Moirom Schneider Cordeiro 17102515

PARTE 1) a) $\frac{V_A - X(t)}{R1} + \frac{V_A}{R2+Z_C} + K i_a = i_a$ | $y(t) = K.i_a.50$; $i_a = \frac{y(t)}{50K}$

$V_A\left(\frac{1}{R1} + \frac{1}{R2+Z_C}\right) - \frac{X(t)}{R1} = i_a(1-K)$ | $V_A = -i_a.Z_L$; $V_A = \frac{-y(t)}{50K}.Z_L$

$-\frac{y(t)}{50K}\left(\frac{Z_L}{R1} + \frac{Z_L}{R2+Z_C}\right) - \frac{y(t)}{50K}.(1-K) = \frac{x(t)}{R1}$

$\frac{y(t)}{50K}\left(\frac{-Z_L}{R1} - \frac{Z_L}{R2+Z_C} - 1 + K\right) = \frac{x(t)}{R1}$

$\frac{y(t)}{x(t)} = \frac{\frac{-50}{R1}}{\frac{Z_L}{R1} + \frac{Z_L}{R2+Z_C} - K + 1} \Rightarrow \frac{y(s)}{x(s)} = \frac{-K}{\frac{s}{50} + \frac{10ms^2}{100ms+1} - K + 1}$

$\frac{y(s)}{x(s)} = \frac{-K}{\frac{100ms^2 + s + 500ms^2 - 5Ks - 50K + 5s + 50}{50(100ms+1)}}$

$\frac{y(s)}{x(s)} = \frac{-K(5s+50)}{0,6s^2 + 6s - 5Ks - 50K + 50}$

a) $q(s) = \underbrace{0,6}_{a_2}s^2 + \underbrace{s(6-5K)}_{a_1} \underbrace{-50K+50}_{a_0}$

s^2	0,6	$-50K+50$
s^1	$6-5K$	0
s^0	b_1	0

$$b_1 = \frac{(6-5K).(-50K+50) - 0,6.0}{6-5K}$$

$$b_1 = -50K+50$$

Critério 1 → $-50K+50 > 0$ → $\boxed{K<1}$ $\qquad$ $6-5K>0$ → $\boxed{K<1,2}$

PARTE II) $C(s) = K\left(\frac{s+1}{s}\right)$ $\qquad G(s) = \frac{-6s-60}{0,6s^2-10}$

$$T(s) = \frac{C(s).G(s)}{1+C(s).G(s)} = \frac{\frac{C_m.G_m}{C_{ol}.G_{ol}}}{\frac{C_{ol}.G_{ol}+C_m G_m}{C_{ol}.G_{ol}}} = T(s) = \frac{C_m.G_m}{C_{ol}.G_{ol}+C_m.G_m}$$

$$T(s) = \frac{K(s+1)(-6s-60)}{s(0,6s^2-10)+K(s+1)(-6s-60)} = \frac{-6Ks^2-66Ks-60K}{0,6s^3-10s-6Ks^2-66Ks-60K}$$

2)

a) $q(s-15) = 0{,}6\,(s-1{,}5)^3 - 6K(s-1{,}5)^2 + (-10-66K)(s-1{,}5) - 60K$

$q(s-15) = 0{,}6s^3 - 2{,}7s^2 + 4{,}05s - 2{,}025 - 6Ks^2 + 18Ks - 13{,}5K - 10s + 15 - 66Ks + 39K$

$q(s-15) = 0{,}6s^3 + (-2{,}7-6K)s^2 + (-5{,}95-48K)s + 12{,}975 + 25{,}5K$

s^3	$0{,}6$	$-5{,}95-48K$
s^2	$-2{,}7-6K$	$12{,}975+25{,}5K$
s^1	b_1	0
s^0	c_1	0

$$b_1 = \frac{(-2{,}7-6K)(-5{,}95-48K) - 0{,}6\,(12{,}975+25{,}5K)}{-2{,}7K-6K} = \frac{288K^2+150K+8{,}28}{-2{,}7-6K}$$

$$c_1 = \frac{\cancel{b_1}\,(12{,}975+25{,}5K) - 0}{\cancel{b_1}} = 12{,}975+25{,}5K$$

$$\frac{288K^2+150K+8{,}28}{-2{,}7-6K} > 0 \rightsquigarrow 288K^2+150K+8{,}28 > 0$$

$K_1 = -0{,}45807$

$K_2 = -0{,}06276$

$K_1 < -0{,}45807 \;;\; K_2 > -0{,}06276$

$12{,}975+25{,}5K > 0$

$25{,}5K > -12{,}975$

$K_3 > -0{,}5088$

$-0{,}14580 > K > -0{,}5088$

b) $q(s-10) = 0{,}6(s-10)^3 - 6K(s-10)^2 + (-10-66K)(s-10) - 60K$

$q(s-10) = 0{,}6(s^3 - 3s^2.10 + 3.100s - 1000) - 6K(s^2 - 2.10s + 100) + (-10s + 100 - 66Ks + 660K - 60K)$

$q(s-10) = 0{,}6s^3 - 18s^2 + 180s - 1000 - 6Ks^2 + 120Ks - 600K + (-10s + 100 - 66Ks + 600K)$

$q(s-10) = 0{,}6s^3 + (-18-6K)s^2 + (170+54K)s + (100-600)$

$q(s-10) = 0{,}6s^3 + (-18-6K)s^2 + (170+54K)s + (-500)$

s^3	0,6	$(170+54K)$
s^2	$-18-6K$	-500
s^1	b_1	
s^0	c_1	

$$b_1 = \frac{(-18-6K)(170+54K) - (0,6)(-500)}{-18,6K}$$

$$b_1 = \frac{-324K^2 - 1992K - 3060 + 300}{-18-6K}$$

$$b_1 = \frac{-324K^2 - 1992K - 2760}{-18-6K}$$

$$-324K^2 - 1992K - 2760 > 0$$

$K > -4,039$

$K < -2,1089$

$C = -500$

$$-18-6K > 0$$

$$-6K > 18$$

$$-K > \frac{18}{6} = 3$$

$K < -3$