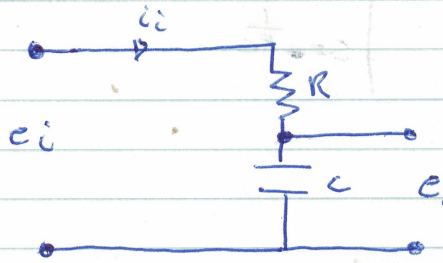
Circuito RC



$$\begin{cases} e_i = R_i \times i_i + \int \frac{1}{C} \times i_i \\ e_o = \int \frac{1}{C} \times i_i \end{cases}$$

$\frac{e_o}{e_i} = ?$

$$E_i(S) = R\, I(S) + \frac{1}{C} \cdot \frac{1}{S} I(S)$$

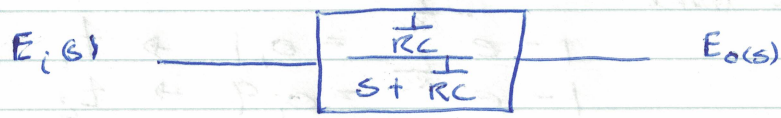
$$E_o(S) = \frac{1}{C} \frac{1}{S} I(S)$$

$$\frac{E_o(S)}{E_i(S)} = \frac{\frac{I(S)}{SC}}{R_i I(S) + \frac{I(S)}{SC}} \times \frac{SC}{I(S)} \times \frac{SC}{I(S)}$$

$$= \frac{1}{RCS + 1}$$

$$= \frac{1}{1 + RCS} \times \frac{\frac{1}{RC}}{\frac{1}{RC}}$$

$$= \frac{\frac{1}{RC}}{\frac{1}{RC} + S} = \frac{\frac{1}{RC}}{S + \frac{1}{RC}}$$



if $e_i = 1$ volt $\Rightarrow F_{i(S)} = \frac{1}{S}$

$$E_{o(S)} = \frac{1}{S} \times \frac{\frac{1}{RC}}{\frac{1}{RC} + S} = \frac{A}{S} + \frac{B}{S + \frac{1}{RC}}$$

$$A = \frac{\frac{1}{RC}}{S(S + \frac{1}{RC})} \cdot S \Big|_{S=0} = 1$$

$$B = \left.\frac{\frac{1}{RC}}{s(s+\frac{1}{RC})}\cdot(s+\frac{1}{RC})\right|_{s=-\frac{1}{RC}}$$

$$= \frac{\frac{1}{RC}}{-\frac{1}{RC}} = -1$$

$$\therefore \quad E_o(s) = \frac{1}{s} + \frac{-1}{s+\frac{1}{RC}}$$

$$\Rightarrow \quad \mathcal{L}^{-1}$$

$$e_o(t) = 1 - e^{-\frac{1}{RC}t} \quad ; \tau = RC \; ; \; t \geq 0$$

$$K = \lim_{s\to 0} \frac{E_o(s)}{E_i(s)} = \lim_{s\to 0} \frac{\frac{1}{RC}}{s+\frac{1}{RC}}$$

$$= 1$$

$\tau = ?$ $\quad e_o(t) = \frac{1}{e^1} - 1$

$$e^{-\frac{1}{RC}t} = e^{-1}$$

$$-\frac{t}{RC} = -1 \Rightarrow t = RC = \tau$$

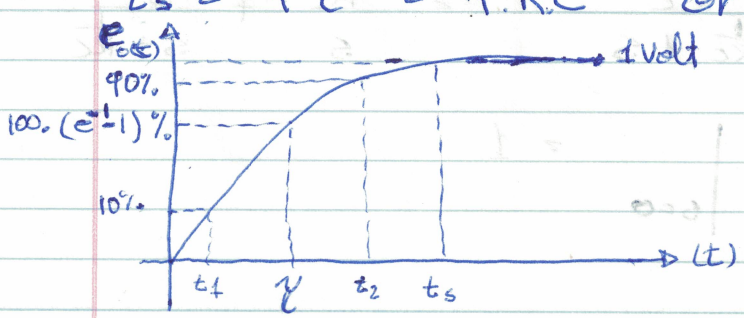
$t_r = ?$ rise time

$$1 - e^{-\frac{t}{RC}} = 0,1 \rightarrow t_1$$
$$1 - e^{-\frac{t}{RC}} = 0,9 \rightarrow t_2$$

$$t_r = t_2 - t_1$$

$t_s = ?$ setting time

$t_s = 4\tau = 4.RC$ or $|e_o(t_s) - 1| = \tau$



$$(1 - e^{-\frac{t_s}{RC}}) - 1 = RC$$
$$-\frac{1}{RC} t_s = \ln(RC)$$