

5b)

$$M_p = 17\%, t_p = 0,5 \text{ sec}$$

T.F = ?

Poles = ?

- From the specification of M_p

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

$$0,17 = e^{-\frac{\pi \xi}{\sqrt{1-\xi^2}}} \Rightarrow \xi = 0,491$$

- From the specification of t_p (peak time):

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

$$0,5 = \frac{\pi}{\omega_n \sqrt{1-\xi^2}} \Rightarrow \omega_n = 7,21 \text{ rad/sec}$$

- Since $0 \leq \xi < 1$ (system is underdamped):

A pair of conjugate poles:

$$p_1, p_2 = -\xi \omega_n \pm j \omega_n \sqrt{1-\xi^2}$$

$$p_1, p_2 = -3,54 \pm j 6,28$$

- Transfer Function:

$$G(s) = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2} = \frac{52}{s^2 + 7,1s + 52}$$