Curso

SISTEMAS Y CONTROL

Clase 17

Fotogramas de los pizarrones de clases filmadas

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Clase 17 –

- Respuesta Temporal 4 (Respuesta temporal del Sistema de Parámetros Concentrados a entradas específicas)

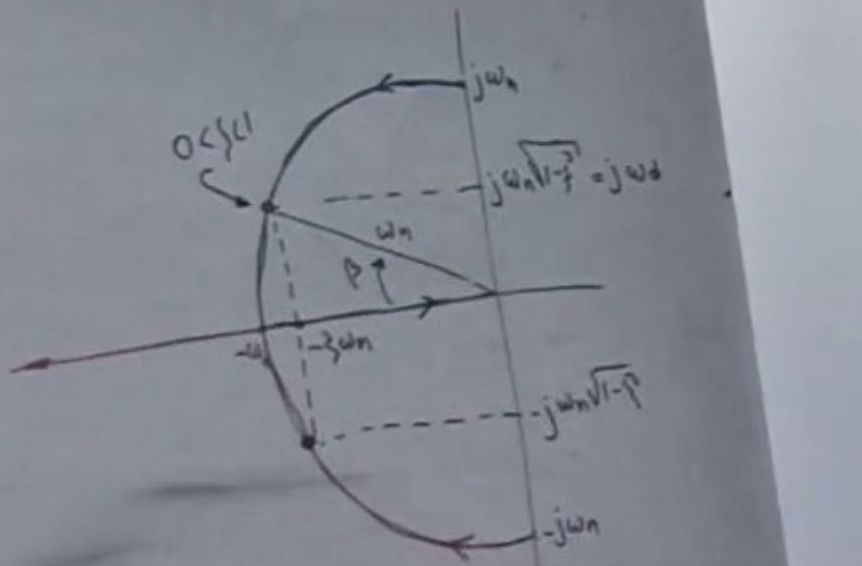
  - Sistema de orden 2, respuesta a escalón (cálculo de ts, tl, td)

Esta clase hace uso de las transparencias, “resp_orden2_mp.pdf”, respuesta_orden2_tl_ts.pdf”

SISTEMA ORDEN 2 - Resp a escalón

$$H(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

$$H(s) = \frac{\omega_n^2 (\alpha s + 1)}{s^2 + 2\zeta\omega_n s + \omega_n^2} \qquad -\frac{1}{\alpha}$$



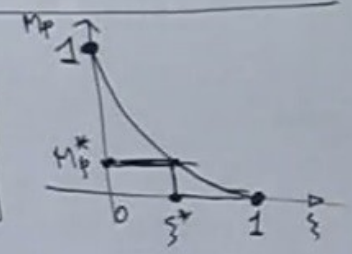
$$\beta = \operatorname{arctg}\left[\frac{\sqrt{1-\zeta^2}}{\zeta}\right] \qquad 0<\zeta<1$$

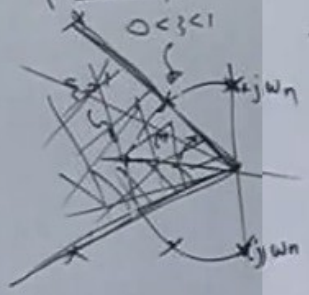
$$\operatorname{Sen}\beta = \sqrt{1-\zeta^2}$$

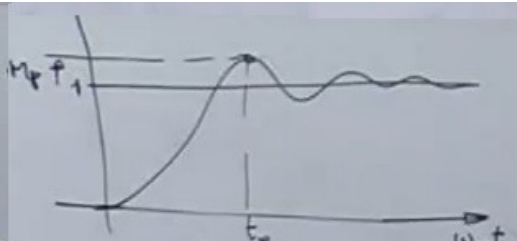
$$y(t) = 1 - \frac{e^{-\xi\omega_n t}}{\sqrt{1-\xi^2}} \operatorname{sen}\left(\underbrace{\omega_n\sqrt{1-\xi^2}}_{\omega_d} t + \underbrace{\operatorname{arctg}\left[\frac{\sqrt{1-\xi^2}}{\xi}\right]}_{\beta}\right)$$

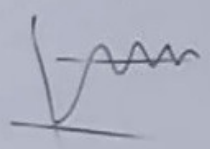
$$M_p = e^{-\frac{\xi\pi}{\sqrt{1-\xi^2}}}$$

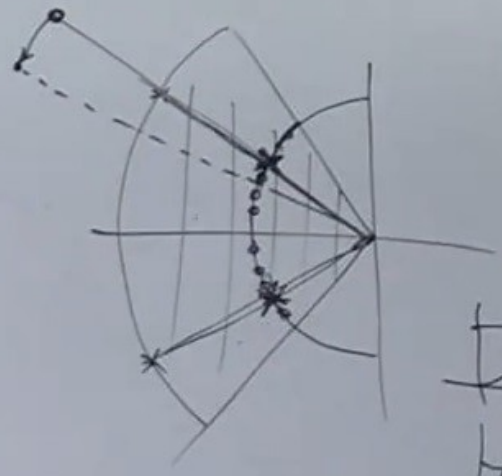
$$t_p = \frac{\pi}{\omega_d} = \frac{\pi}{\omega_n\sqrt{1-\xi^2}}$$

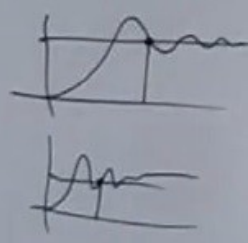






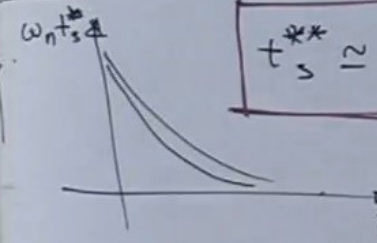






$$y(t) = 1 - \frac{e^{-\xi\omega_n t}}{\sqrt{1-\xi^2}} \operatorname{sen}\left(\underbrace{\omega_n\sqrt{1-\xi^2}}_{\omega_d} t + \underbrace{\operatorname{arctg}\left[\frac{\sqrt{1-\xi^2}}{\xi}\right]}_{\varphi}\right)$$

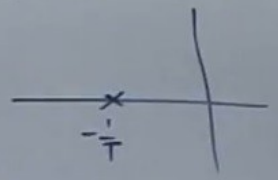
Tiempo de asentamiento t_s

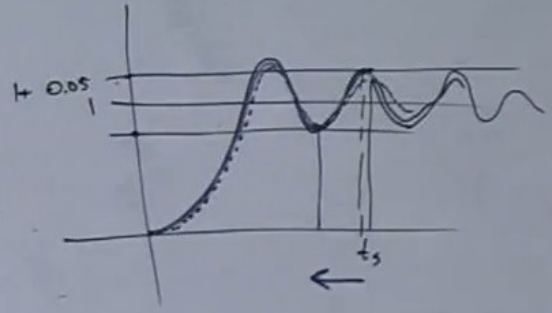


$$t_s^{**} \simeq \frac{3}{\xi\omega_n}$$

$$\omega_n t_s^{**} = \frac{3}{\xi}$$

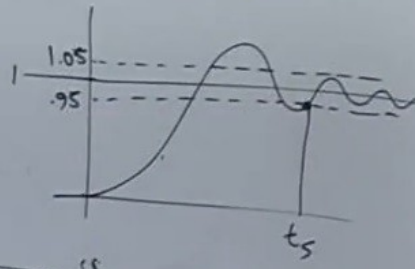
$t_s \simeq 3T$





t_s^*

$\omega_n t_s^*$



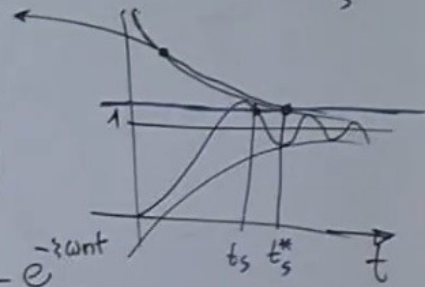
$$1 + \frac{e^{-\xi\omega_n t}}{\sqrt{1-\xi^2}}$$

$\omega_n t_s^*$

$$\frac{e^{-\xi\omega_n t}}{\sqrt{1-\xi^2}} \leq 0.05$$

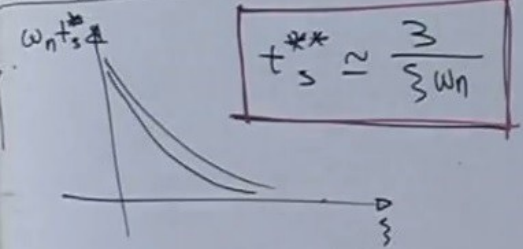
$$e^{-\xi\omega_n t} \leq 0.05\sqrt{1-\xi^2}$$

$$1 - \frac{e^{-\xi\omega_n t}}{\sqrt{1-\xi^2}}$$



$$y(t) = 1 - \frac{e^{-\xi\omega_n t}}{\sqrt{1-\xi^2}} \operatorname{sen}\left(\underbrace{\omega_n\sqrt{1-\xi^2}}_{\omega_d}\, t + \underbrace{\operatorname{arctg}\left[\frac{\sqrt{1-\xi^2}}{\xi}\right]}_{\phi}\right)$$

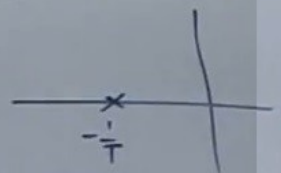
Tiempo de asentamiento t_s

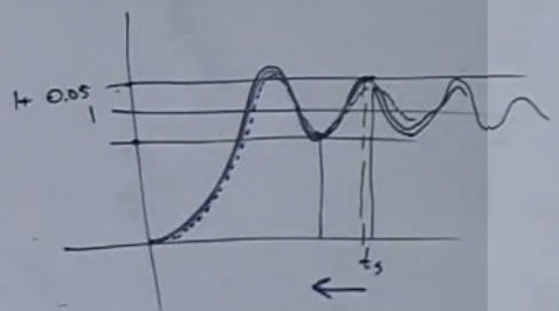


$$t_s^{**} \simeq \frac{3}{\xi\omega_n}$$

$$\omega_n t_s^{**} = \frac{3}{\xi}$$

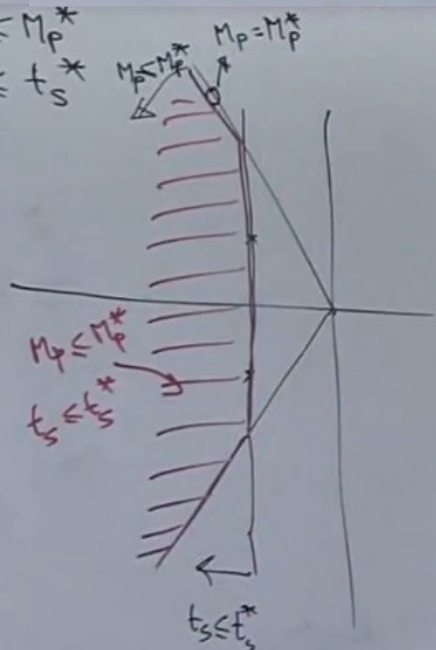
$t_s \simeq 3T$





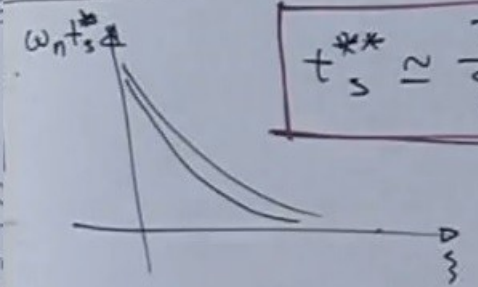
$M_p \leq M_p^*$

$t_s \leq t_s^*$



$$y(t) = 1 - \frac{e^{-\zeta\omega_n t}}{\sqrt{1-\zeta^2}} \operatorname{sen}\left(\underbrace{\omega_n\sqrt{1-\zeta^2}}_{\omega_d}\, t + \underbrace{\operatorname{arctg}\left[\frac{\sqrt{1-\zeta^2}}{\zeta}\right]}_{\beta}\right)$$

Tiempo de asentamiento t_s



$$t_s^{**} \simeq \frac{3}{\zeta\omega_n}$$

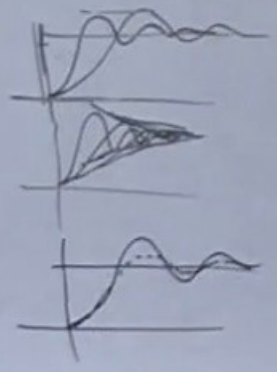
$$\omega_n t_s^{**} = \frac{3}{\zeta}$$

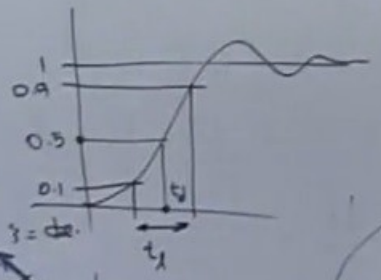
t. de levantamiento

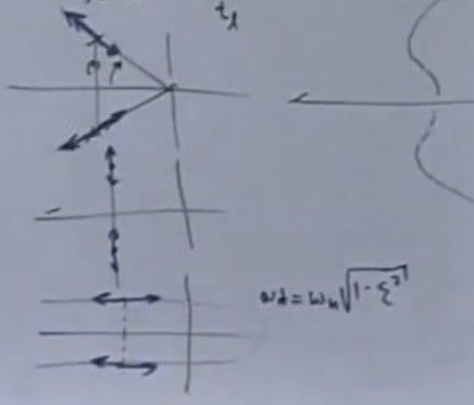
$t_{r\ 10\text{-}90\%}$ (aprox) $\rightarrow$ $\begin{cases} \omega_n t_r \simeq 0.8 + 2.5\,\zeta \\ \omega_n t_r \simeq 1 - 0.4167\,\zeta + 2.917\,\zeta^2 \end{cases}$

t. de retardo

t_d (aprox) $\rightarrow$ $\begin{cases} \omega_n t_d \simeq 1 + 0.7\,\zeta \\ \omega_n t_d \simeq 1.1 + 0.125\,\zeta + 0.469\,\zeta^2 \end{cases}$







$$y(t) = 1 - \frac{e^{-\zeta\omega_n t}}{\sqrt{1-\zeta^2}} \operatorname{sen}\left(\underbrace{\omega_n\sqrt{1-\zeta^2}}_{\omega_d} t + \underbrace{\operatorname{arctg}\left[\frac{\sqrt{1-\zeta^2}}{\zeta}\right]}_{\beta}\right)$$

Tiempo de asentamiento t_s

$\omega_n t_s^*$

$$t_s^{**} \simeq \frac{3}{\zeta\omega_n}$$

$$\omega_n t_s^{**} = \frac{3}{\zeta}$$

ζ

t. de levantamiento

$t_{r\ 10\text{-}90\%}$ (aprox) $\longrightarrow \begin{cases} \omega_n t_r \simeq 0.8 + 2.5\,\zeta \\ \omega_n t_r \simeq 1 - 0.4167\,\zeta + 2.917\,\zeta^2 \end{cases}$

t. de retardo

t_d (aprox) $\longrightarrow \begin{cases} \omega_n t_d \simeq 1 + 0.7\,\zeta \\ \omega_n t_d \simeq 1.1 + 0.125\,\zeta + 0.469\,\zeta^2 \end{cases}$