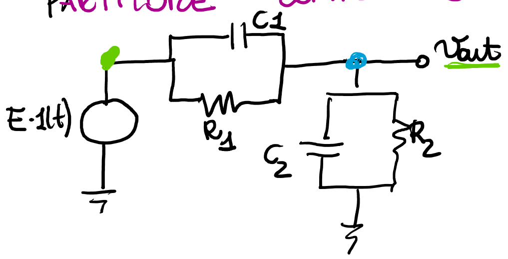
Richiami di elettrotecnica: analisi di circuiti a singola costante di tempo nel dominio del tempo e della frequenza

giovedì 25 febbraio 2021 10:23

PARTITORE COMPENSATO

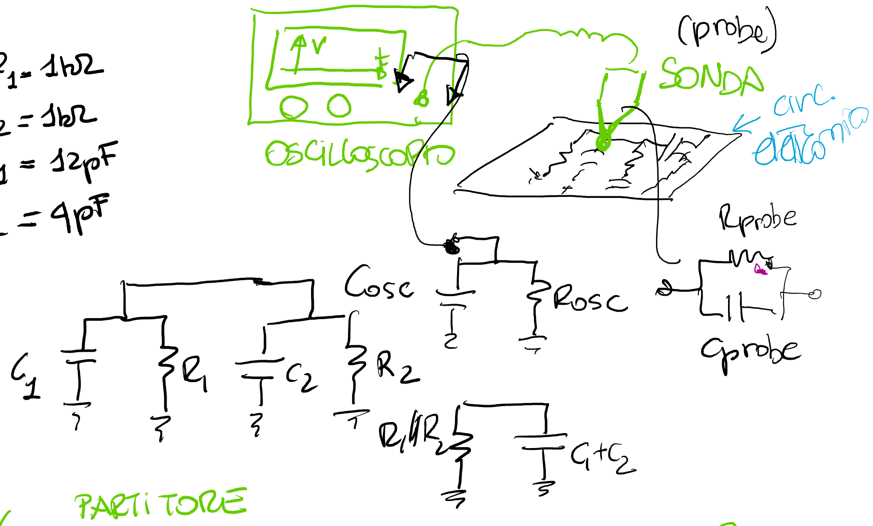


$R_1 = 1k\Omega$

$R_2 = 1k\Omega$

$C_1 = 12pF$

$C_2 = 4pF$

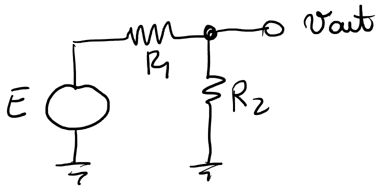


$$\tau = (C_1 + C_2)(R_1 // R_2) = 8\,ms$$

PARTITORE SOVRA COMPENSATO

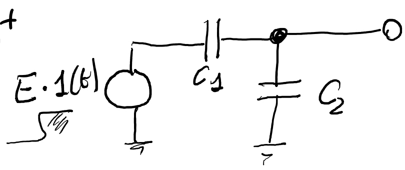
$$\frac{C_1}{C_1+C_2} > \frac{R_2}{R_1+R_2}$$

$t \to \infty$



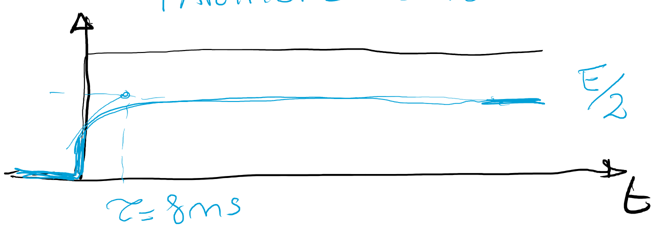
$$V_{out} = \frac{R_2}{R_1+R_2} E$$

$t = 0^+$



$$V_{out}(0^+) = \frac{C_1}{C_1+C_2} \cdot E = \frac{12}{16} E = \frac{3}{4} E$$

PARTITORE SOTTOCOMPENSATO



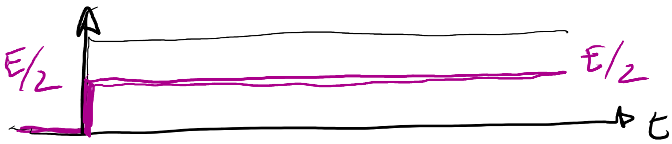
$C_1 = 4pF$ $R_1 = 1k\Omega$

$C_2 = 12pF$ $R_2 = 1k\Omega$

$$\frac{C_1}{C_1+C_2} < \frac{R_2}{R_1+R_2}$$

$$V_{out}(0^+) = \frac{C_1}{C_1+C_2} E = \frac{E}{4}$$

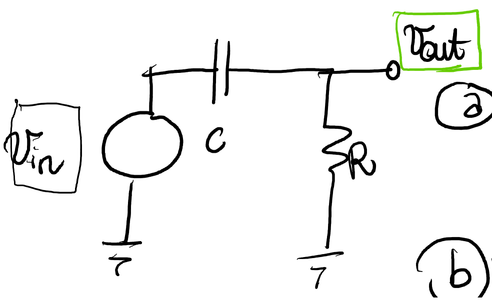
PARTITORE COMPENSATO

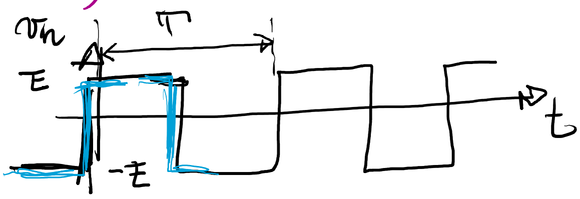


$$\frac{C_1}{C_1+C_2} \cancel{E} = \frac{R_2}{R_1+R_2} \cancel{E}$$

$$C_1 R_1 = C_2 R_2$$

ESERCIZIO: Risposta di un circuito CR all'onda quadra





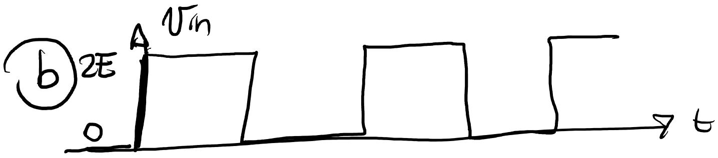
$T = 10\,ms$

$E = 1V$

$T = 10\,ms$

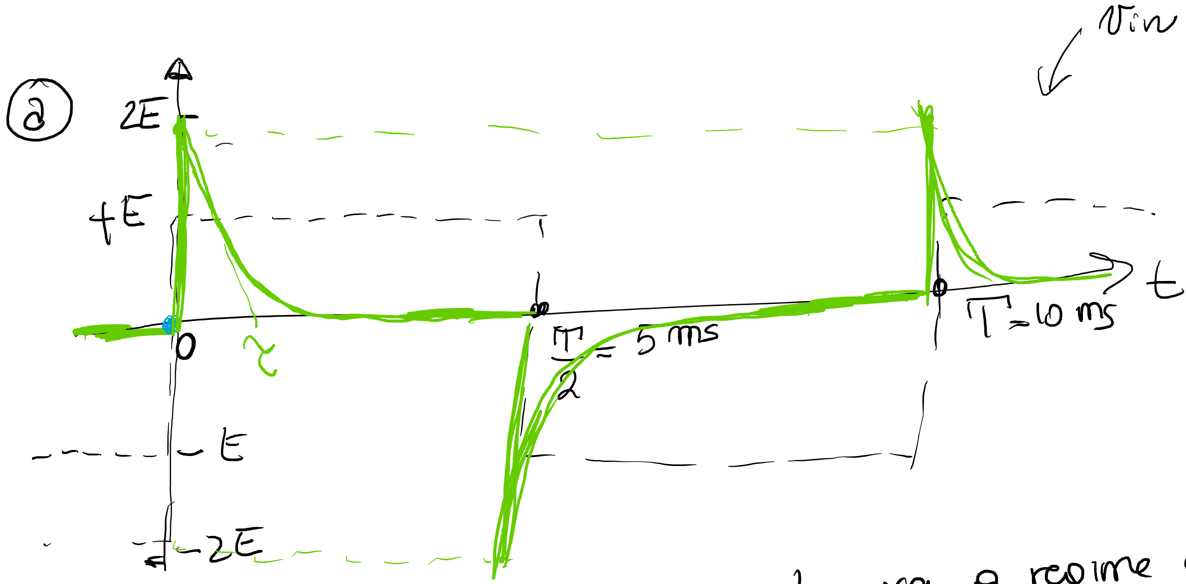
$R = 2k\Omega$

$C = 100 pF$

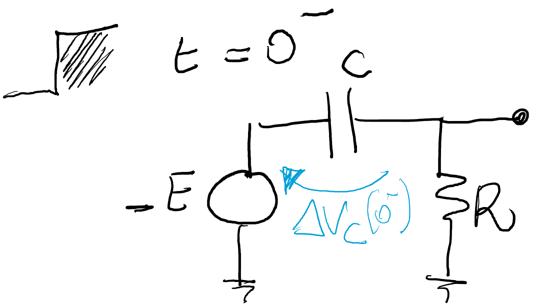


$T = 10 ms$

ⓒ $T = 400 ms$ come in ⓐ

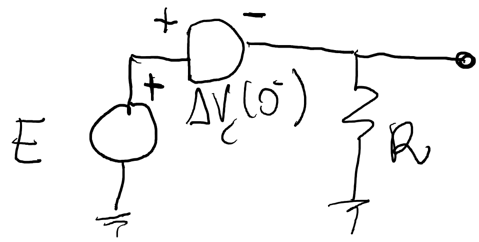


$\tau = CR = 200 ms \ll \frac{T}{2}$ circuito va a regime entro ogni frazione del periodo

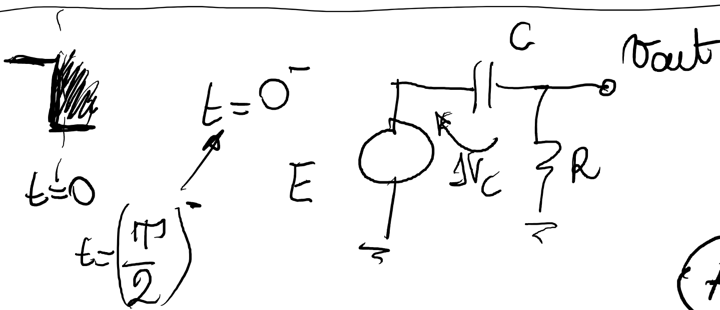


$\Delta V_c(0^-) = -E$

$t = 0^+$ $\Delta V_c(0^+) = \Delta V_c(0^-)$

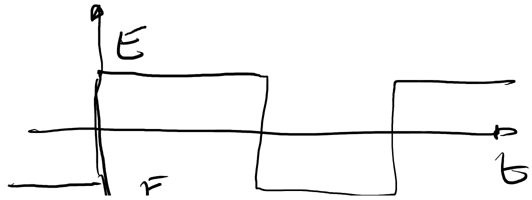


$v_{out}(0^+) = 2E$

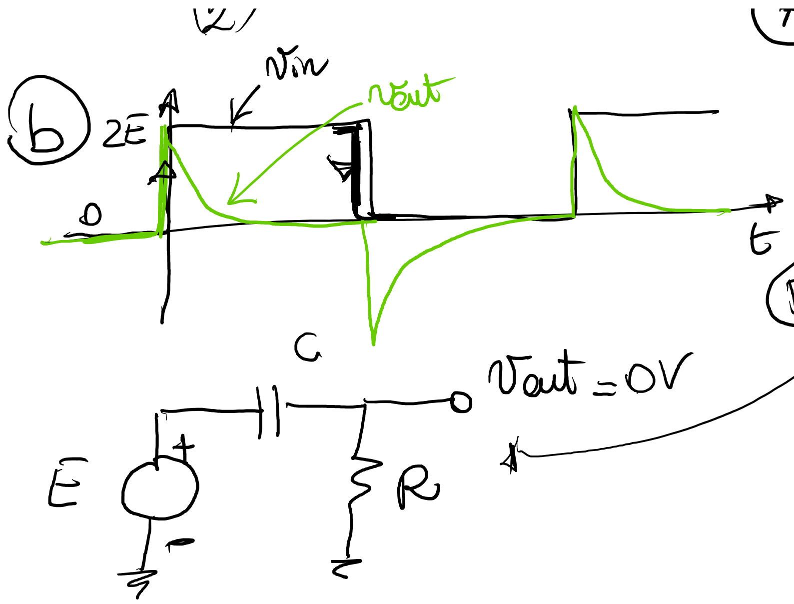


$\Delta V_c(0^-) = E$

Ⓐ



v_{in} v_{out}



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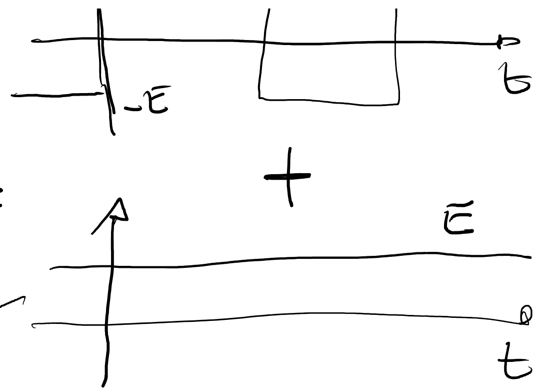
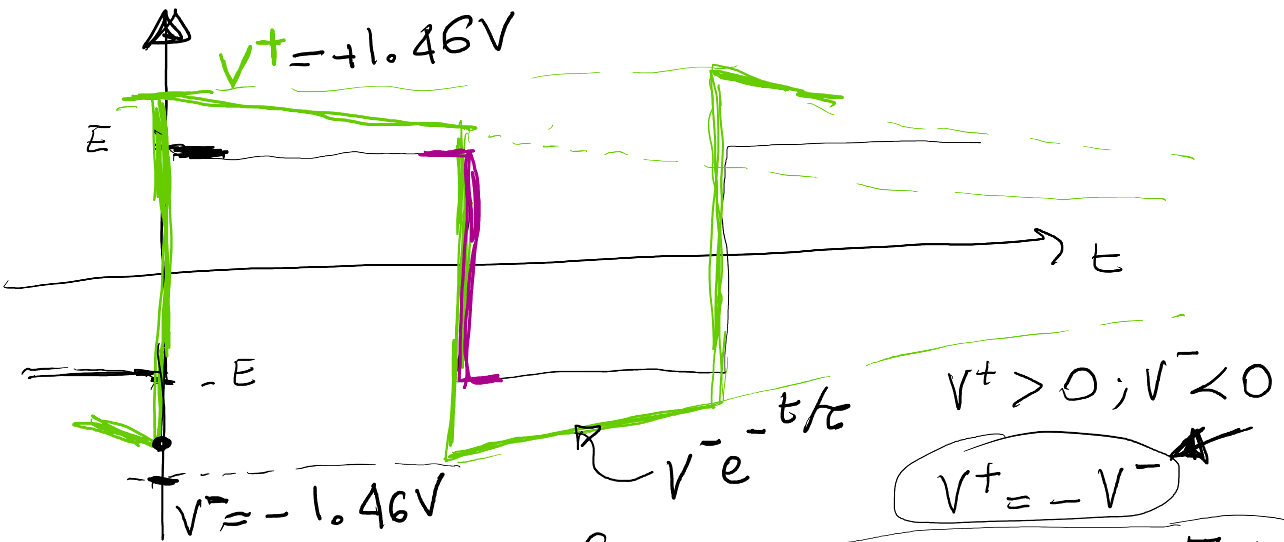


(c) $T = 400\,ms$

$\frac{T}{2} = 200\,ms$

$\tau = 200\,ms$

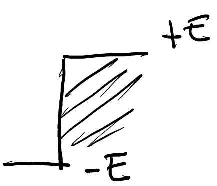
$\tau = \frac{T}{2}$ il circuito non va a regime in ogni frazione del periodo



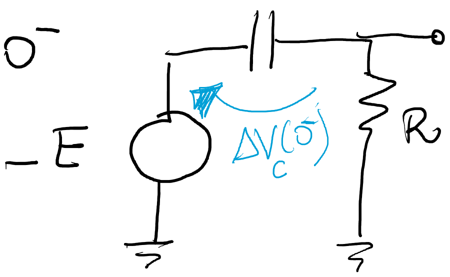
$V^+ > 0 ; V^- < 0$

$V^+ = -V^-$

$v_{out} = -V^- \exp\left(-\frac{T}{2}/\tau\right)$

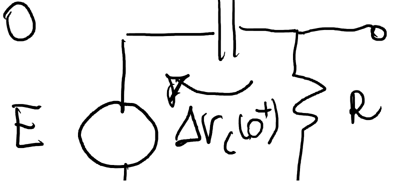


$t = 0^-$



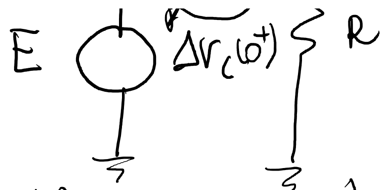
$\Delta V_c(0^-) = -E - V^- \exp\left(-\frac{T}{2}/\tau\right)$

$t = 0^+$



$v_{out} = V^+$

$\Delta V_c(0^+) = E - V^+$

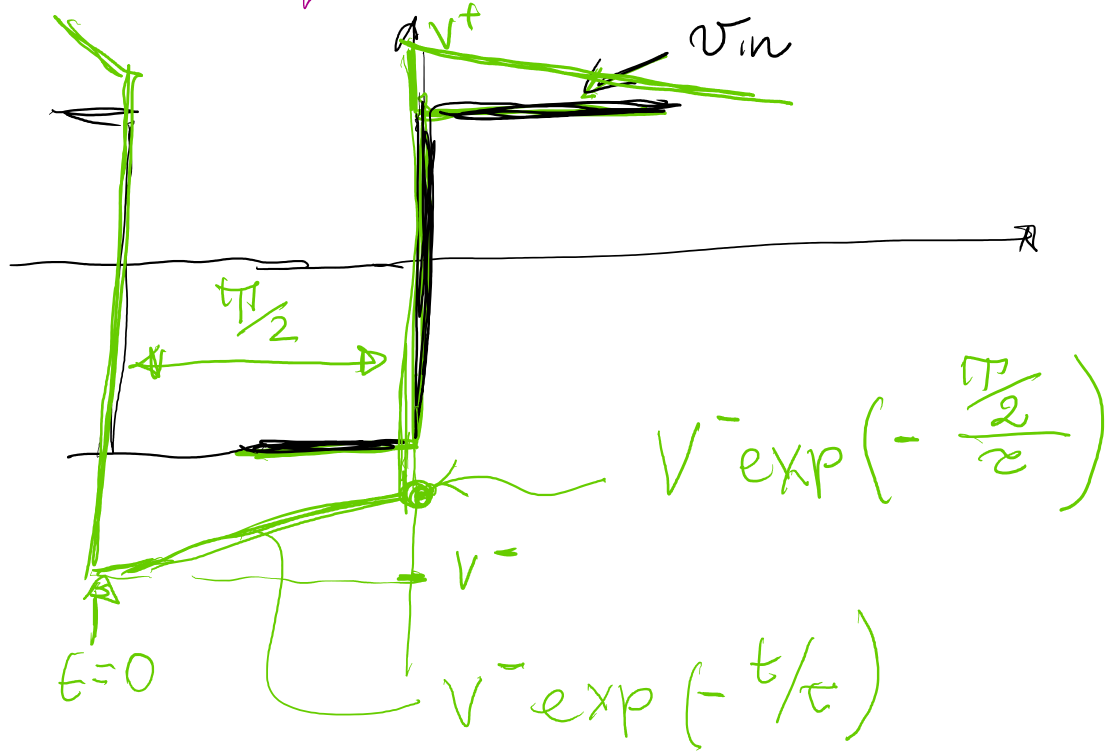


$$\Delta V_c(0^+) = E - V$$

$$\Delta V_c(0^+) = \Delta V_c(0^-) \Rightarrow E - V^+ = -E - V^- \exp\left(-\frac{\pi}{2}/\tau\right)$$

$$E - V^+ = -E + V^+ \exp\left(-\frac{\pi}{2}/\tau\right)$$

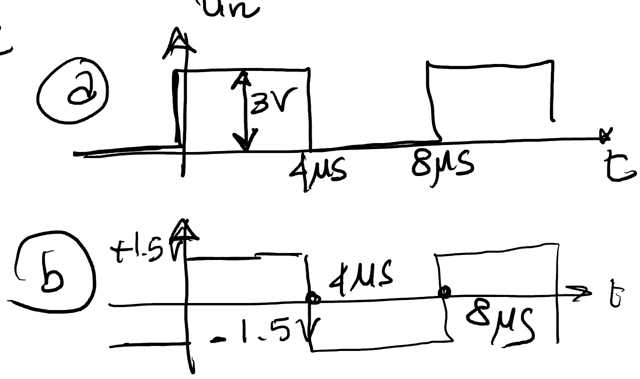
$$V^+ = +1.46V = -V^-$$



PROPOSTA DI ESERCIZIO

$R_1 = 2k$ $R_3 = 3k$

$R_2 = 6k$ $C = 50\,pF$



RETI IN REGIME SINUSOIDALE - ANALISI NEL DOMINIO DELLA FREQUENZA

$$g(t) = \sqrt{2}\, A_{eff} \sin(\omega t + \varphi)$$

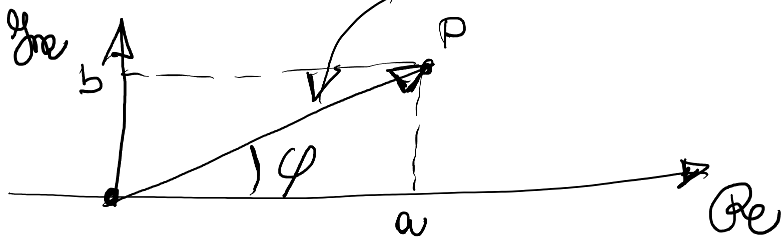
A_{eff}: ampiezza efficace; ω: pulsazione; φ: fase

$$\omega = 2\pi f = \frac{2\pi}{T}$$

f: frequenza; T: periodo

$$\bar{A} = A_{eff}\, e^{j\varphi}$$

FASORE



$$A_{eff} = \sqrt{a^2 + b^2}$$

$$\varphi = \mathrm{atan}\left(\frac{b}{a}\right)$$

- RESISTENZA $\quad v(t) = R\, i(t) \qquad \bar{V} = R\, \bar{I}$

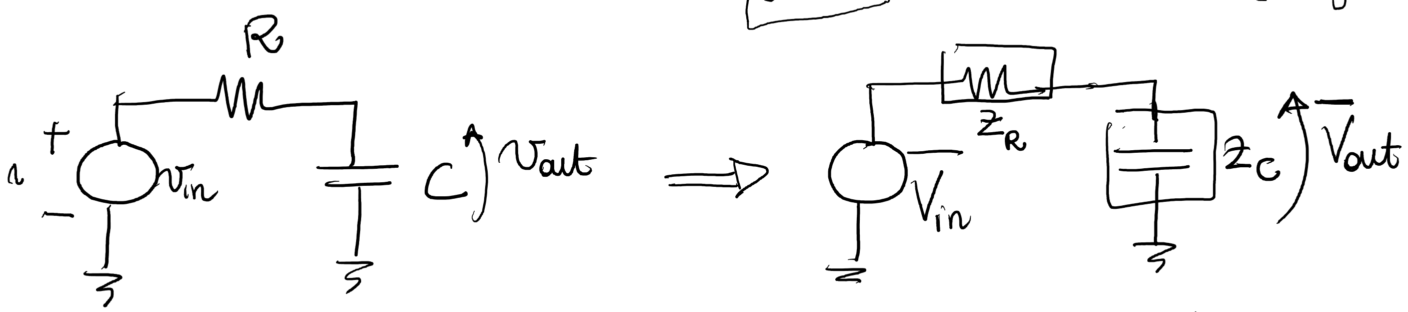
- CONDENSATORI $\quad i(t) = C \dfrac{dv(t)}{dt}$

$$v(t) = \sqrt{2}\, V_{eff} \sin(\omega t + \varphi)$$

$$i(t) = C \sqrt{2}\, V_{eff}\, \omega \sin\left(\omega t + \varphi + \frac{\pi}{2}\right)$$

$$\bar{I} = j\omega C \bar{V} \Rightarrow \bar{V} = \boxed{\frac{1}{j\omega C}}\, \bar{I}$$

$$Z(\omega) = \frac{\bar{V}}{\bar{I}} = \frac{1}{j\omega C}$$



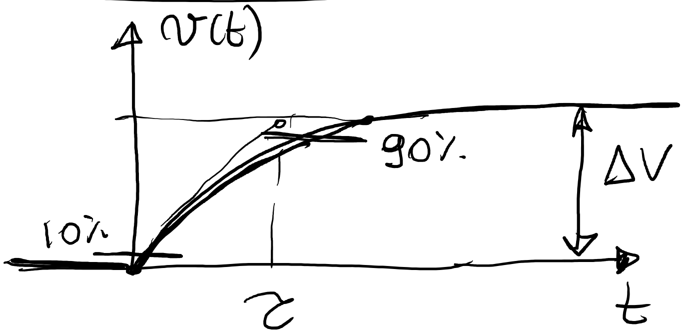
$$Z_R = R \qquad Z_C = \frac{1}{j\omega C}$$

$$\overline{V}_{out} = \frac{Z_C}{Z_C + Z_R} \overline{V}_{in}$$

FUNZIONE DI TRASFERIMENTO

$$T(j\omega) = \frac{\overline{V}_{out}}{\overline{V}_{in}} = \frac{1/j\omega C}{1/j\omega C + R} = \frac{1}{1 + j\omega CR}$$

numero complesso → modulo, fase



$$v(t) = \Delta V \left[1 - \exp\left(-t/\tau\right)\right]$$

RISE TIME

$$t_{rise\ 10\% - 90\%} = 2.2\,\tau$$