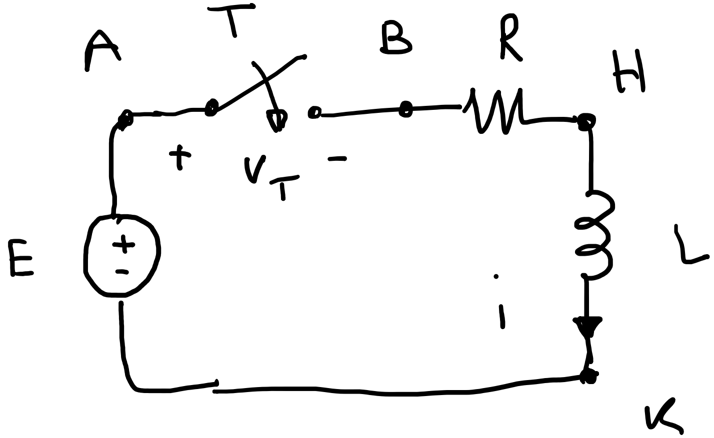
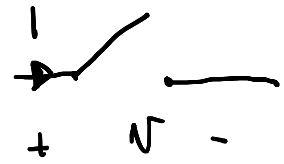
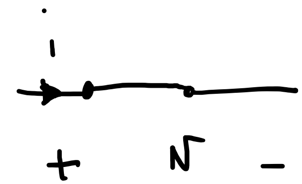




APERTO $i = 0$



CHIUSO $v = 0$

$t = 0$ T SI CHIUDE

$i(t) = ?$ $\underline{t > 0}$ $v_T = 0$

$$-E + Ri + L\frac{di}{dt} = 0$$

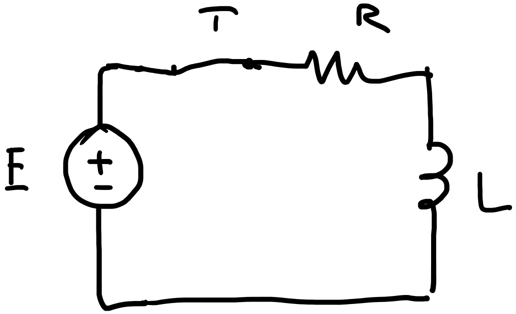
$$\begin{cases} L\dfrac{di}{dt} + Ri = E \\ i(0^+) = i_0 = 0 \end{cases}$$

$t = 0^-$ T APERTO $\rightarrow$ $i(0^-) = 0$

$E_M = \frac{1}{2} L i^2$ ENERGIA INDUTTORE $\Rightarrow$ CONTINUA $\Rightarrow$ i CONTINUA

PRINCIPIO CONTINUITÀ ENERGIA

$i(0^+) = i(0^-) = 0$



$$\begin{cases} L\dfrac{di}{dt}+Ri=E \\ i(0^+)=0 \end{cases}$$

$$i(t) = -\frac{E}{R}e^{-\frac{R}{L}t}+\frac{E}{R}$$

EQ. OMOGENEA $\quad L\dfrac{di_g}{dt}+Ri_g=0 \qquad i_g = Ae^{-\frac{R}{L}t}$

i_g = INTEGRALE GENERALE DELL'EQ. OMOGENEA

$L\dfrac{di_p}{dt}+Ri_p=E \qquad i_p$ FUNZIONI COSTANTI DEL TEMPO

$$\Downarrow$$

$$\frac{di_p}{dt}=0 \Rightarrow i_p=\frac{E}{R}$$

$$i = i_g(t)+i_p(t) = Ae^{-\frac{R}{L}t}+\frac{E}{R}$$

$$i(0^+) = Ae^{-\frac{R}{L}0}+\frac{E}{R} = A+\frac{E}{R} = 0 \Rightarrow A=-\frac{E}{R}$$

$$i(t) = -\frac{E}{R} e^{-\frac{R}{L}t} + \frac{E}{R} \qquad R, L > 0$$

$$\lim_{t \to +\infty} -\frac{E}{R} e^{-\frac{R}{L}t} = 0$$ TERMINE TRANSITORIO

CIRCUITO STABILE

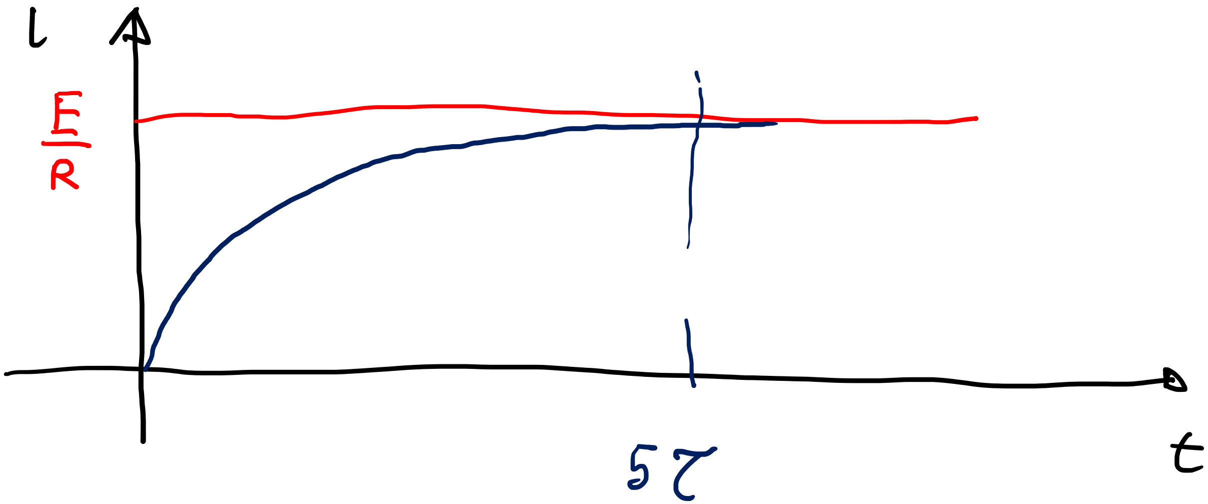
$\frac{E}{R}$ TERMINE DI REGIME : PER $t \to +\infty$

$$i(t) \simeq \frac{E}{R}$$

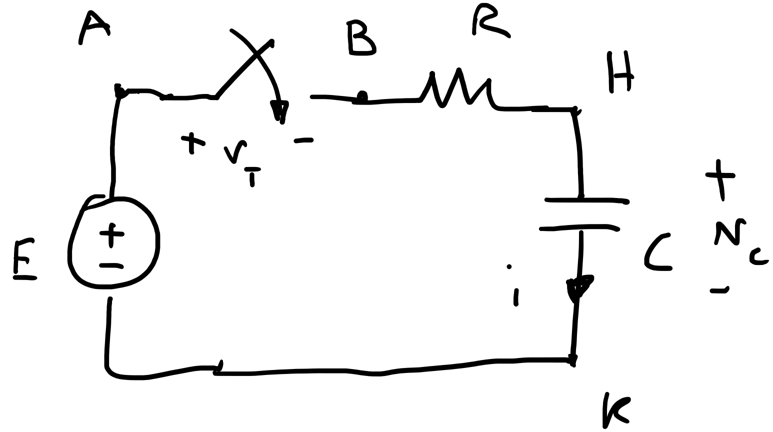
$\tau = \frac{L}{R}$ TEMPO CARATTERISTICO (s)

$$i(t) = -\frac{E}{R} e^{-\frac{t}{\tau}} + \frac{E}{R}$$

t	$e^{-\frac{t}{\tau}}$
5τ	7×10^{-3}
10τ	2×10^{-5}



$$i = -\frac{E}{R}e^{-\frac{t}{\tau}} + \frac{E}{R}$$



$t > 0$ T CHIUSO $v_T = 0$

$$\begin{cases} -E + Ri + v_c = 0 \\ i = C \dfrac{dv_c}{dt} \end{cases}$$

$$\begin{cases} RC \dfrac{dv_c}{dt} + v_c = E \\ v_c(0^+) = v_0 = 0 \end{cases}$$

$$E_e = \frac{1}{2} C v_c^2 \Rightarrow v_c(0^+) = v_c(0^-)$$

$t = 0^-$ T APERTO , $i = 0$, $v_T = ?$

$$-E + v_T(0^-) + v_c(0^-) = 0$$

$$v_c(t) = v_c(t_0) + \frac{1}{C} \int_{t_0}^{t} i(t')\, dt'$$

$t_0 = -\infty$ $v_c(t_0) = 0$

T NON SI È MAI CHIUSO

$v_c(0^-) = 0$

$$\begin{cases} RC \dfrac{dv_c}{dt} + v_c = E \\ v_c(0^+) = 0 \end{cases}$$

$$v_c(t) = v_g(t) + v_p(t)$$

$$RC \frac{dv_g}{dt} + v_g = 0 \qquad v_g = A e^{-\frac{t}{RC}}$$

τ = COSTANTE DI TEMPO $= RC > 0$

$$RC \frac{dv_p}{dt} + v_p = E$$

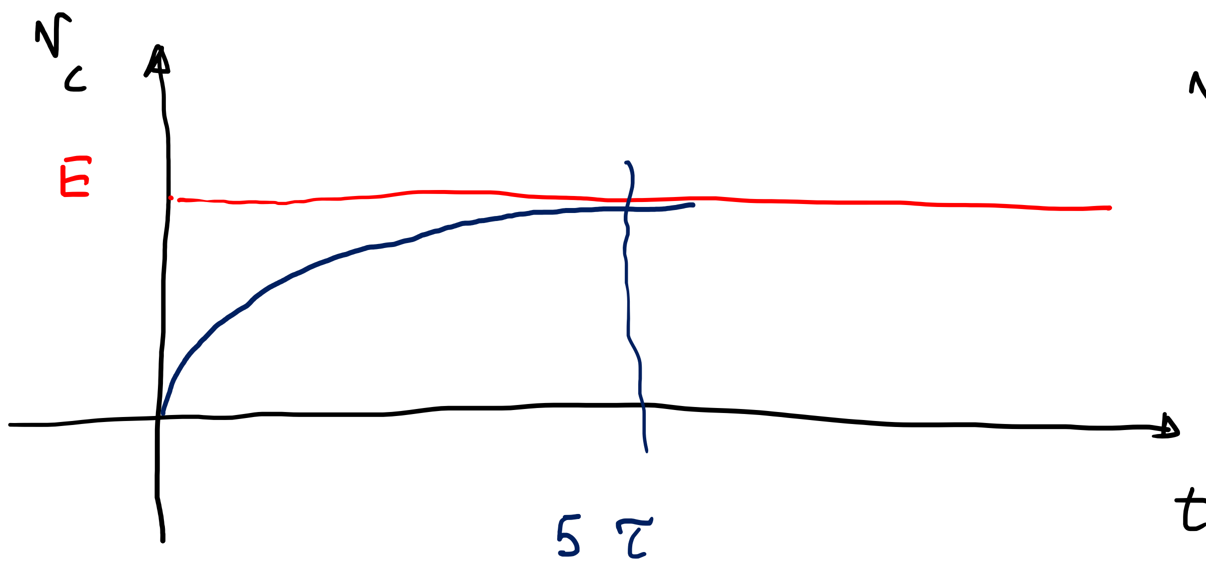
v_p = FUNZIONE COSTANTE DEL TEMPO

$$v_p = E$$

$$v_c(t) = A e^{-\frac{t}{RC}} + E$$

$$v_c(0) = A e^{-\frac{0}{RC}} + E = A + E = 0 \Rightarrow A = -E$$

$$v_c(t) = -E e^{-\frac{t}{RC}} + E$$



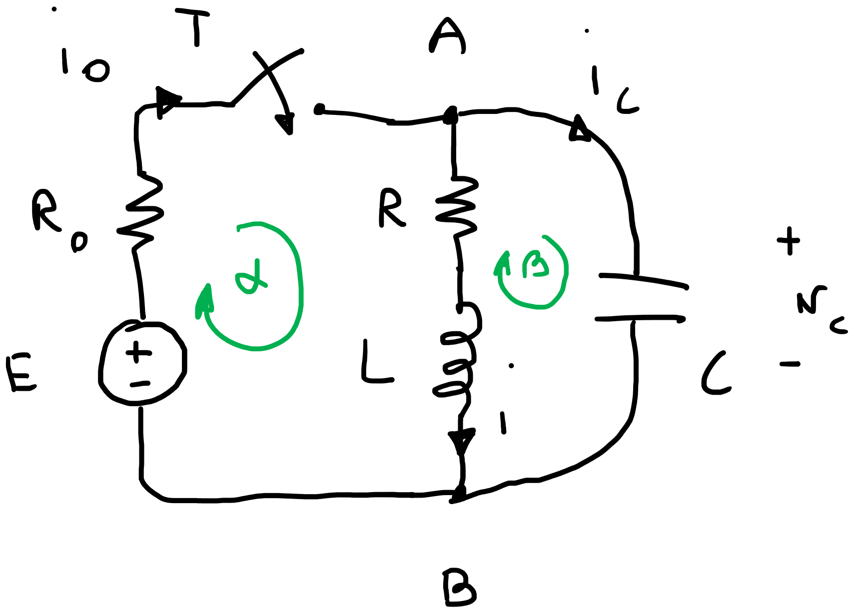
$$v_c(t) = -E\, e^{-\frac{t}{RC}} + E$$

$\tau = RC$

VARIABILI DI STATO:

- CORRENTI INDUTTORI
- TENSIONI CONDENSATORI

VARIABILI A CUI È ASSOCIATA UNA ENERGIA



$t < 0$ T È APERTO

$t > 0$ T È CHIUSO

$t > 0$

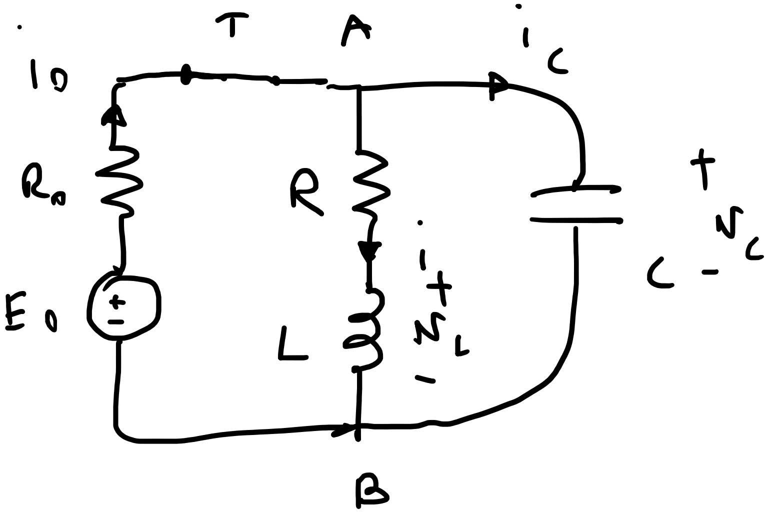
LKC A) $-i_0 + i + i_C = 0$

LKT α) $-E + R_0 i_0 + R i + L \dfrac{di}{dt} = 0$

$N_{NODI} = 2$, $N_{RAMI} = 3$, LKT $(N_{RAMI} - N_{NODI} + 1) = 2$

β) $-L \dfrac{di}{dt} - R i + v_C = 0$

CONDENSATORE $\quad i_C = C \dfrac{dv_C}{dt}$



EQUAZIONI DI STATO

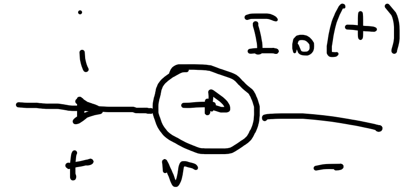
$$v_L = L \frac{di}{dt}$$

$$i_C = C \frac{dv_C}{dt}$$

$$\begin{cases} \dfrac{di}{dt} = \dfrac{v_L}{L} \\[2ex] \dfrac{dv_C}{dt} = \dfrac{i_C}{C} \end{cases}$$

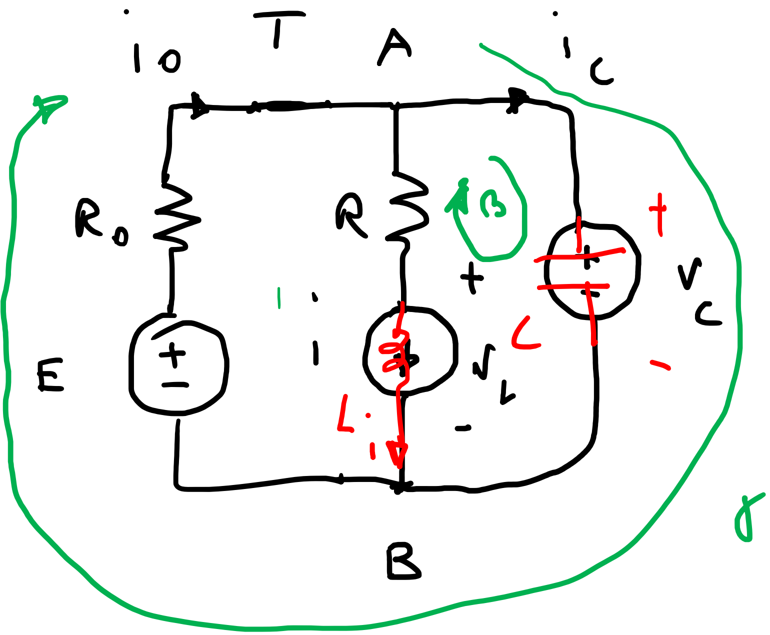
SISTEMA DI EQUAZIONI DIFFERENZIALI DEL PRIMO ORDINE NELLE VARIABILI DI STATO (v_C, i)

GENERATORE DI CORRENTE



I_0 = CORRENTE IMPRESSA = FUNZIONE DEL TEMPO ARBITRARIA

$$i(t) = I_0(t) \qquad p_{ASS}(t) = v(t)\, i(t) = v(t)\, I_0(t) \gtrless 0$$



$$\begin{cases} \dfrac{di}{dt} = \dfrac{v_L}{L} = \dfrac{1}{L}\left[v_c - Ri\right] \\[2ex] \dfrac{dv_c}{dt} = \dfrac{i_c}{C} = \dfrac{1}{C}\left[\dfrac{E - v_c}{R_0} - i\right] \end{cases}$$

$i(0^+) = 0 \,, \quad v_c(0^+) = 0$

$\gamma)\quad -E + R_0 i_0 + v_c = 0 \Rightarrow i_0 = \dfrac{E - v_c}{R_0}$

$A)\quad -i_0 + i + i_c = 0 \Rightarrow i_c = i_0 - i = \dfrac{E - v_c}{R_0} - i$

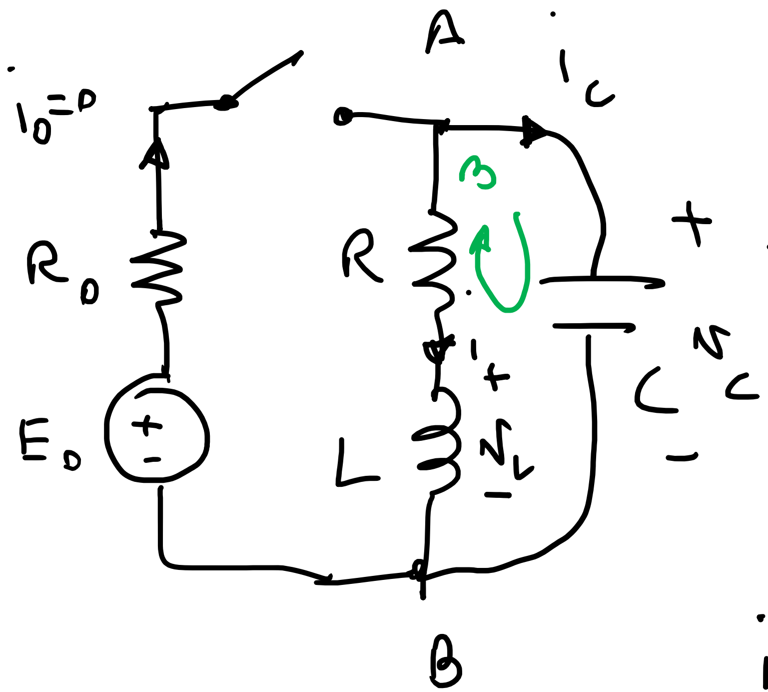
$B)\quad -v_L - Ri + v_c = 0 \Rightarrow v_L = v_c - Ri$

CONDIZIONI INIZIALI

$i(0^+) = i(0^-)$

$v_c(0^+) = v_c(0^-)$

$t = 0^-$



$$-i_0 + i + i_c = 0$$

$$\underset{0}{\underset{\parallel}{i_0}} \qquad i = -i_c$$

IPOTESI REGIME STAZIONARIO

$$\frac{d}{dt} = 0 \qquad i_c = C\frac{dv_c}{dt} = 0$$

$$i = -i_c = 0 \qquad v_L = L\frac{di}{dt} = 0$$

$i(0^-) = 0$

$v_c(0^-) = 0$

$$-\underset{0}{\underset{\parallel}{v_L}} - R\underset{0}{\underset{\parallel}{i}} + v_c = 0 \Rightarrow v_c = 0$$