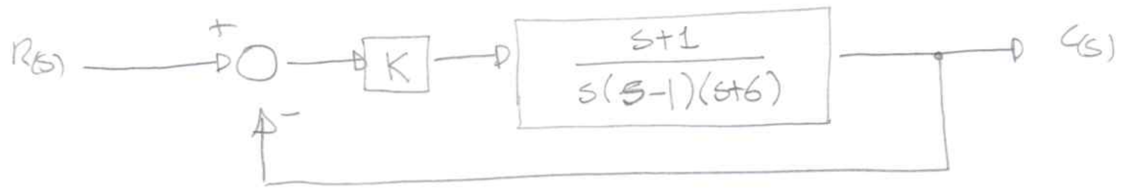
3.



- Determine closed loop transfer function:

$$\frac{C(s)}{R(s)} = \frac{\dfrac{K\cdot(s+1)}{s(s-1)(s+6)}}{1+\dfrac{K(s+1)}{s(s-1)(s+6)}} = \frac{K(s+1)}{s(s-1)(s+6)+K(s+1)}$$

$$\boxed{1 = \frac{s(s-1)(s+6)}{s(s-1)(s+6)}}$$

- Denominator Polinomical:

$$\begin{aligned} P(s) &= s(s-1)(s+6)+K(s+1) \\ &= (s^2-1)(s+6)+Ks+K \\ &= s^3+6s^2-s^2-6s+Ks+K \\ &= s^3+5s^2+(K-6)s+K \end{aligned}$$

→ All coefficientes are Positive ?

- Apply Routh-Hurwitz criterion:

3	1	K-6
2	5	K
1	b_{n-1}	
0	c_{n-1}	

$$b_{n-1} = -\frac{\begin{vmatrix} 1 & K-6 \\ 5 & K \end{vmatrix}}{5} = -\frac{(K-5(K-6))}{5}$$

$$= -\frac{(K-5K+30)}{5} = \frac{4K-30}{5}$$

$$c_{n-1} = -\frac{\begin{vmatrix} 5 & K \\ b_{n-1} & 0 \end{vmatrix}}{b_{n-1}} = -\frac{(0-\cancel{b_{n-1}}\cdot K)}{\cancel{b_{n-1}}}$$

$$= K$$

- $\begin{cases} b_{n-1} \\ c_{n-1} \end{cases}$ → must Be > 0 in order to be stable.

$$\begin{cases} \dfrac{4K-30}{5} > 0 \\ K > 0 \end{cases} \Leftrightarrow \begin{cases} 4K-30>0 \\ - \end{cases} \begin{cases} K > \dfrac{30}{4} \\ - \end{cases} \begin{cases} K > 7{,}5 \\ \end{cases}$$

3.

$$\frac{\dfrac{K(s+1)}{s(s-1)(s+6)}}{1+\dfrac{K(s+1)}{s(s-1)(s+6)}}$$

$$\frac{K(s+1)}{s(s-1)(s+6)} \cdot \frac{1}{1+\dfrac{K(s+1)}{s(s-1)(s+6)}}$$

$$\frac{K(s+1)}{s(s-1)(s+6)+K(s+1)}$$

c. a

$$s(s^2+6s-s-6)+Ks+K$$

$$s^3+6s^2-s^2-6s+Ks+K$$

$$s^3+5s^2+(-6+K)s+K$$

$$\begin{array}{c|ccc}
3 & 1 & K-6 & 0 \\
2 & 5 & K & 0 \\
1 & b_{n-1} & & \\
0 & & &
\end{array}$$

$$K-(5K+30)$$

$$b_{n-1} = \frac{-1}{5}\begin{vmatrix} 1 & K-6 \\ 5 & K \end{vmatrix}$$

$$= -\frac{1}{5}(-4K+30)$$

$$= \frac{4K}{5} - \frac{30}{5}$$

$$4K > 30$$

$$K > \frac{30}{4}$$