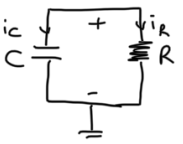
first order circuits

- contains one independent energy storage element (capacitor or inductor)
- two types: RC or RL

pasif: resistors – capacitors – inductors

aktif: opamps

R-C



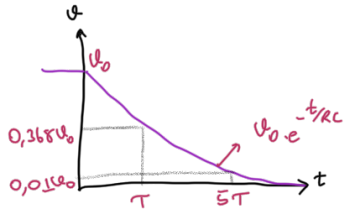
$V(0) = V_0$

$i_C + i_R = 0$

$C \cdot \frac{dV}{dt} + \frac{V}{R} = 0$

$\int_{V(0)}^{V(t)} \frac{dV}{V} = \int_{t=0}^{t} -\frac{dt}{RC}$

$V(t) = V_0 \cdot e^{-\frac{t}{RC}}$ (doğal tepki)



τ = zaman sabiti = RC

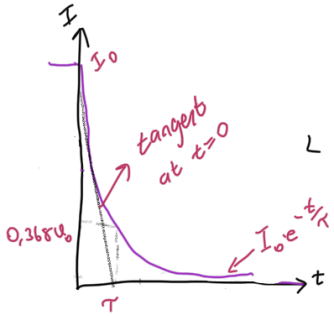
- τ ↓ devrenin tepkisi daha hızlı oluşur

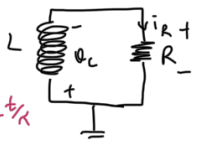
- $i_R = \frac{V(t)}{R} = \frac{V_0 \cdot e^{-\frac{t}{RC}}}{R}$

$P(t) = \frac{V_0^2}{2} e^{-\frac{2t}{RC}}$

$E_R(t) = \frac{1}{2} C V_0^2 (1 - e^{-\frac{2t}{RC}})$

R-L





$I(0) = I_0$

$V_R + V_L = 0$

$L \cdot \frac{di}{dt} + i \cdot R = 0$

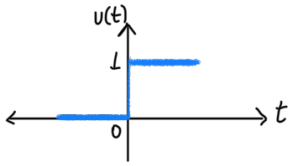
$\int_{i(0)}^{i(t)} \frac{di}{i} = \int_{t=0}^{t} -\frac{R\,dt}{L}$

$I(t) = I_0 \cdot e^{-\frac{Rt}{L}}$

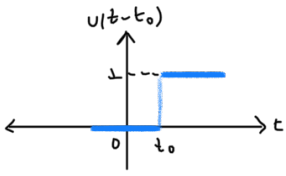
τ = zaman sabiti = $\frac{L}{R}$

teklik fonksiyonları

unit step function



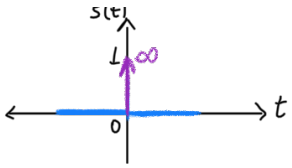
$u(t) = \begin{cases} 1, & t > 1 \\ \text{tanımsız}, & t = 0 \\ 0, & t < 1 \end{cases}$



$u(t-t_0) = \begin{cases} 1, & t > \\ \text{tanımsız}, & t = \\ 0, & t < \end{cases}$ (gecikirme)

impulse (dürtü) function

derivative of the unit step function



$$\delta(t)=\frac{du(t)}{dt}=\begin{cases}0, & t>1\\ \text{tanımsız}, & t=0\\ 0, & t<1\end{cases}\quad(\infty)$$

$$\int_{0^-}^{0^+}\delta(t)\,dt=1$$

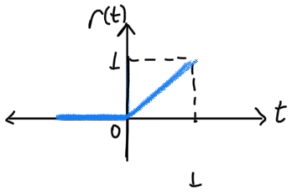
$$\int_a^b f(t)\,\underbrace{\delta(t-t_0)}_{t=t_0\text{ harici }0}\,dt = f(t_0)\int_{a}^{b}\delta(t-t_0)\,dt = f(t_0)$$

$$\int_{a}^{b}\delta(t-t_0)\,dt=\int_{t_0^-}^{t_0^+}\delta(t-t_0)\,dt=1$$

$$(a<t_0<b)$$

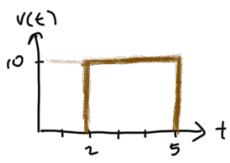
rampa function

integral of the unit step function



$$r(t)=\int_{-\infty}^{t}u(\lambda)\,d\lambda=t\,u(t)$$

$$r(t)=\begin{cases}0, & t<0\\ t, & t\geq 0\end{cases}$$



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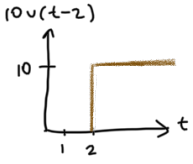
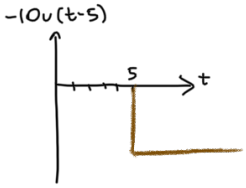
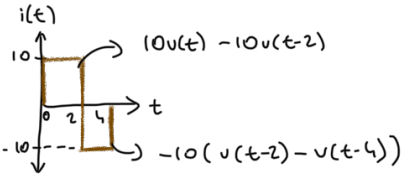


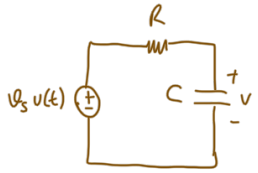


$$v(t)=10\,(u(t-2)-u(t-5))$$



$$i(t)=10\,u(t)-20\,u(t-2)+10\,u(t-4)$$

RC devrelerinin basamak tepkisi



$$v(t)=\begin{cases}V_0 & t<0\\ V_S+(V_0-V_S)\,e^{-\frac{t}{\tau}}, & t>0\end{cases}$$

$$i(t)=\frac{v_s}{R}\,e^{-\frac{t}{\tau}}\,u(t)\quad(t<0\to 0)$$

$\searrow(t>0)$