Adda247

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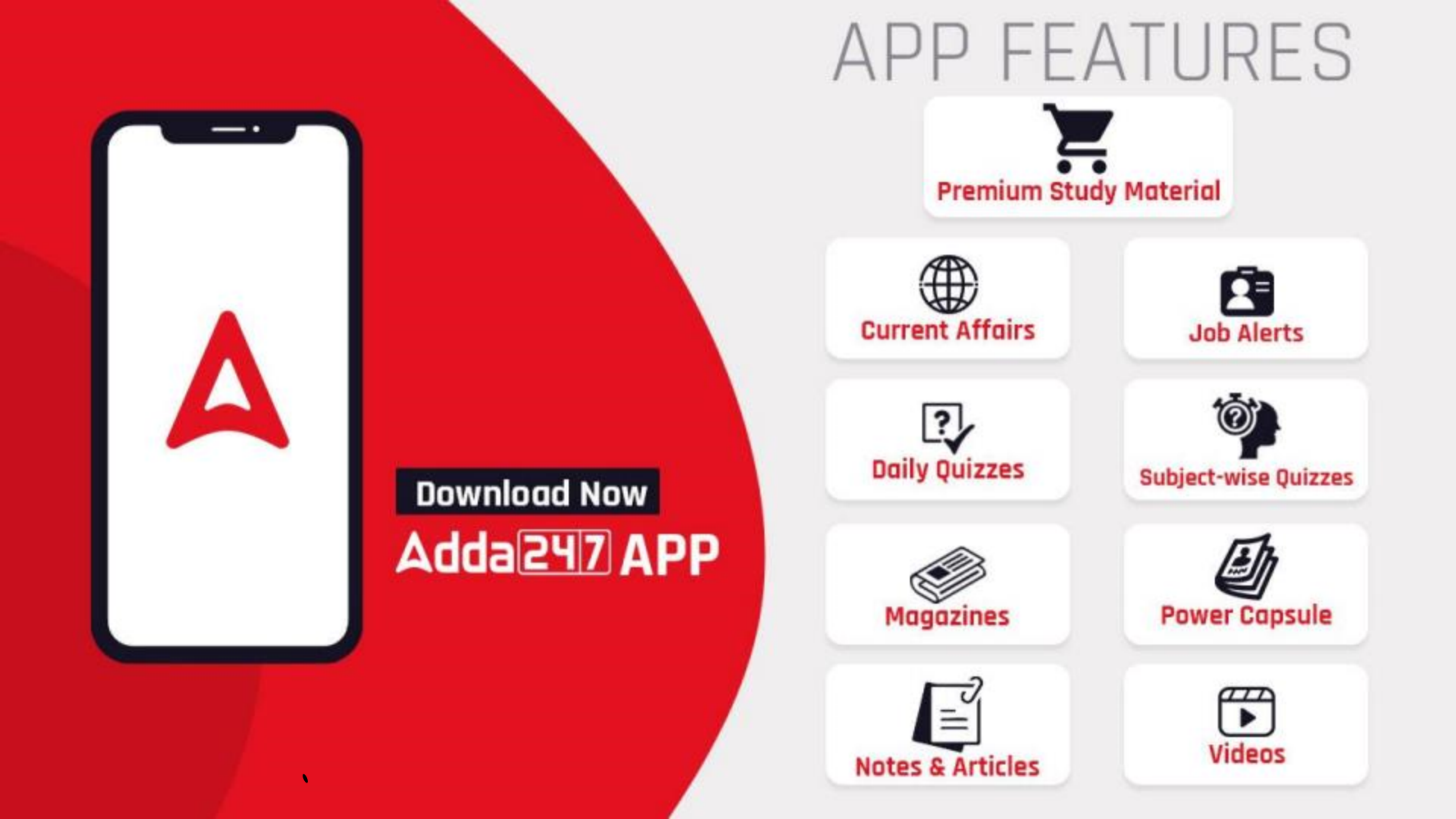
Belief creates the actual fact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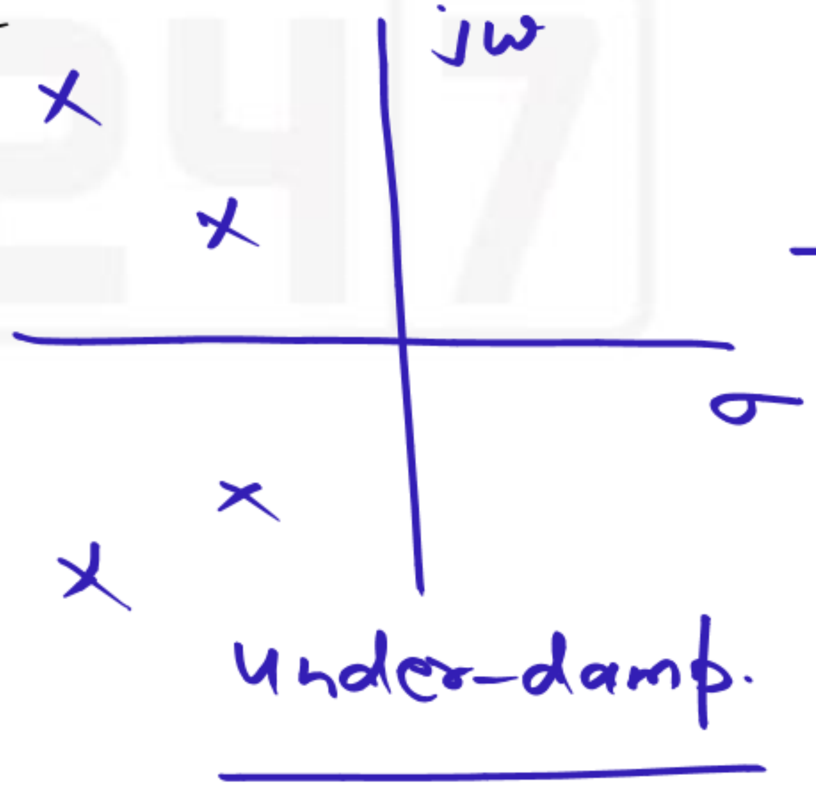
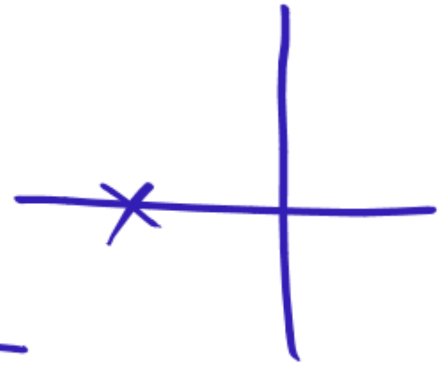
Control system

underdamped system

$$s^2 + 2\zeta\omega_n s + \omega_n^2 = 0$$

$\zeta < 1$

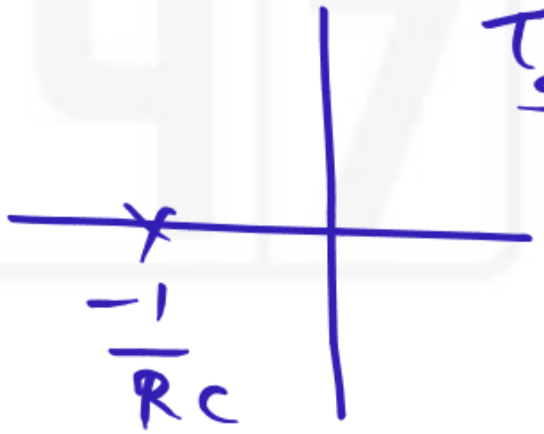




$G(s) \to \dfrac{1}{\underbrace{2}_{\tau}s+1}$

$\dfrac{1}{\underbrace{5RC}_{T}+1}$

$T_s \to \dfrac{1}{|\text{real part of the pole}|}$



$T_s = 4RC$ — 98%

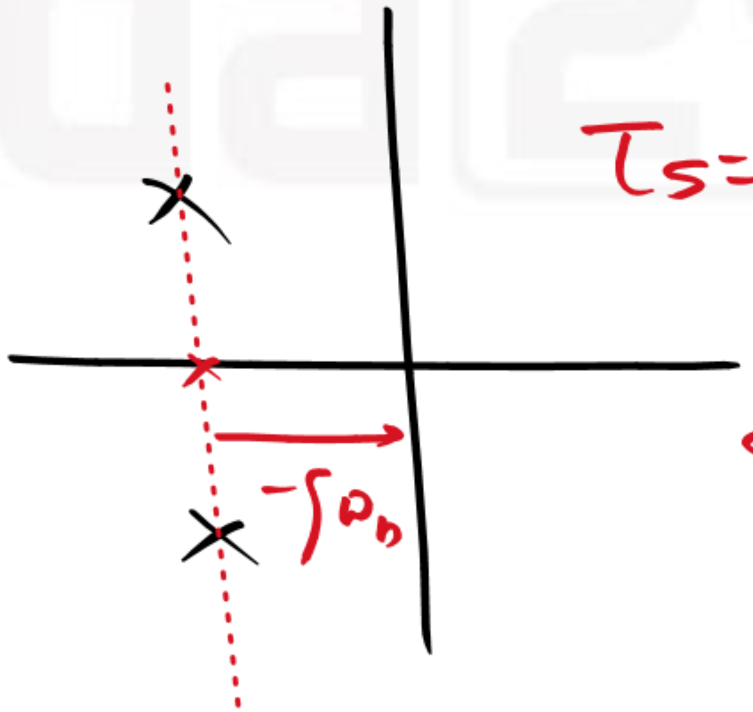
$= 5RC \to 99\%$

$= 3RC \to 95\%$

$T_s \to \dfrac{1}{|-1/RC|} \to RC$

Char. eq^n $\rightarrow$ $s^2 + 2\zeta\omega_n s + \omega_n^2 = 0$

$s_1, s_2 \rightarrow -\zeta\omega_n \pm j\omega_n\sqrt{1-\zeta^2}$



$\tau_s = \frac{1}{|-\zeta\omega_n|} = \frac{1}{\zeta\omega_n}$

settling time $= 4\tau_s = \frac{4}{\zeta\omega_n}$

(i) $\zeta < 1 \rightarrow$ underdamp

(ii) $\zeta = 0$

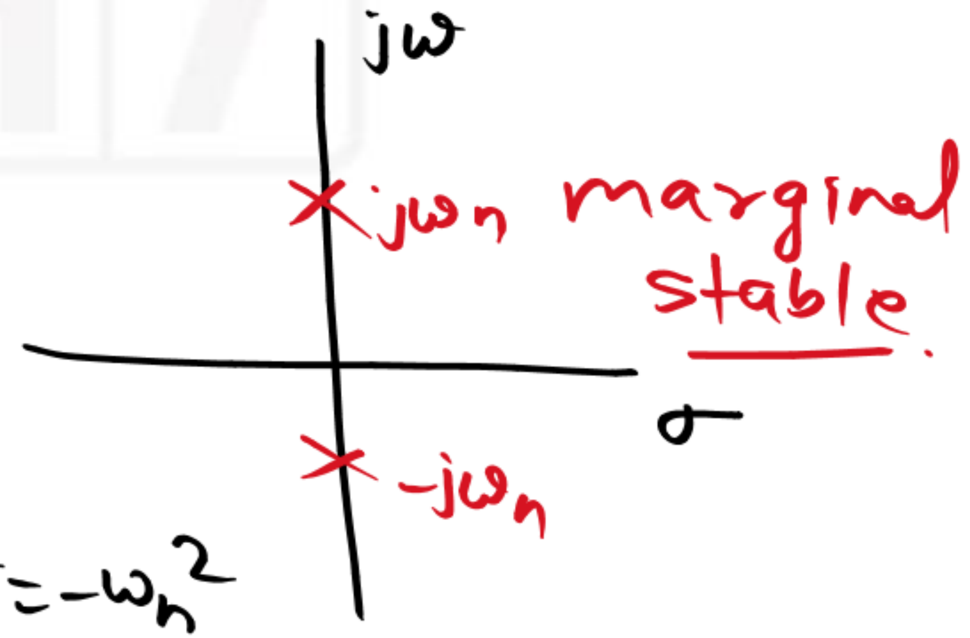
$$\frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

$\zeta = 0$

$$\frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2 + \omega_n^2}$$

$$s^2 + \omega_n^2 = 0 \Rightarrow s^2 = -\omega_n^2$$

$$s = \pm\sqrt{-\omega_n^2} = \pm j\omega_n$$



type of damping

$\zeta = 0$

$$\frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2+\omega_n^2}$$

$$c(t) = [1-\cos(\omega_n t)]$$

$\zeta < 1$

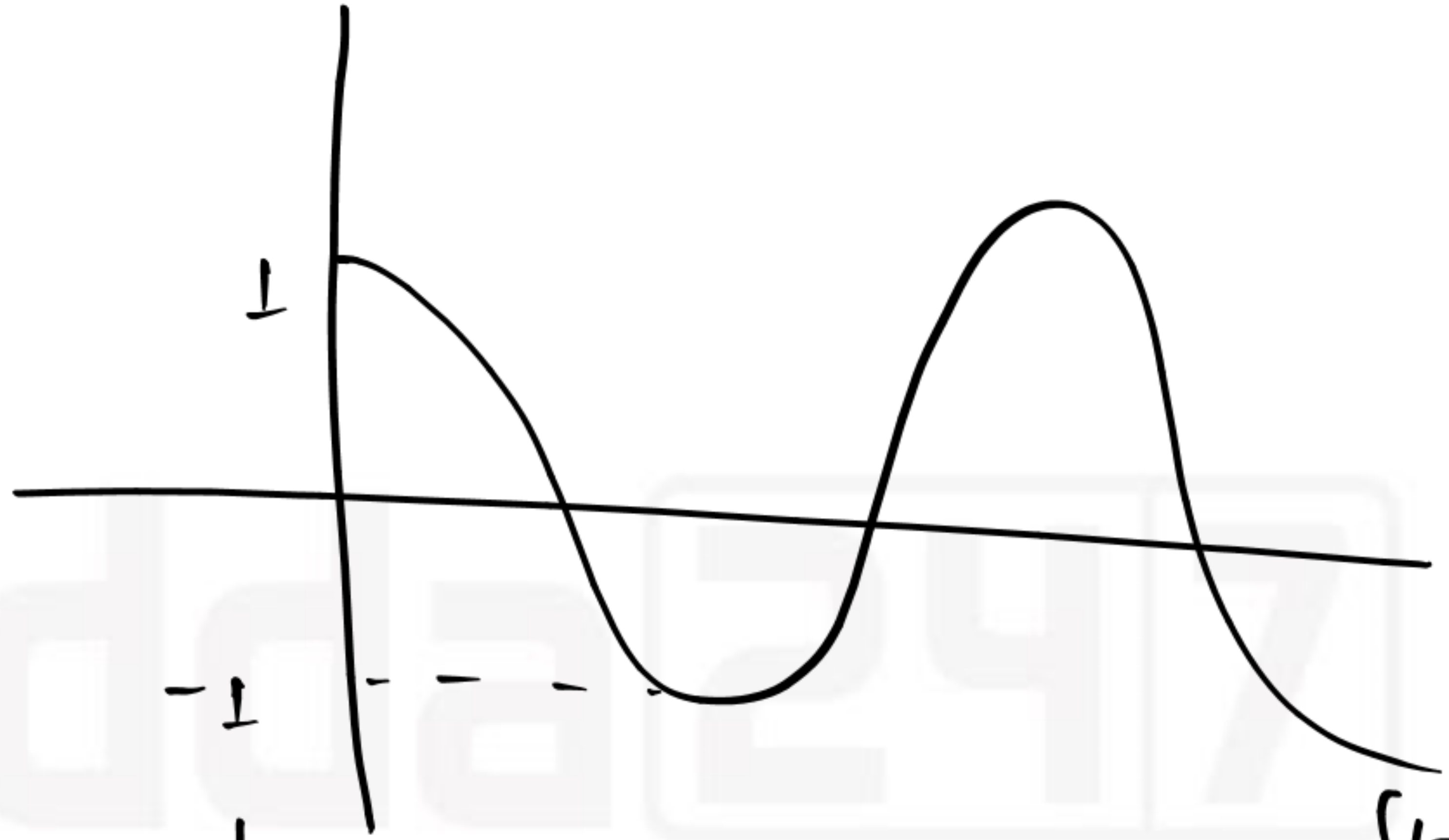
$$c(t) = 1 - \frac{e^{-\zeta\omega_n t}}{\sqrt{1-\zeta^2}}\left(\sin\left(\omega_n\sqrt{1-\zeta^2}\,t + \tan^{-1}\frac{\sqrt{1-\zeta^2}}{\zeta}\right)\right)$$

$\zeta = 0$

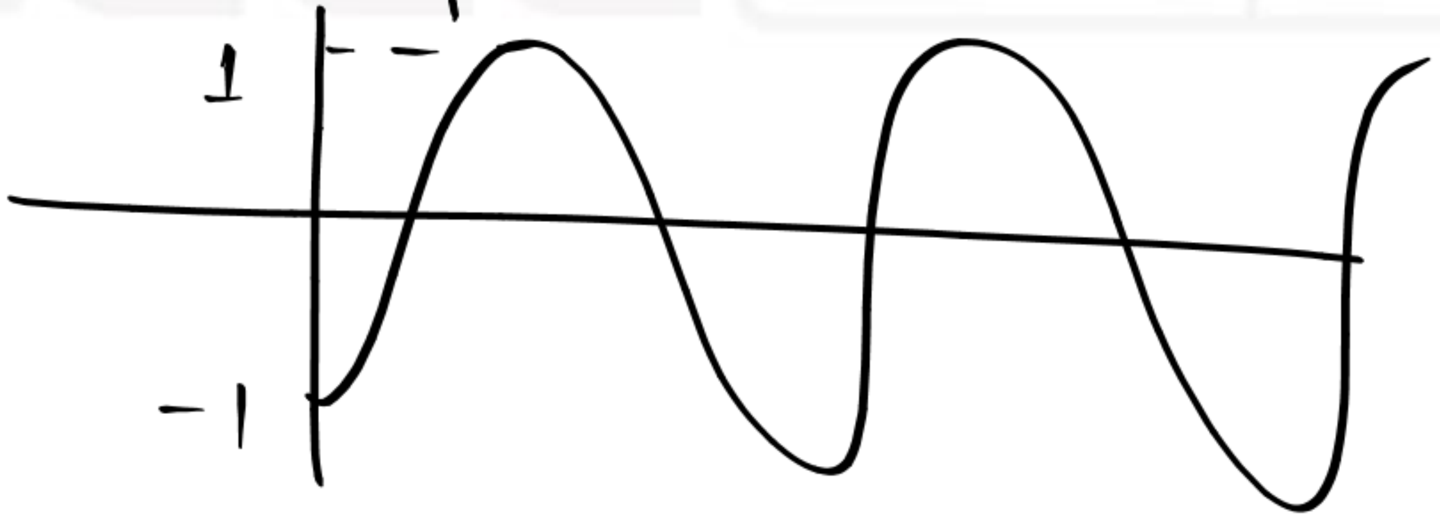
$$c(t) = 1 - \sin[\omega_n t + 90^\circ]$$

$$c(t) = (1-\cos\omega_n t)u(t)$$

$\cos \omega_n t$

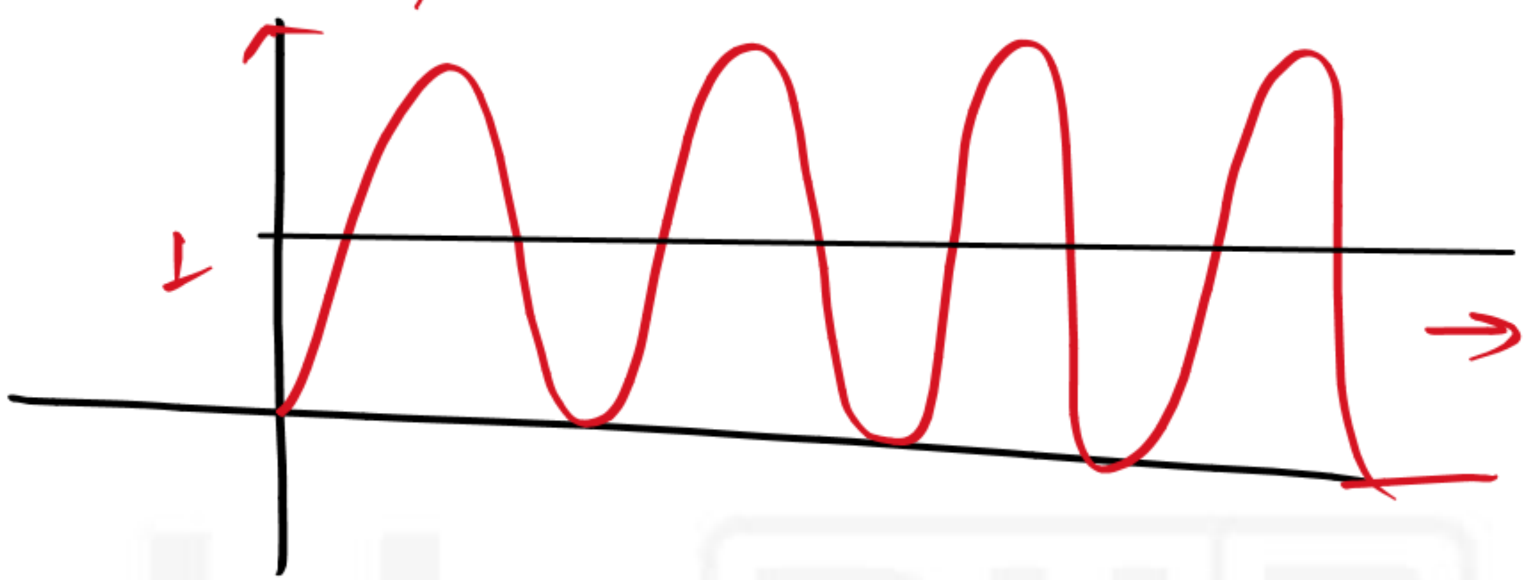


$-\cos \omega_n t$

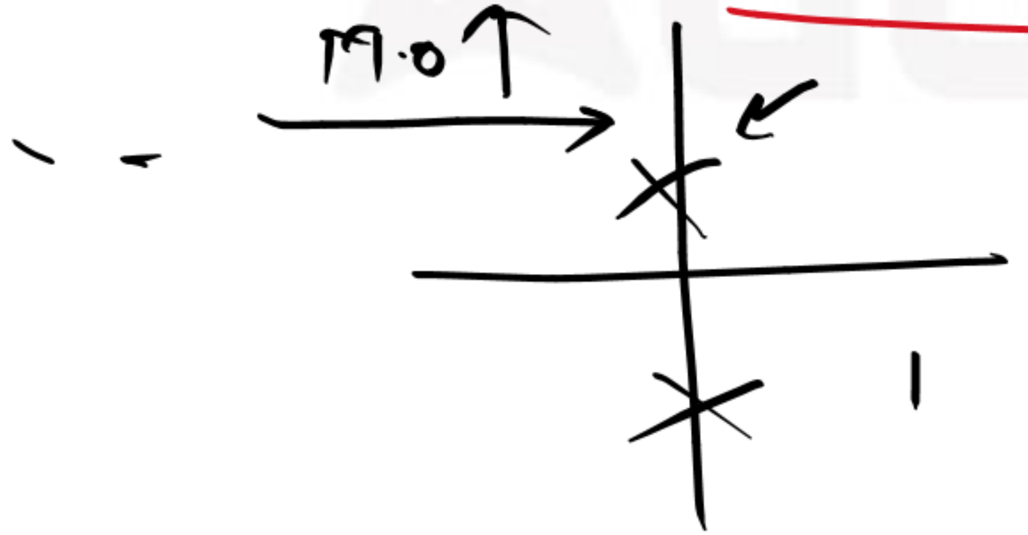


$(1-\cos \omega_n t)$

$\zeta = 0$



undamped

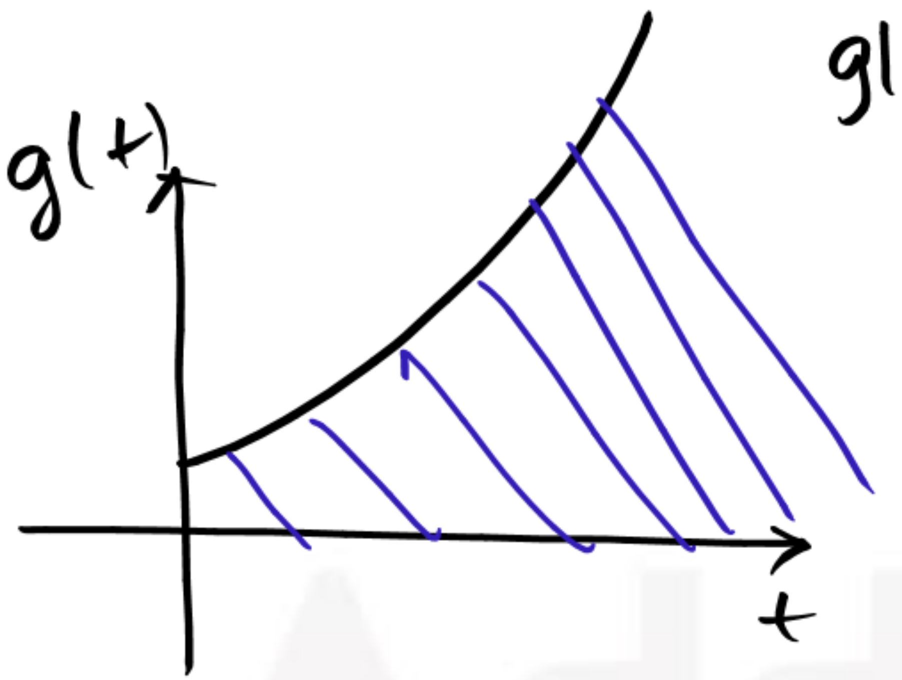


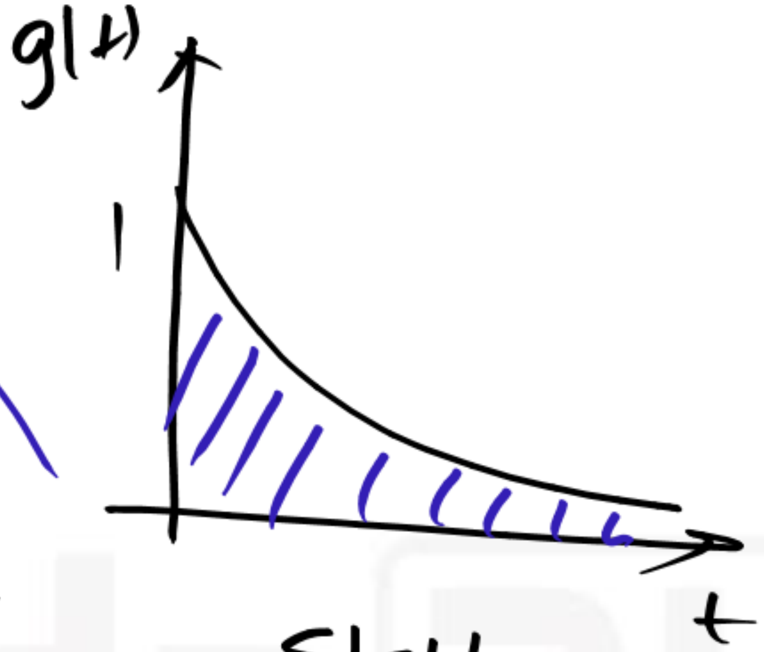
Max^m overshoot → ?

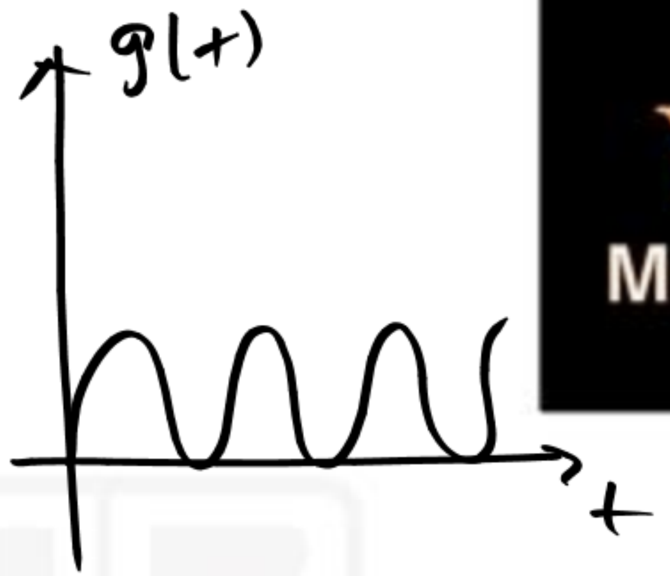
M.O → $e^{\frac{-\zeta\pi}{\sqrt{1-\zeta^2}}} \times 100 = 100\%$

$$M.O = \frac{c(t)_{max} - c(t)_{des}}{c(t)_{des}} = \frac{2-1}{1} \times 100$$

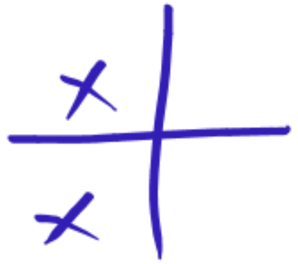
$= 100\%$

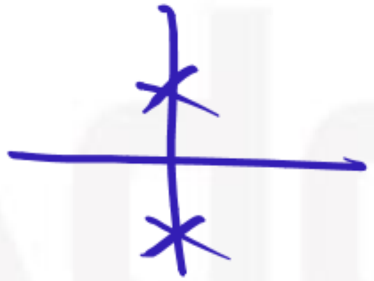






unstable	Stable	marginal stable.
$g(t) \to \infty \quad t \to \infty$	$g(t) \neq \infty$ at any t.	$g(t) \neq \infty$ at any t
$\int \lvert g(t) \rvert dt = \infty$	$\int g(t) dt < \infty$	$\int \lvert g(t) \rvert dt = \infty$
unst.	Stable	marginal stable

$\zeta < 1$  → underdamped

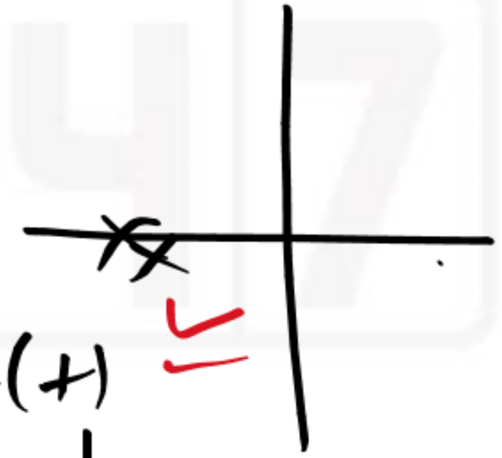
$\zeta = 0$  → marginal stable / undamped

$\zeta = 1$ →  → critically damped

$\zeta = 1$

* $\dfrac{C(s)}{R(s)} = \dfrac{\omega_n^2}{s^2 + 2\omega_n s + \omega_n^2}$

$\Rightarrow \dfrac{\omega_n^2}{(s+\omega_n)^2}$



for unit step I/p

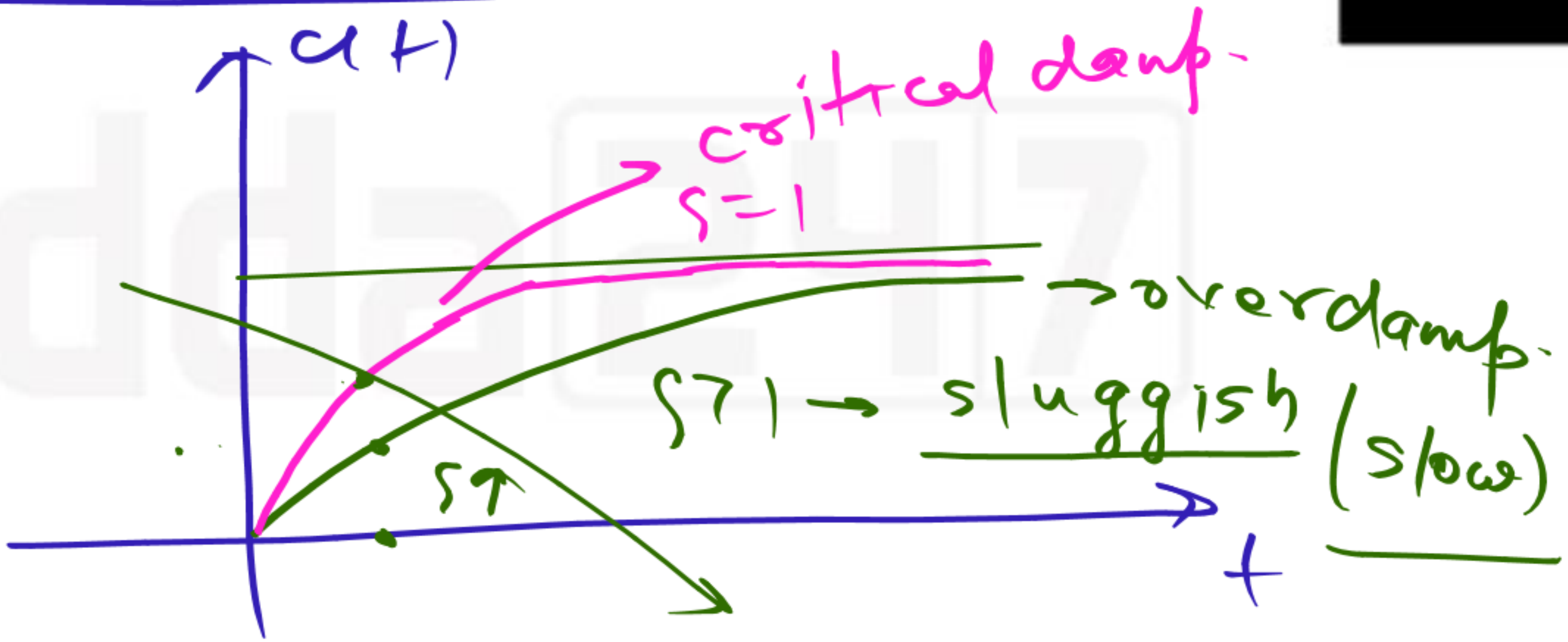
$C(s) = \dfrac{1}{s} \times \dfrac{\omega_n^2}{(s+\omega_n)^2}$

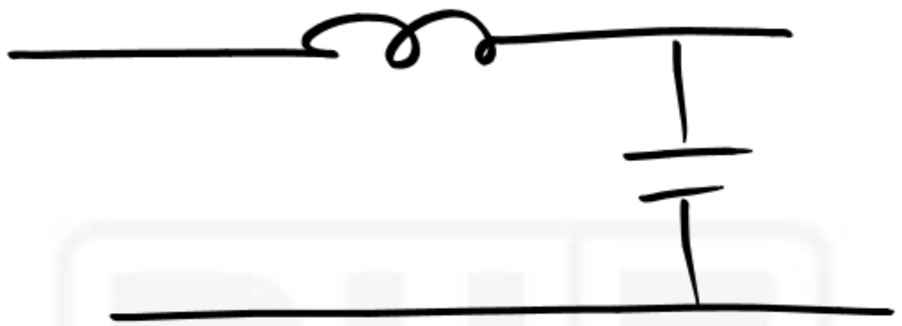
$\zeta > 1$

overdamped system

$$\zeta = \frac{R}{2}\sqrt{\frac{C}{L}}$$

$R \rightarrow \zeta$





$$\frac{V_o(s)}{V_i(s)} = \frac{1/Cs}{R+Ls+\frac{1}{Cs}}$$

$$\frac{V_o(s)}{V_i(s)} = \frac{\frac{1}{Cs}}{sL+\frac{1}{Cs}} \Rightarrow \frac{1}{LCs^2+1} \Rightarrow \frac{1/LC}{s^2+\frac{1}{LC}}$$

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Watching

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