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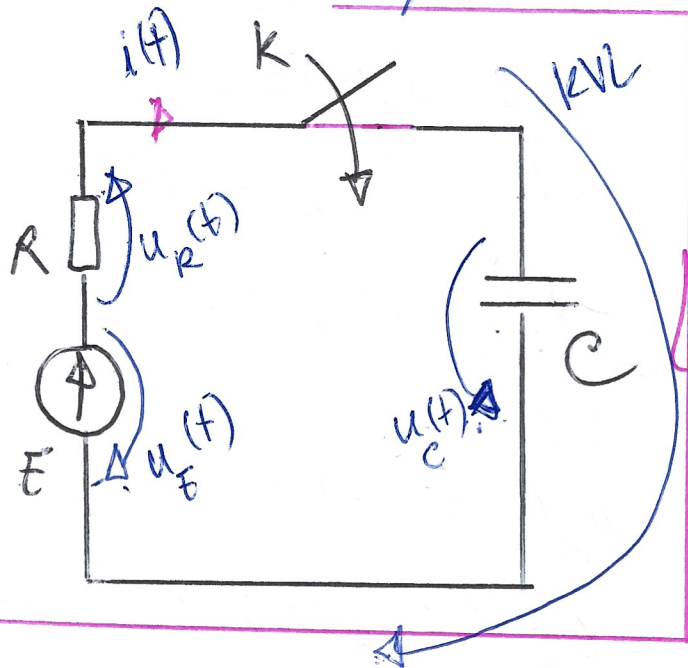
RC Circuit - Time Domain
Explicit Euler Method



$t_0 = 0 \quad u_C(0) = 0$

KVL $\sum_{k=1}^{N} u_k = 0 \; ; \; N = 3$

$-u_E(t) + u_R(t) + u_C(t) = 0 \quad (1)$

$$\begin{cases} u_E(t) = E \\ u_R(t) = R \cdot i(t) \\ q = C \cdot u_C(t) \; ; \; i = \frac{dq}{dt} \end{cases}$$

$u_E(t) = u_R(t) + u_C(t) \Rightarrow E = R \cdot i(t) + u_C(t) \Rightarrow$

$\Rightarrow E = R \cdot C \frac{du_C(t)}{dt} + u_C(t) \quad \left| \begin{array}{l} \text{Not: } \tau = R \cdot C \\ u_C(t) = u \end{array} \right. \Rightarrow$

$\Rightarrow E = \tau \cdot \frac{du}{dt} + u \Rightarrow \boxed{\frac{du}{dt} = \frac{E-u}{\tau}}$

Explicit Euler Method.

$\frac{du}{dt} = \frac{E-u}{\tau} \rightarrow \frac{u_{j+1} - u_j}{\Delta t} = \frac{E - u_j}{\tau} \Rightarrow$

$$\Rightarrow \boxed{u_{j+1} = u_j + \left(\frac{E-u_j}{\tau}\right) \cdot \Delta t} \quad (2)$$

$$\boxed{\Delta t = t_{j+1} - t_j} \quad (5)$$

$$\boxed{u_C(t) = E\left(1 - e^{-t/\tau}\right) V} \quad (3)$$

$$\begin{cases} t_0 = 0 \\ u_C(0) = 0 \end{cases} \quad (4)$$