SISTEMAS DE 2° ORDEN

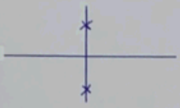
$$G(s) = \frac{k\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

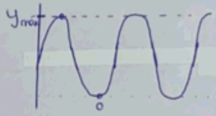
- k = ganancia del sistema
- ω_n = frecuencia natural (NO Amor)
- ξ = factor amortiguamiento
- $\sigma = \xi\omega_n$ = factor atenuación
- $\omega_d = \omega_n\sqrt{1-\xi^2}$ = frecuencia amor
- $\theta = \arccos(\xi) = \mathrm{artg}\left(\frac{\omega_d}{\sigma}\right)$

- $\xi < 0 \rightarrow$ SIST. INESTABLE
  - Polos reales positivos.

- $\xi = 0 \rightarrow$ SISTEMA OSCILADOR
  - Polos imaginarios puros

$$G(s) = \frac{k\omega_n^2}{s^2+\omega_n^2}$$





$y_{max} = 2k$

$\omega_n = \frac{2\pi}{T}$

$y_{min} = 0$

- $\xi = 1 \rightarrow$ SISTEMA CRIT. AMORTIGUADO
  - Polo doble

$$G(s) = \frac{k\omega_n^2}{(s+\omega_n)^2}$$

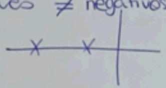
$y(0) = 0$

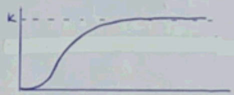
$y(\infty) = k$

$t_s = \frac{\pi}{\sigma} = \frac{\pi}{\xi\omega_n}$

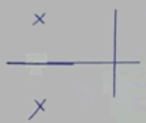
- $\xi > 1 \rightarrow$ SISTEMA SOBREAMORTIGUADO (+ tiempo que c.amort)
  - DOS polos reales $\neq$ negativos

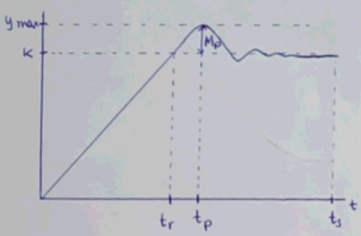
$$G(s) = \frac{k\omega_n^2}{(s+P_1)(s+P_2)}$$





- $0 < \xi < 1 \rightarrow$ SISTEMA SUBAMORTIGUADO
  - Polos complejos conjugados





$y_{max} = M_p k + k$

t_r (t subida) $= \frac{\pi - \theta}{\omega_d}$

t_p (t pico) $= \frac{\pi}{\omega_d}$

t_s (t establecimiento) $= \frac{\pi}{\sigma}$

M_p (sobreoscilación) $= e^{-\sigma t_p} \cdot 100\ \%$

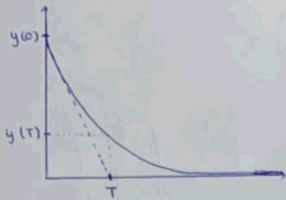
SISTEMAS DE 1^er^ ORDEN

$$G(s) = \frac{k}{Ts + 1}$$;

- k = ganancia
- T = cte del sistema
- SIEMPRE $+1$

- $\sigma = \frac{1}{T}$ — Factor de atenuación

- IMPULSO : $R(s) = 1$; $y(t) = \frac{k}{T} \cdot e^{-t/T}$



$y(0) = \frac{k}{T}$

$y'(0) = -\frac{k}{T^2}$

$y(T) = 0'37 \frac{k}{T}$

- ESCALÓN : $R(s) = \frac{1}{s}$; $y(t) = k(1 - e^{-t/T})$

$y(0) = 0$

$y'(0) = \frac{k}{T}$

$t_s = \frac{\pi}{\sigma}$

- RAMPA : $R(s) = \frac{1}{s^2}$; $y(t) = k(t - T) + kTe^{-t/T}$

$k = m \Rightarrow$ pendiente