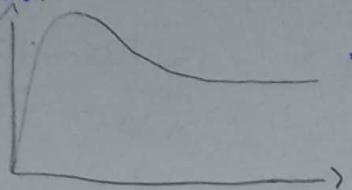
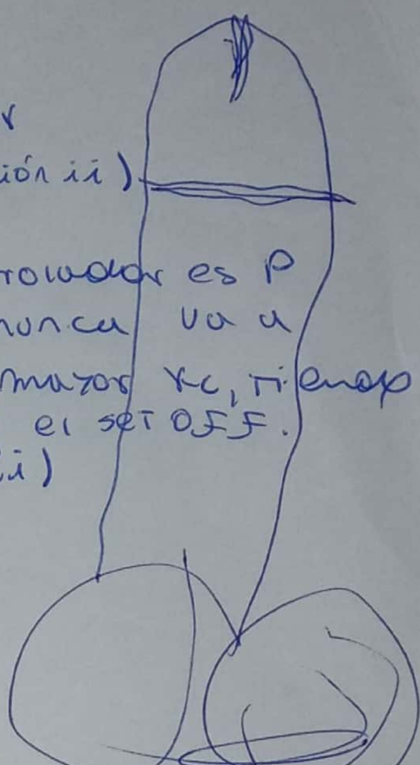
1er PARCIAL 17-06-2020

TEORÍA

a) 

→ es un sistema con dinámica en el numerador sin ceros positivos (opción ii).



b) ~~$\frac{C(s)}{R(s)} = \frac{0,5 \cdot K_c \cdot 3 \cdot \frac{1}{s}}{1 + 0,5 \cdot K_c \cdot 3}$~~

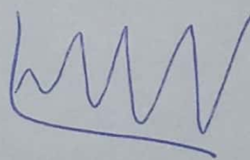
b) - Como el controlador es P el offset nunca va a ser 0. A mayor K_c, tiendo muy a 0 el set OFF. (opción iii)

c) $\frac{Y(s)}{X(s)} = \frac{s+8}{(s+3).(s+1).(s-1)}$ $x(t) = 1\,\mu(t)$ $X(s) = 1/s$

$Y(s) = \frac{s+8}{(s+3).(s+1).(s-1)} \cdot \frac{1}{s}$

$\lim y(t \to \infty) = \lim_{s \to 0} \cancel{s} \cdot \frac{(s+8)}{\cancel{s}\,\underbrace{(s+3)}_{3}.\underbrace{(s+1)}_{1}.\underbrace{(s-1)}_{-1}} = -8/3$

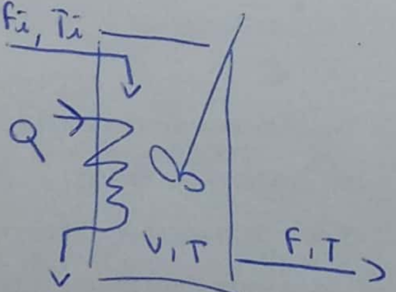
d) PARTE REAL POSITIVA y PARTE COMPLEJA → NO ACOTADO y oscilatorio (opción vii)



e) $x(t) = A \operatorname{sen}(\omega t)\,\mu(t)$

↳ sistema de 1er orden → retraso. menor amplitud e igual frecuencia.

PROBLEMA 1



$F_{iss} = 0{,}71\ m^3/min$

$T_{iss} = 68\ °C$

$T_{ss} = 103{,}5\ °C$

$\rho = 1\ kg/m^3$

$C_p = 1\ Kcal/kg\,°C$

$V_{eq} = 2{,}7\ m^3$

a) $0 = \rho F_{iss} - \rho F_{ss} \rightarrow F_{iss} = F_{ss}$

$0 = \rho F_{iss} C_p (T_{iss} - T_{ss}) + Q_{ss} \rightarrow \boxed{Q_{ss} = 25{,}205\ Kcal/min}$

b) ~~A: cte F: cte A $\frac{dX(t)}{dt}$ = $\underbrace{\ldots}_{cte}$~~

2

~~Asumo~~ fi y f quedan ctes con los valores de s.s.
(son iguales)

$$\rho c_p V \frac{dT(t)}{dt} = \rho c_p f_i T_i(t) - \rho c_p f_i T(t) + Q(t)$$

$$- \qquad 0 = \rho c_p f_i T_{iss} - \rho c_p f_i T_{ss} + Q_{ss}$$

$$\rho c_p V \frac{d\bar{T}(t)}{dt} = \rho c_p f_{iss} \bar{T}_i(t) - \rho c_p f_{iss} \bar{T}(t) + \bar{Q}(t)$$

$$\underbrace{\frac{V}{f_{iss}}}_{\tau = 3,8 \text{ min}} \frac{d\bar{T}(t)}{dt} + \bar{T}(t) = \underbrace{\ }_{Kp_1 = 1} \bar{T}_i(t) + \underbrace{\frac{1}{\rho c_p f_{iss}}}_{Kp_2 = 1,408} \bar{Q}(t)$$

$$T(s) = \frac{1}{3,8 \cdot s + 1} T_i(s) + \frac{1,408}{3,8 \cdot s + 1} \bar{Q}(s)$$

c -

$$\bar{T}_i(t) = 3u(t) - u(t-1) + u(t-2) + (t-2)u(t-2) - (t-3)u(t-3)$$

$$\bar{T}_i(s) = \frac{3}{s} - \frac{e^{-s}}{s} + \frac{e^{-2s}}{s} + \frac{e^{-2s}}{s^2} - \frac{e^{-3s}}{s^2}$$

$$T_i(s) = \frac{3 - e^{-s} + e^{-2s}}{s} + \frac{e^{-2s} - e^{-3s}}{s^2}$$

$$T_i(s) = \frac{3 \cdot s - e^{-s} \cdot s + e^{-2s} \cdot s + e^{-2s} - e^{-3s}}{s^2}$$

$$T(s) = \left[3s - e^{-s}s + e^{-2s} \cdot s + e^{-2s} - e^{-3s}\right] \cdot \frac{1}{s^2 (3,8 \cdot s + 1)}$$

• Media, varianza, mediana, coeficiente de asimetría, kurtosis

$$\log P_x = 8,04494 - \frac{1554,3}{222,65 + T}$$

$$\frac{}{(3{,}8 \cdot s+1)} = \frac{A}{(3{,}8 \cdot s+1)} + \frac{B}{s} + \frac{C}{s^2}$$

$A = 14{,}44$
$B = -3{,}8$
$C = 1$ ✓

$$T(s) = [3 s - e^{-s} s + e^{-2s} s + e^{-2s} - e^{-3s}] \cdot \left[\frac{14{,}44}{(3{,}8 \cdot s+1)} - \frac{3{,}8}{s} + \frac{1}{s^2}\right]$$

sin e:

$$\mathcal{L}^{-1}\left\{\frac{3 \cdot 14{,}44}{3{,}8} \cdot \frac{s}{s+5/19}\right\} \to \frac{s}{s+5/19} = \mathcal{L}^{-1}\left\{\left(1 - \frac{5/19}{s+5/19}\right) \cdot 11{,}4\right\} = \left[\delta(x) - \frac{5}{19} e^{-5/19 x}\right] u(x)$$

$\hookrightarrow [11{,}4\,\delta(x) - 3 \cdot e^{-5/19 x}\, u(x)$

con e^{s}:

$\hookrightarrow 3 \cdot s \cdot -\frac{3{,}8}{s} = -11{,}4 \to \mathcal{L}^{-1}\{-11{,}4\} = -11{,}4\,\delta(x)$

$\hookrightarrow 3 \cdot s \cdot \frac{1}{s^2} = \frac{3}{s} \quad \mathcal{L}^{-1}\{3/s\} = 3\,u(x)$

Terminos de $u(x)$: $\cancel{11{,}4\,\delta(x)} - \cancel{11{,}4\,\delta(x)} + (-3 \cdot e^{-5/19 x} + 3)\, u(x)$

con e^{-s} → demora de 1.

$\hookrightarrow e^{-s} \cdot s \cdot \frac{11{,}4}{3{,}8 \cdot s+1}$

$\hookrightarrow 3{,}8 \cdot e^{-s} \cdot \frac{s}{s+5/19} = 3{,}8 \cdot e^{-s} \cdot \left[1 - \frac{5/19}{s+5/19}\right]$

Anti T. $= 3{,}8\,\delta(x-1) - e^{-5/19(x-1)}\, u(x-1)$

$\hookrightarrow e^{-s} \cdot s \cdot \frac{-3{,}8}{s} = -3{,}8 \cdot e^{-s} \overset{\text{ANT}}{=} -3{,}8\,\delta(x-1)$

$\hookrightarrow e^{-s} \cdot \frac{\cancel{s}}{s^{\cancel{2}}} \to \text{ANT} = u(x-1)$

Terminos con $u(x-1) = (-e^{-5/19(x-1)} + 1)\, u(x-1)$

con $e^{-2s} \cdot s$ → demora de 2

$\hookrightarrow$ terminos $= (-e^{-5/19(x-2)} + 1)\, u(x-2)$

e^{-2s}

$(3{,}8 \cdot e^{-s/1{,}4(\tilde{t}-2)} - 3{,}8 + \tilde{t} - 2)\,u(\tilde{t}-2)$

con e^{-3s}

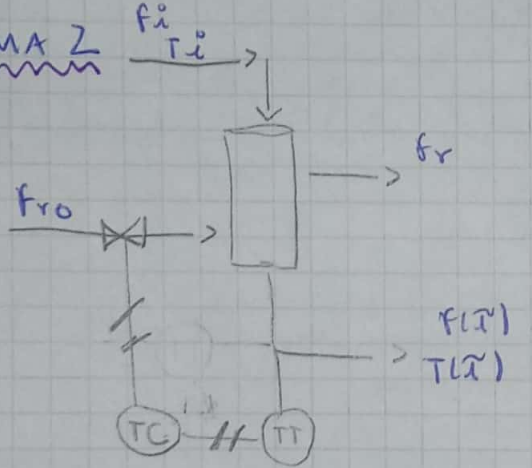
$(3{,}8 \cdot e^{-s/1{,}4(\tilde{t}-3)} - 3{,}8 + \tilde{t} - 3)\,u(\tilde{t}-3)$

$\bar{T}(\tilde{t}) = (-3\,e^{-s/1{,}4\,\tilde{t}} + 3)\,u(\tilde{t}) - (-e^{-\frac{s}{1{,}4}(\tilde{t}-1)} + 1)\,u(\tilde{t}-1) + (\cancel{\;}\,e^{-\frac{s}{1{,}4}(\tilde{t}-2)} + 1 \ldots$

$\ldots + 3{,}8 \cdot e^{-s/1{,}4(\tilde{t}-2)} - 3{,}8 + \tilde{t})\,u(\tilde{t}-2) + (3{,}8 \cdot e^{-\frac{s}{1{,}4}(\tilde{t}-3)} - 6{,}8 + \tilde{t})\,u(\tilde{t}-3)$

PROBLEMA 2

a-



Objetivo = T

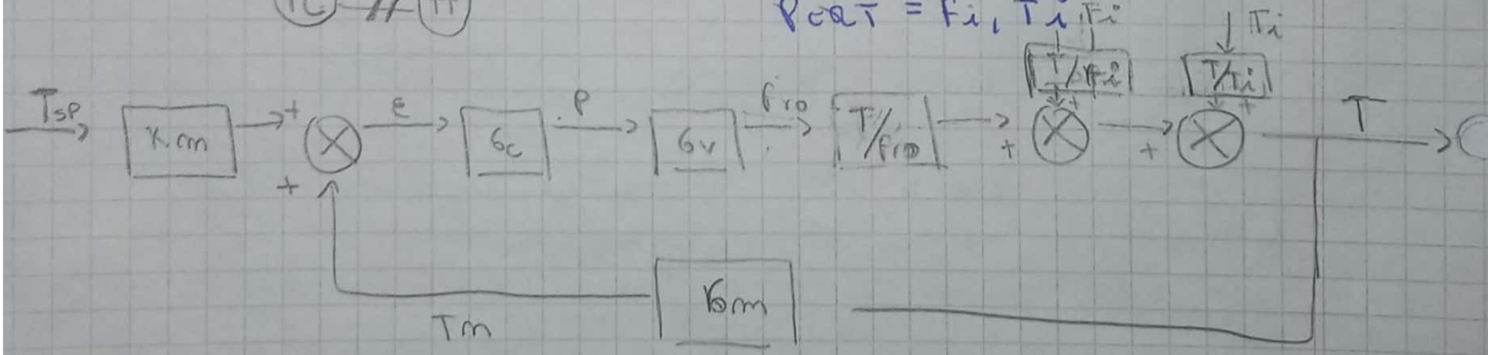
Entrada = fi, Ti, Fro

Salida = fr, f, T

Medidas = T   NM = fr, F

Manip = fro

Pert = fi, Ti, fi



$\bar{T}/\bar{T}_i(\tilde{t}) = 3\,u(\tilde{t})$ $T_i(s) = 3/s$

$$T(s) = \frac{0{,}2 \cdot e^{-0{,}5s}}{(10 \cdot s+1) \cdot (5 \cdot s+1)} \cdot \frac{1}{1 + \dfrac{50 \cdot (1+0{,}001s) \cdot 3 \cdot 0{,}6 \cdot e^{-0{,}5 \cdot s} \cdot 0{,}5}{(10 \cdot s+1) \cdot (5s+1) \cdot (3 \cdot s+1) \cdot (s+1)}} \cdot \frac{3}{s}$$

$$T(s) = \frac{0{,}2 \cdot e^{-0{,}5 \cdot s} \cdot (3 \cdot s+1) \cdot (s+1)}{(10 \cdot s+1) \cdot (5 \cdot s+1) \cdot (3 \cdot s+1) \cdot (s+1) + 45 \cdot (1+0{,}001 \cdot s) \cdot e^{-0{,}5 \cdot s}} \cdot \frac{3}{s}$$

$\tilde{T}(\tilde{t} \to \infty) = \lim_{s \to 0} s \cdot T(s) = 0{,}013$

offset $= 0 - 0{,}013 = \boxed{-0{,}013}$

... 2do orden amortiguado. 6

5

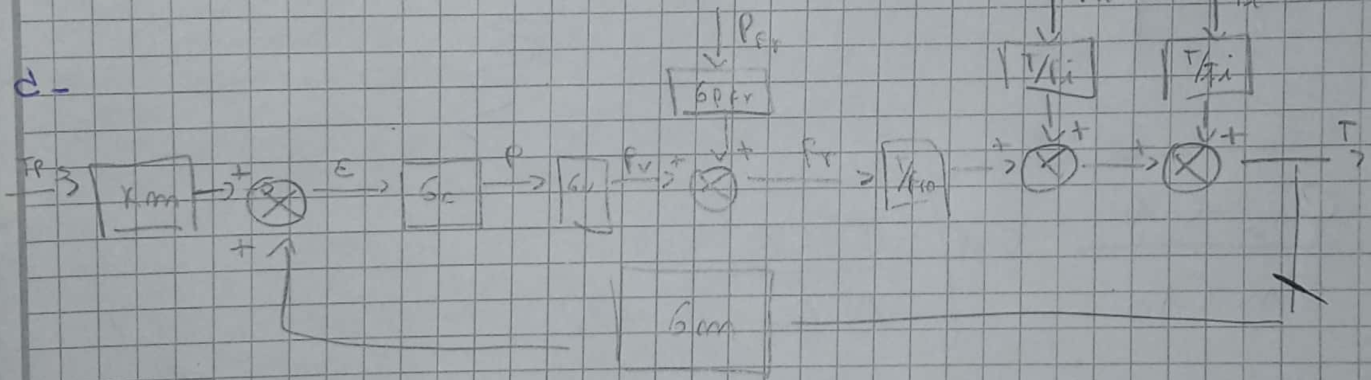
$G_P(s) = 2/s$

$\cancel{T(s) = \frac{0,6 \cdot e^{-0,5 \cdot s} \cdot (3 s+1)(s+1)}{(10 \cdot s+1) \cdot (5 \cdot 2+1)}}$

$$T(s) = \frac{0,5 \cdot 50 \cdot (1+0,001 \cdot s) \cdot 3 \cdot 0,6 \cdot e^{-0,5 \cdot s} \cdot (s \cdot +1) \cdot 2/s}{(3s+1) \cdot (10 \cdot s+1) \cdot (5 \cdot s+1) \cdot (s+1) + 45 (1+0,001 \cdot s) \cdot e^{-0,5 \cdot s}}$$

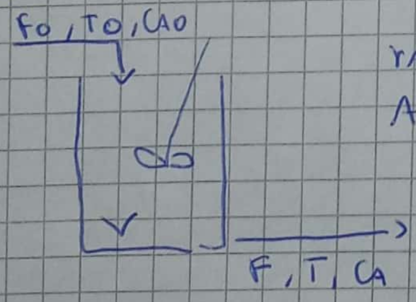
$\lim_{s \to 0} s \cdot T(s) = 1,457$ off set $= 2 - 1,457 = \boxed{0,043}$

d-



PROBLEMA 3

a-



$r_A = k C_A^2$

$A \to B$

$F_0 = cte$

$T_0 = cte$

$K = cte$

$V = cte \to F_0 = F$

$$V \frac{d C_A(\hat{t})}{d\hat{t}} = F\, C_{A_0}(\hat{t}) - F\, C_A(\hat{t}) - V \cdot K \cdot C_A(\hat{t})^2$$

$$C_A(\hat{t})^2 = C_{A_{ss}}^2 + 2\, C_{A_{ss}} \cdot \bar{C}_A(\hat{t})$$

$$V \frac{d \bar{C}_A(\hat{t})}{d\hat{t}} = F\, \bar{C}_{A_0}(\hat{t}) - (F + V K \cdot 2 C_{A_{ss}})\, \bar{C}_A(\hat{t})$$

$$\underbrace{\frac{V}{F + 2 K V C_{A_{ss}}}}_{\tau} \frac{d \bar{C}_A(\hat{t})}{d\hat{t}} + \bar{C}_A(\hat{t}) = \underbrace{\frac{F}{F + 2 V K C_{A_{ss}}}}_{K_P} \bar{C}_{A_0}(\hat{t})$$

$$\frac{C_A(s)}{C_{A_0}(s)} = \frac{F / (F + 2 K V C_{A_{ss}})}{V / (F + 2 K V C_{A_{ss}}) \cdot s + 1}$$

rta de un sistema de 2do orden amortiguado. 6

p. $A = 5 \rightarrow \boxed{\begin{matrix} A=5 \\ K_P = 1 \end{matrix}}$ $B = 5$ $A = 3$ $\frac{3}{5} = \exp\left(\frac{-\pi \xi}{\sqrt{1-\xi^2}}\right) \rightarrow \boxed{\xi = 0{,}16}$

$x_p = 1{,}1 = \frac{\pi \cdot \tau}{\sqrt{1-\xi^2}} \rightarrow \boxed{\tau = 0{,}346}$

$$\frac{CA(s)}{TO(s)} = \frac{1}{\tau^2 s^2 + 2\xi\tau \cdot s + 1}$$

c) $F_0 = 3\,\delta(t)$ $\rightarrow$ rta típica de sistema de primer orden

pto de donde arranca $= \frac{3 \cdot K_P}{\tau} = 4{,}5$

τ es cuando ocurre el 63,2% del cambio $\rightarrow CA(t) = 1{,}656$

$\tau = 2$

$K_P = 3$

$$\boxed{\frac{CA(s)}{F_0(s)} = \frac{3}{2 \cdot s + 1}}$$