|K|<\frac{1}{8}$ STABILE

PUNTO 3) $K=-100$ 2 POLI INSTABILI

$$G(s) = -10\,\frac{s+1}{(s+8)^2(s^2+4)}$$

CENTRO STELLA

$$s_0 = \frac{\sum p - \sum z}{n-m} = \frac{-8-8+1}{3} = -5$$

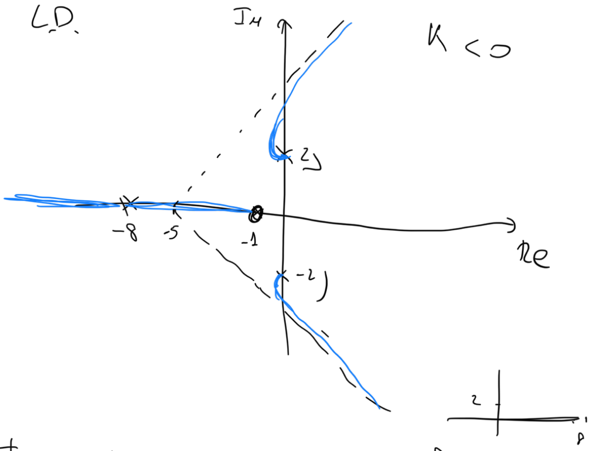
ASINTOTI

$h=0,1,2$

L.D. $\frac{(2h+1)\pi}{n-m} \Rightarrow \frac{\pi}{3}\,;\ \pi\,;\ \frac{5}{3}\pi$

L.C. $\frac{2h\pi}{n-m} \overset{h=0,1,2}{\Rightarrow} 0\,;\ \frac{2}{3}\pi\,;\ \frac{4}{3}\pi$

L.D.



FASE USCITA $2j$ $8+2j$

CONDIZIONE DI FASE

$$\sum \angle p - \sum \angle z = (2h+1)\pi$$

$$\angle(s+8) + \underbrace{\angle(s-z)}_{x} + \angle(s+2j) - \angle(s+1) = \pi \Big|_{s=2j}$$

$$2\angle(2j+8) + x + \angle(4j) - \angle(1+2j) = \pi$$

$$2\,tg^{-1}\left(\frac{1}{4}\right) + x + \pi/2 - tg^{-1}\left(\frac{1}{2}\right) = \pi$$

$$28 + x + \cancel{90} - 63.4 = 180$$

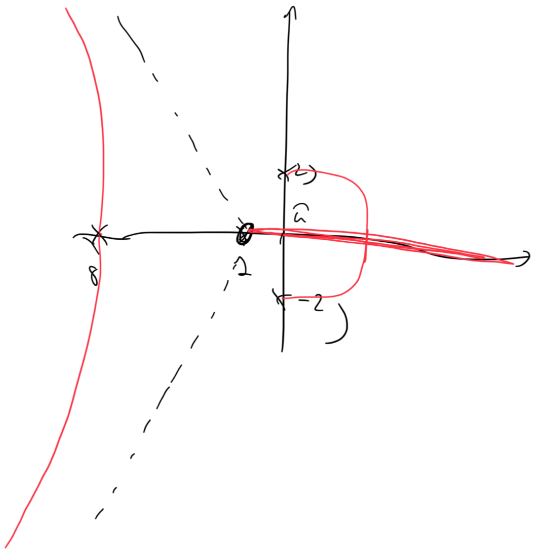
$$x + 54.5 = 180$$

$$x \simeq 125{,}5^\circ$$

STABILITÀ PER $K<0$ con luogo diretto (avevo ~~K~~ negativo)

$K < \hat{K}$ STABILE $\quad K > \hat{K}$ 2 PD

LUOGO COMPLEMENTARE



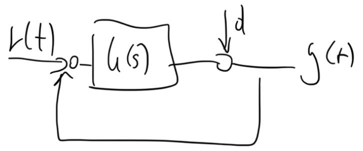
STABILITÀ $K \cancel{>0}$ con L.C.

$K < \hat{K} \rightarrow$ 2 PD

$K > \hat{K} \rightarrow$ 1 PD

ESERCIZIO 4

$G(s)$ TIPO 1 $\quad K_G = 3 \quad d(t) = 6t$

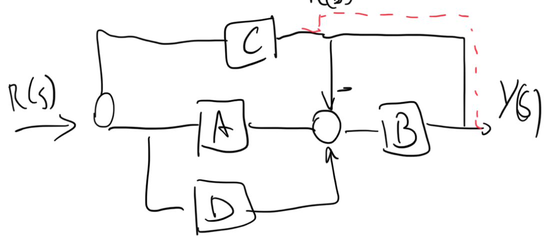


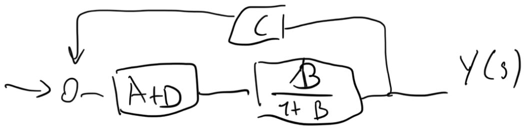
$$\frac{y(t)}{d(t)} = \frac{1}{1+G(s)}$$

$$\lim_{t\to\infty} = \lim_{s\to 0} \cancel{s}\,\frac{6}{\cancel{s}^4} \cdot \frac{\cancel{8}}{\cancel{s}+3} = 2$$

FILA B

ES 1, $F(s) = \frac{Y(s)}{R(s)}$





$$F(s) = \frac{\frac{(A+D)B}{1+\cancel{B}}}{1+\frac{(A+D)BC}{1+\cancel{B}}} =$$

$$= \frac{(A+D)B}{1+B+(A+D)BC} = \frac{AB+DB}{1+B+ABC+BCD}$$

$A = 2 \quad B = \frac{1}{s+4} \quad C = s \quad D = 1/s$

$$F(s) = \frac{\frac{2}{s+4} + \frac{1}{(s+4)s}}{1+\frac{1}{(s+4)}+\frac{2s}{s+4}+\frac{\cancel{s}}{s(s+4)}} =$$

$$= \frac{2s+1}{s(s+4)+s+2s\,s+s} =$$

$$= \frac{2s+1}{s^2+4s+s+2s\,s+s} = \frac{2s+1}{s^2+(4+1+2s)s+s}$$

$\Rightarrow \quad 5+25>0$

$2>-1$

ES 2

$$G(s)=\frac{-1000\,(s+10)}{(s+100)^2\,(s^2+100)}$$

FORMA DI BODE

$$G(s)=\frac{-1\cancel{000}\cdot 1\cancel{0}\left(\frac{s}{10}+1\right)}{100\cdot 1\cancel{0000}\left(\frac{s}{100}+1\right)^2\left(\frac{s^2}{100}+1\right)}=$$

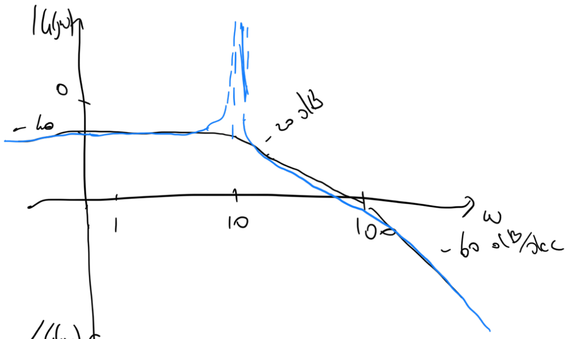
$$=-0.01\,\frac{\left(1+\frac{s}{10}\right)}{\left(1+\frac{s}{100}\right)^2\left(1+\frac{s^2}{100}\right)}$$

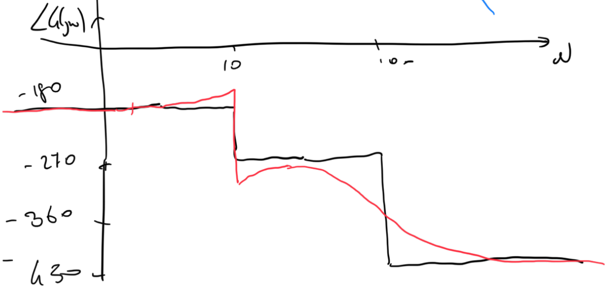
$G_0=-0.01$

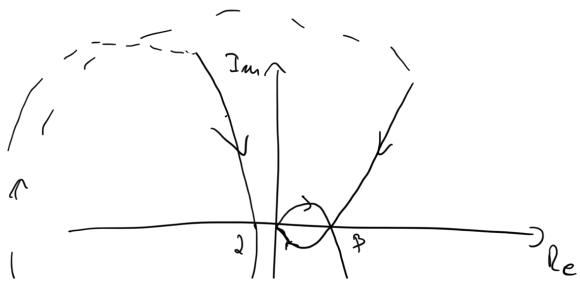
ZERI 1 STABILE IN $\omega=10$

POLI 2 IN $\omega=100$

2 IN $\omega=10$ PURAMENTE IMMAGINARI







$k > 0$ $\quad |k| > \frac{1}{2}$ $\quad$ 1 PD

$|k| < 1/2$ $\quad$ 2 PD

$k < 0$ $\quad |k| < \frac{1}{B}$ $\quad$ STABILE

$k > 1/B$ $\quad$ 2 PD

ES 3

$$G(s) = + \frac{s^2+16}{s(s+3)^2(s+1)(4-s)}$$

CENTRO STELLA

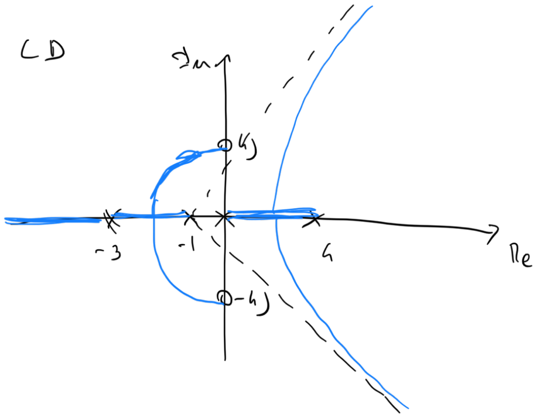
$$s_0 = \frac{\Sigma p - \Sigma z}{n-m} = \frac{-6-1+4}{3} = -1$$

ASINTOTI

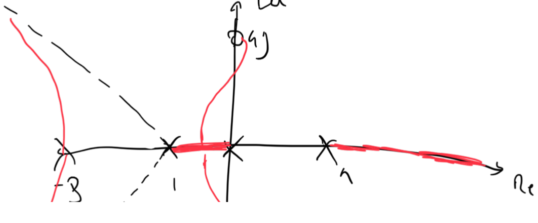
L.D. $\frac{(2h+1)\pi}{n-m} = \frac{\pi}{3}\,;\ \pi,\ \frac{5}{3}\pi$ $\quad (h=0,1,2)$

L.C. $\frac{2h\pi}{n-m} = 0,\ \frac{2}{3}\pi\ ;\ \frac{4}{3}\pi$

LD



L.C.



CONDIZIONE DI FASE

$$\sum \angle p - \sum \angle t = 2h\pi$$

$$\angle s + 2\angle s+3 + \angle s+1 + \angle s-4 - \angle s+4j - \angle s+4j = 0$$

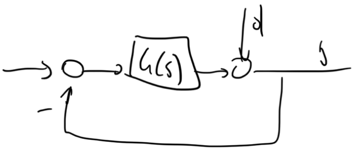
CALCOLO IN $s = 4j$

$$4j + 2\,tg^{-1}(3+4j) + tg^{-1}(4j+1) + tg^{-1}(4j-4) - tg^{-1}8j - x\ \pi$$

$$\frac{\pi}{2} + 106.2 + 75\ \cancel{1}35 - \frac{\pi}{2} - x = 0$$

$$x = 316$$

ES 4)



$G(s)$ tipo 0 , $K_G = 2$ $d(t) = 3$

$$F(s) = \frac{Y(s)}{D(s)} = \frac{1}{1 + G(s)}$$

$$\lim_{t \to \infty} y(t) = \lim_{s \to 0} \cancel{s}\,\frac{3}{\cancel{s}} \cdot \frac{1}{1+2} = 3$$