VIDEO 1

$$G(S) = \frac{20(S+5)}{S(S+1)(S+4)} \quad \begin{cases} OS\% = 9{,}5\% \\ ts = 0{,}745 seg \end{cases}$$

$$U(S) \longrightarrow \boxed{\frac{1}{S^3+5S^2+4S}} \xrightarrow{X_1(S)} \boxed{OS^2+20S+100} \longrightarrow Y(S)$$

$$\frac{X_1(S)}{U(S)} = \frac{1}{S^3+5S^2+4S}$$

$$(S^3+5S^2+4S)X_1(S) = U(S)$$

$$\dddot{X}_1 + 5\ddot{X}_1 + 4\dot{X}_1 = U$$

$\dddot{X}_1 \rightarrow \dot{X}_3$, $5\ddot{X}_1 \rightarrow 5\dot{X}_3$, $4\dot{X}_1 \rightarrow 4X_2$

$$\begin{cases} X_1 = X_1 \\ X_2 = \dot{X}_1 \\ X_3 = \dot{X}_2 = \ddot{X}_1 \\ \dot{X}_3 = \dddot{X}_1 \end{cases}$$

$$\dot{X}_3 = -5X_3 - 4X_2 + U \quad (1)$$

$$Y(S) = (b_2S^2 + b_1S + b_0)X_1(S)$$

$$= OS^2 + 20S + 100)X_1(S)$$

$$= (20S + 100)X_1(S)$$

$$= 20\dot{X}_1 + 100X_1 \Rightarrow y = 20X_2 + 100X_1 \quad (2)$$

$\dot{X}_1 \rightarrow X_2$, $X_1 \rightarrow X_1$

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -4 & -5 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} U$$

$$y = \begin{bmatrix} 100 & 20 & 0 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix}$$

$$\%OS = e^{-(\zeta\pi/\sqrt{1-\zeta^2})} \times 100$$

$$0{,}095 = e^{-(\zeta\pi/\sqrt{1-\zeta^2})}$$

$$\ln(0{,}095) = \ln\left(e^{-(\zeta\pi/\sqrt{1-\zeta^2})}\right)$$

$$-2{,}3539 = \frac{-\zeta\pi}{\sqrt{1-\zeta^2}} \longrightarrow (2{,}3539)^2\left(\sqrt{1-\zeta^2}\right)^2 = (\zeta\pi)^2$$

$$5{,}5407(1-\zeta^2) = \zeta^2\pi^2$$

$$5{,}5407 - 5{,}5407\zeta^2 = \zeta^2\pi^2$$

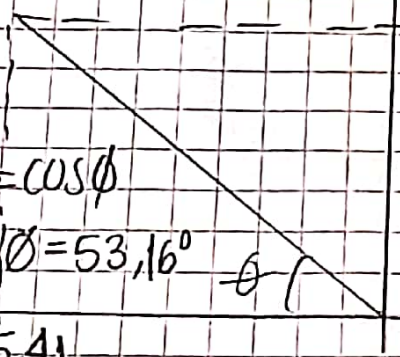
$$5{,}5407 = \zeta^2\pi^2 + 5{,}5407\zeta^2$$

$$5{,}5407 = \zeta^2(\pi^2 + 5{,}5407)$$

$$\zeta^2 = \frac{5{,}5407}{\pi^2 + 5{,}5407}$$

$$\zeta = 0{,}5996$$

S-PLANE



$$\zeta = \cos\phi$$

$$\phi = 53{,}16^\circ$$

$$s = \sigma + j\omega d$$

$$\omega d\,\sigma = \zeta\omega n$$

$$ts = 0{,}74$$

$$\sigma = \frac{4}{0{,}74}$$

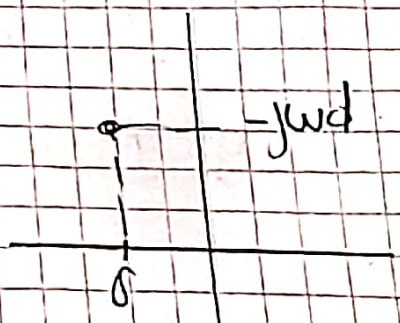
$$\sigma = 5{,}405$$

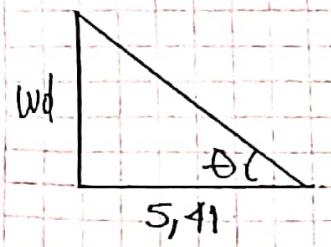
$$\sigma = \zeta\omega n$$

$$5{,}405 = 0{,}5996\,\omega n \longrightarrow \omega n = 9{,}02$$

$$\cos d(0{,}5996) = 53{,}158$$

$$ts = \frac{4}{\sigma}$$





$$\tan\phi = \frac{Wd}{5,41}$$

$$\tan(53,16) \times 5,41 = Wd$$

$$Wd = 7,21$$