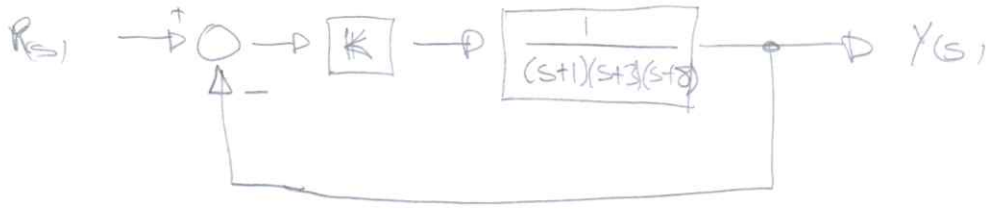
5.

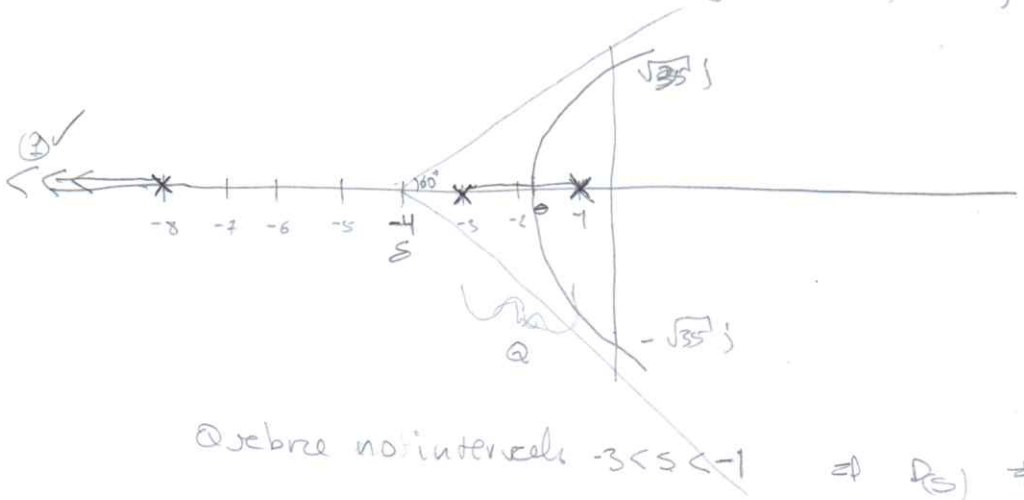


a) LGR

$$FTMA = \frac{K}{(s+1)(s+3)(s+8)}$$

Zeros: nen ; polos: -1; -3; -8 ; 3 ramos ; 3 Assymptotes

$\delta = -4$; angulos 60°; 180°; 300°



② sobre no intervalo $-3 < s < -1$ $\Rightarrow D(s) \Rightarrow (s+1)(s+3)(s+8)+K=0$

$(s^2+3s+s+3)(s+8)+K=0$

$s^3+3s^2+s^2+3s+8s^2+24s+8s+24+K=0$

$(s^3+12s^2+35s+24)+K=0$

$$\frac{dK}{ds} = \phi$$

$$K = -(s^3+12s^2+35s+24)$$

$$\frac{dK}{ds} \Rightarrow -(3s^2+24s+35) = \phi$$

$$s_1 = \frac{-12+\sqrt{39}}{3} = -1{,}918 \checkmark$$

$$s_2 = \frac{-12-\sqrt{39}}{3} = -6{,}08 \text{ não pertence a } -3 < s < -1$$

$$s^3+12s^2+35s+24+K=0 \;\Big|_{s=jw}$$

$$-jw^3-12w^2+35jw+24+K=0$$

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$$\text{Im} \begin{cases} w^3+35w=0 \\ \text{Re} \; -12w^2+24+K=0 \end{cases} \begin{cases} w=\sqrt{35} \wedge w=0 \wedge w=-\sqrt{35} \\ -12.35+24+K=0 \Leftrightarrow K=396 \end{cases}$$

$0 < K < 396$