c) $t_s = 7(s)$ , $t_p = 3(s)$

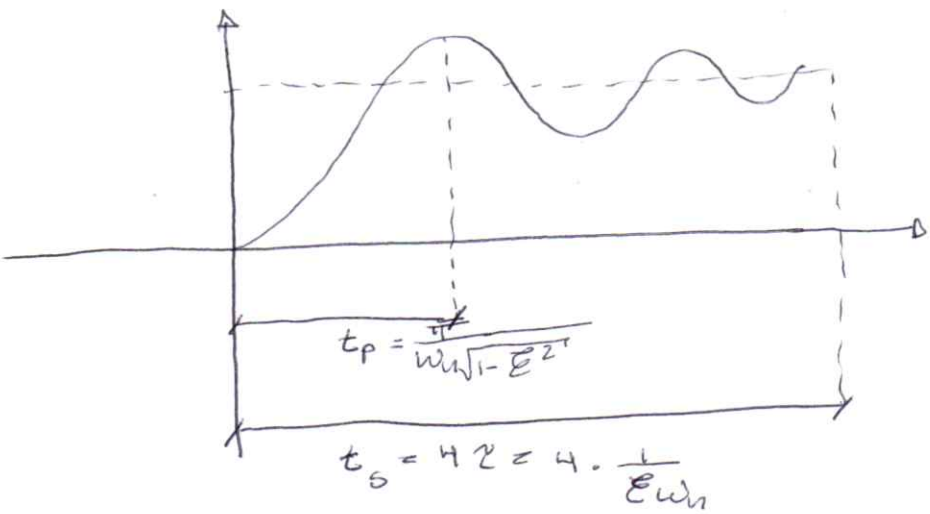
$t_p ; \omega_n \to \varepsilon^2$

$t_p ; \varepsilon^2 \to \omega_n$

$$\begin{cases} t_s = \dfrac{4}{\varepsilon \omega_n} \\ t_p = \dfrac{\pi}{\omega_n \sqrt{1-\varepsilon^2}} \end{cases}$$ duas eq duas incog.

$t_s = 4\tau$ 1ª ordem

$= \dfrac{4}{\varepsilon \omega_n}$ 2ª ordem $\Rightarrow \tau = \dfrac{1}{\varepsilon \omega_n}$




$$\frac{4}{t_s} = \frac{\cancel{4}}{\cancel{4}\tau} = \frac{1}{\cancel{4}} \cdot \varepsilon \omega_n \cdot \cancel{4}$$

$$\frac{4}{t_s} = \frac{1}{\tau} = \varepsilon \omega_n$$

$$\varepsilon \omega_n = 0,571$$

$$y_{(t_p)} = 1 + e^{\frac{-\varepsilon\pi}{\sqrt{1-\varepsilon^2}}}$$

$$\frac{\omega_n^2}{s^2 + 2 \times 0,571 + \omega_n^2} = \frac{?\ 1,423}{s^2 + 1,143s + 1,423}$$

5C) $t_s = 7\ sec$ , $t_p = 3\ sec$ T.F = ?

Poles = ?

- From the specification of $t_s$ and $t_p$:

$$\begin{cases} t_s = \dfrac{4}{\xi \omega_n} \\ t_p = \dfrac{\pi}{\omega_n \sqrt{1-\xi^2}} \end{cases} \Leftrightarrow \begin{cases} 7 = \dfrac{4}{\xi \omega_n} \\ 3 = \dfrac{\pi}{\omega_n \sqrt{1-\xi^2}} \end{cases}$$

$$\begin{cases} \xi = 0{,}479 \\ \omega_n = 1{,}193 \ rad/sec \end{cases}$$

- Since $0 \leq \xi < 1 \rightarrow$ system is Underdamped:

Pair of complex conjugate poles:

$$\boxed{P_1, P_2 = -\xi\omega_n \pm j\omega_n \cdot \sqrt{1-\xi^2}}$$

$$P_1, P_2 = -0{,}57 \pm j\,1{,}05$$

- transfer Function:

$$\boxed{G(s) = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}} = \frac{1{,}423}{s^2 + 1{,}143 s + 1{,}423}$$

$$\boxed{\xi = \sqrt{\frac{1}{1 + \frac{\pi^2 t_s^2}{t_p^2 4^2}}} = \sqrt{\frac{1}{1 + \left(\frac{\pi t_s}{4 t_p}\right)^2}}}$$

$M_p = 18\%$

$t_p = 3$

$\omega_d = 1{,}047$

$t_r = 1{,}977$