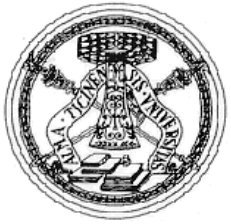


Corso di Laurea Specialistica in
MEDICINA e CHIRURGIA
corso integrato FISICA - disciplina FISICA

CORRENTE ELETTRICA

parte II^{a}

- EFFETTO JOULE
- CIRCUITO DI CARICA DEL CONDENSATORE
- CIRCUITO DI SCARICA DEL CONDENSATORE
- STIMOLATORE CARDIACO

EFFETTO JOULE

effetto termico della corrente elettrica

energia cinetica elettroni ceduta per urto al reticolo molecolare del conduttore → generazione di calore

$$\Delta T = L = \Delta q\, \Delta V = i\, \Delta t\, \Delta V = i^2 R\, \Delta t = \frac{\Delta V^2}{R} \Delta t$$

$$W = \frac{L}{\Delta t} = i\, \Delta V = i^2\, R = \frac{\Delta V^2}{R}$$

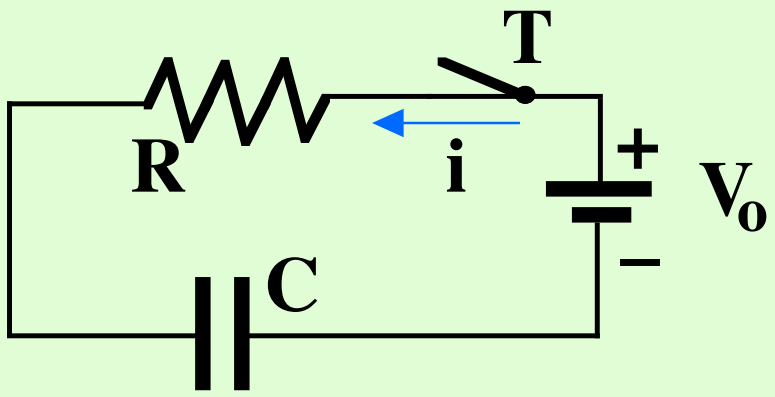
produzione di calore

1 caloria = 4.18 joule

$$Q(\text{cal}) = \frac{1}{4.18} W \Delta t = \frac{1}{4.18}\, i^2 R\, \Delta t = \frac{1}{4.18}\, i\, \Delta V\, \Delta t =$$

$$= \frac{1}{4.18} \frac{\Delta V^2}{R} \Delta t$$

CARICA DEL CONDENSATORE



chiusura interruttore T :

$i = 0$

$i = i(t)$

$i = 0$

$$V_R(t) + V_C(t) = V_o$$

$$R\, i(t) + \frac{q(t)}{C} = V_o \quad \rightarrow \quad R\frac{dq}{dt} + \frac{q}{C} = V_o$$

$$\frac{dq}{dt} = -\frac{q}{RC} + \frac{V_o}{R}$$

$$\frac{dq}{dt} = -\frac{1}{RC}(q - V_o\, C)$$

CARICA DEL CONDENSATORE

$$\frac{dq}{dt} = -\frac{1}{RC}(q - V_0 C)$$

$$\frac{d(V_0 C)}{dt} = 0$$

$$\frac{d(q - V_0 C)}{dt} = -\frac{1}{RC}(q - V_0 C) \rightarrow q - V_0 C = A\, e^{\alpha t}$$

$$t = 0 \rightarrow q = 0 \rightarrow A = -V_0 C$$

$$q(t) = V_0 C\,(1 - e^{\alpha t})$$

$$\frac{dq}{dt} = -\alpha V_0 C\, e^{\alpha t} = \frac{V_0}{R}\, e^{\alpha t} \xrightarrow{t \to 0} \alpha = -\frac{1}{RC}$$

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

$$q(t) = V_0 C \left(1 - e^{-\frac{t}{RC}} \right)$$

$$RC \rightarrow \frac{V}{\frac{\Delta Q}{\Delta t}} \frac{\Delta Q}{V} = \Delta t$$

- dimensioni $[R][C] \equiv [t]$

$$RC \equiv \tau$$

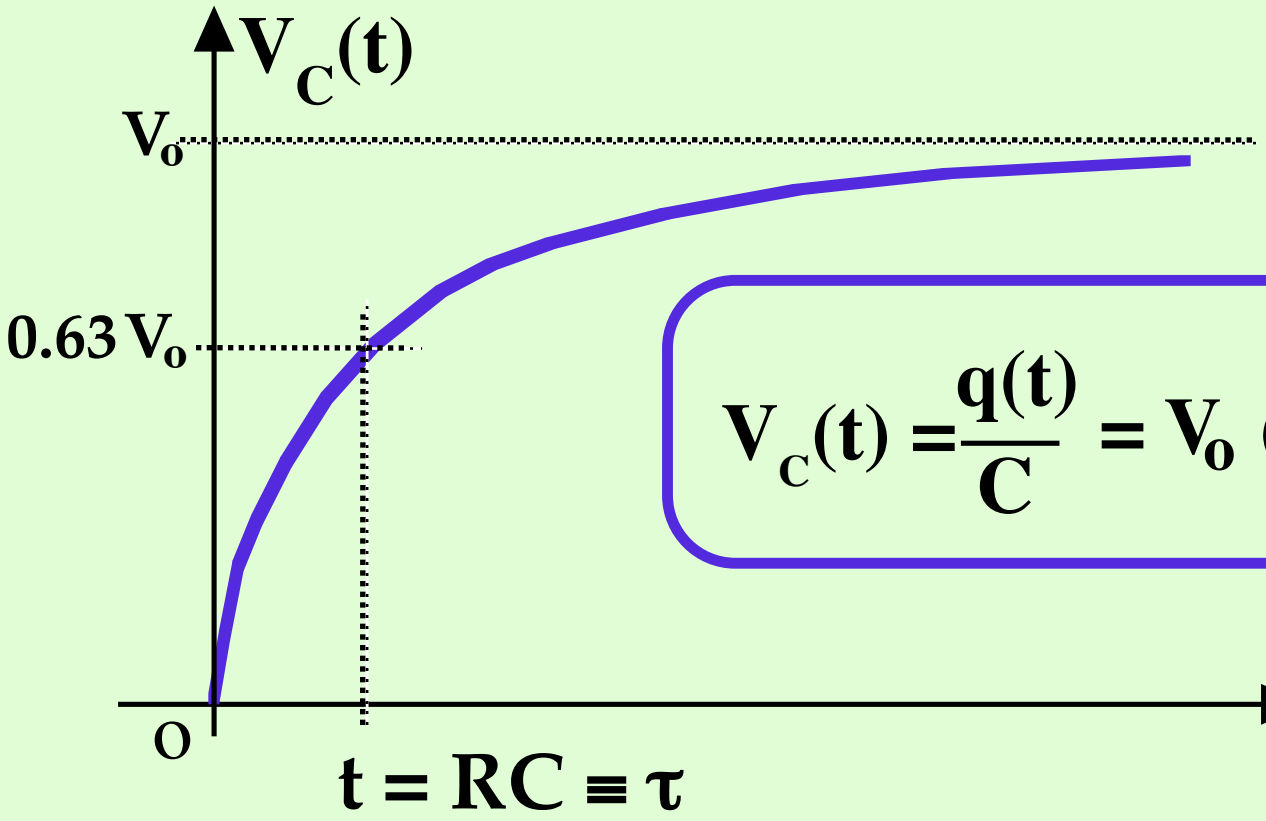
τ = costante di tempo del circuito

$$t = RC = \tau$$

$$e^{-\frac{t}{RC}} = e^{-1} = \frac{1}{e} = \frac{1}{2.718} = 0.368$$

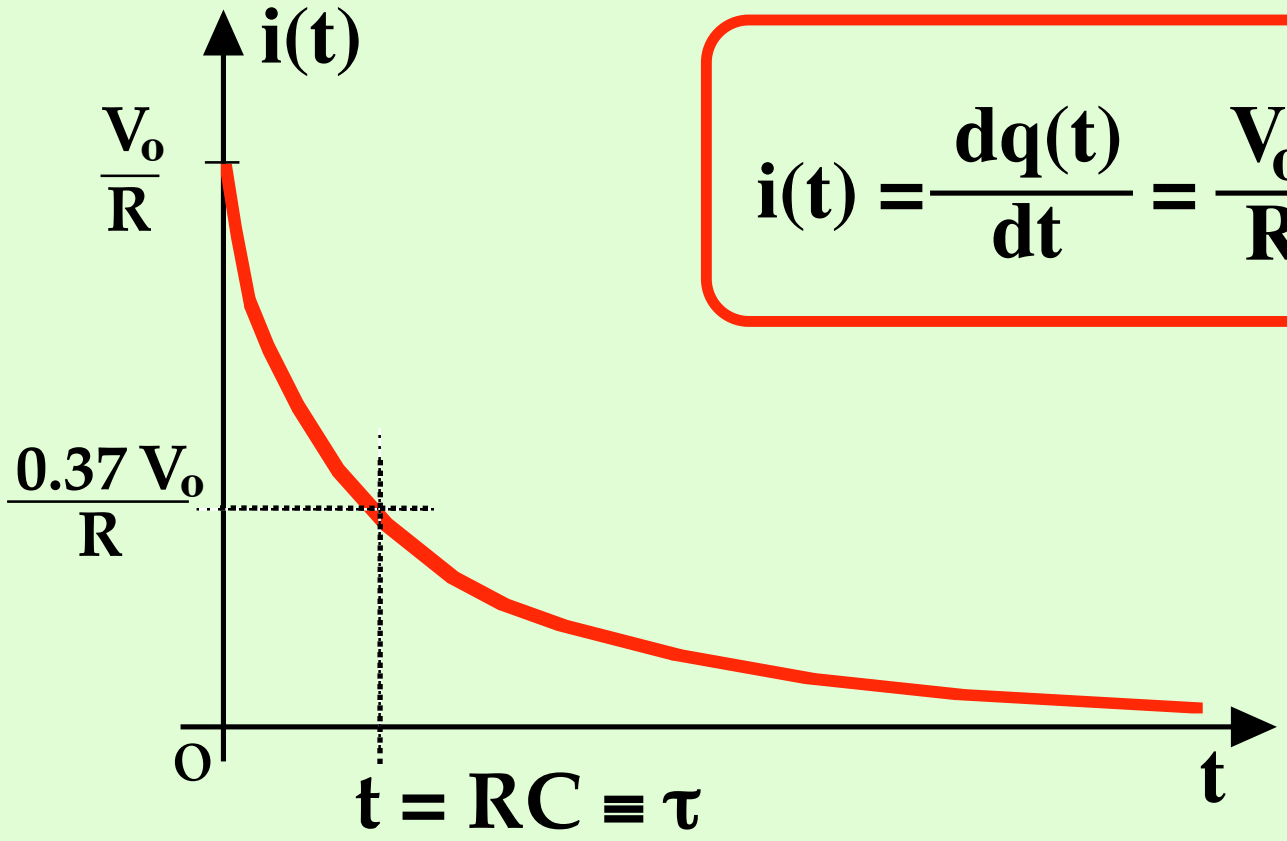
ampiezza al tempo zero smorzata del 36.8% dopo un tempo pari alla costante di tempo

CARICA DEL CONDENSATORE



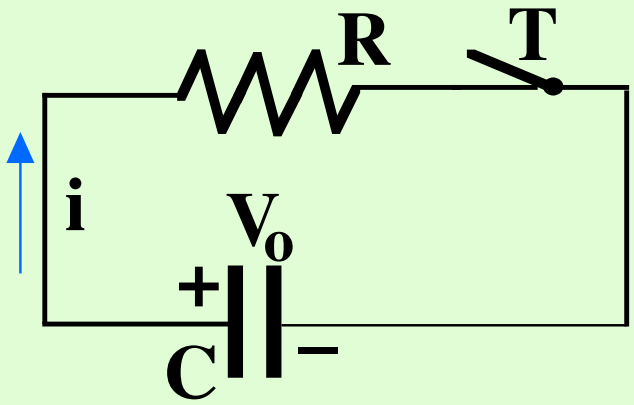
$$V_C(t) = \frac{q(t)}{C} = V_o\,(1 - e^{-\frac{t}{RC}})$$

CARICA DEL CONDENSATORE



$$i(t) = \frac{dq(t)}{dt} = \frac{V_o}{R}\, e^{-\frac{t}{RC}}$$

SCARICA DEL CONDENSATORE



chiusura interruttore T :

$i = 0$

$i = i(t)$

$i = 0$

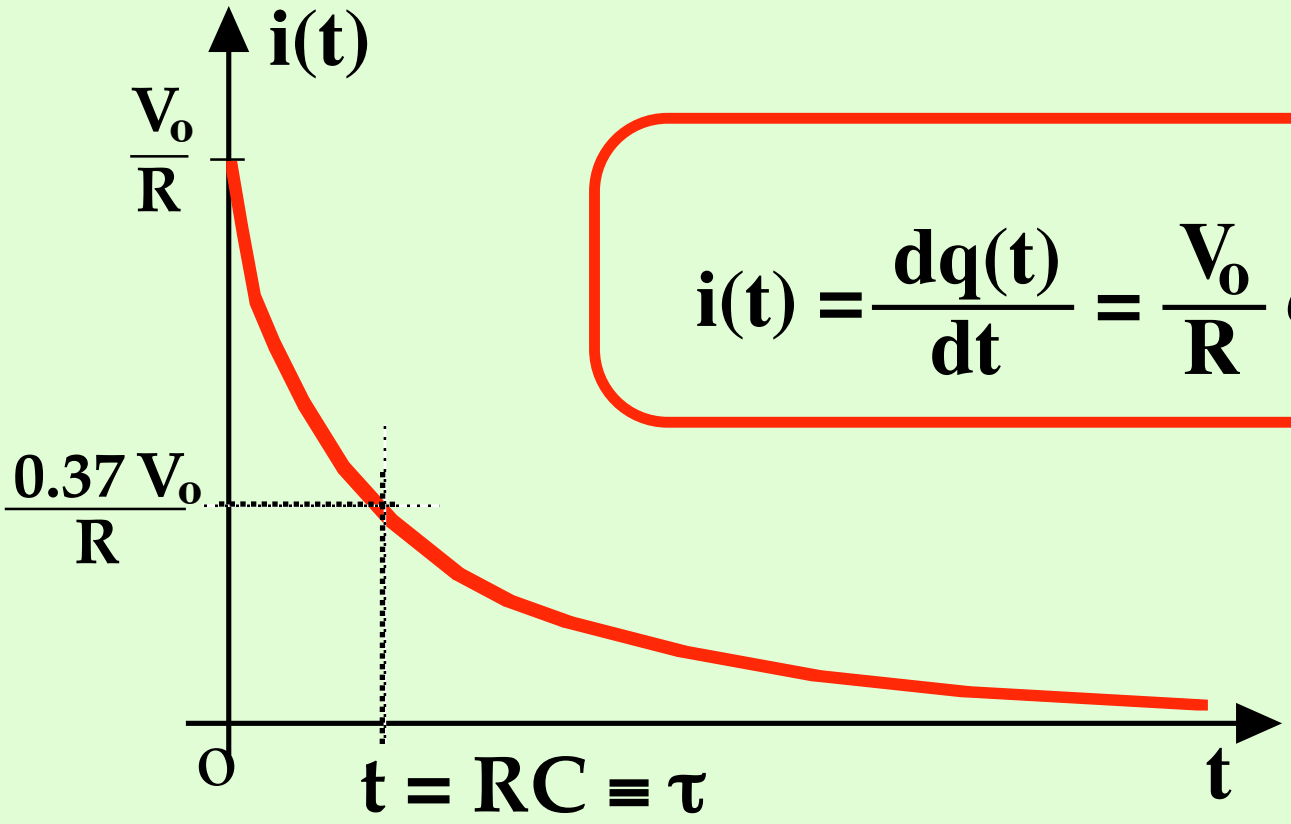
$$V_R(t) + V_C(t) = 0 \rightarrow R\frac{dq}{dt} + \frac{q}{C} = 0$$

$$q(t) = V_o\, C\; e^{-\frac{t}{RC}}$$

$$i(t) = \frac{dq(t)}{dt} = \frac{V_o}{R}\, e^{-\frac{t}{RC}}$$

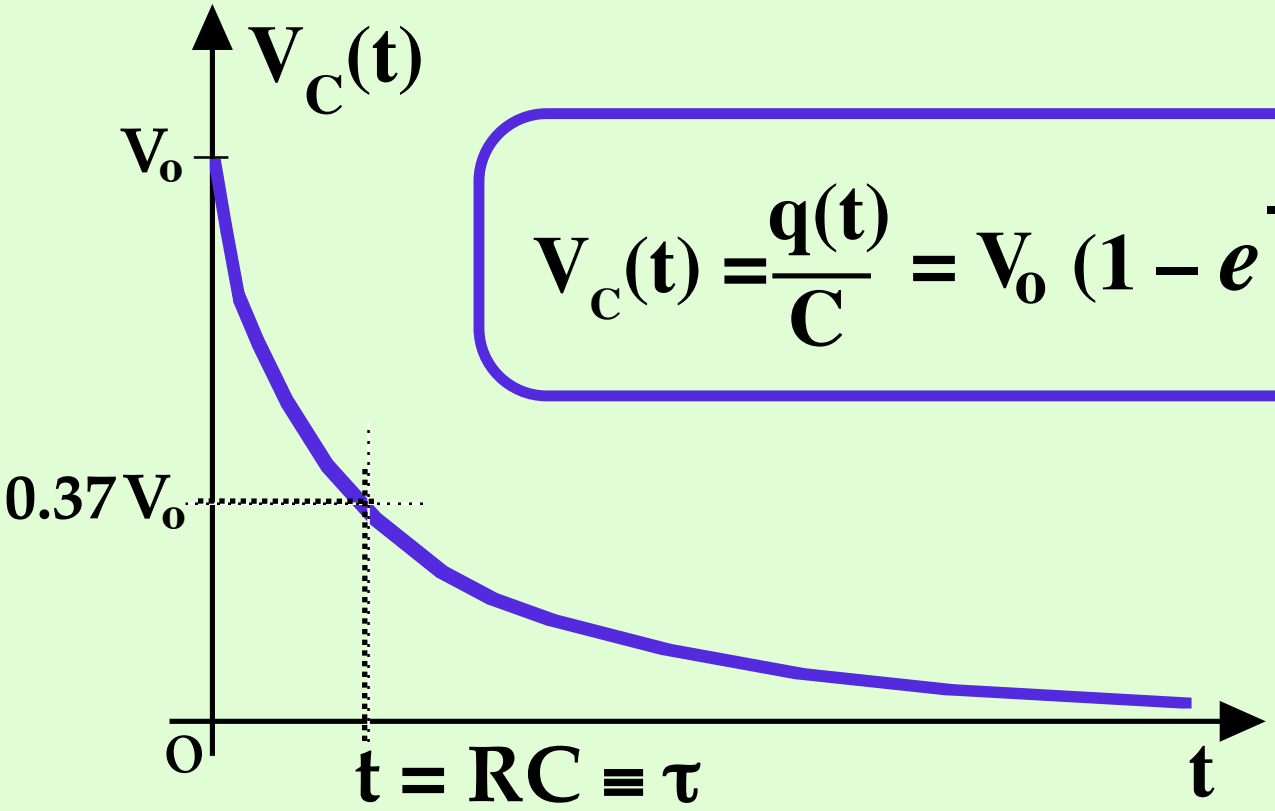
$$V_C(t) = \frac{q(t)}{C} = V_o\; e^{-\frac{t}{RC}}$$

SCARICA DEL CONDENSATORE



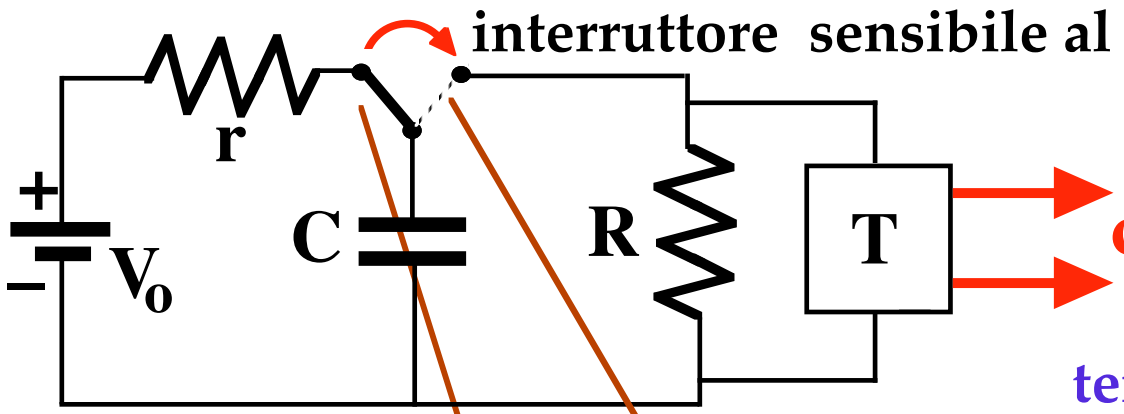
$$i(t) = \frac{dq(t)}{dt} = \frac{V_o}{R}\, e^{-\frac{t}{RC}}$$

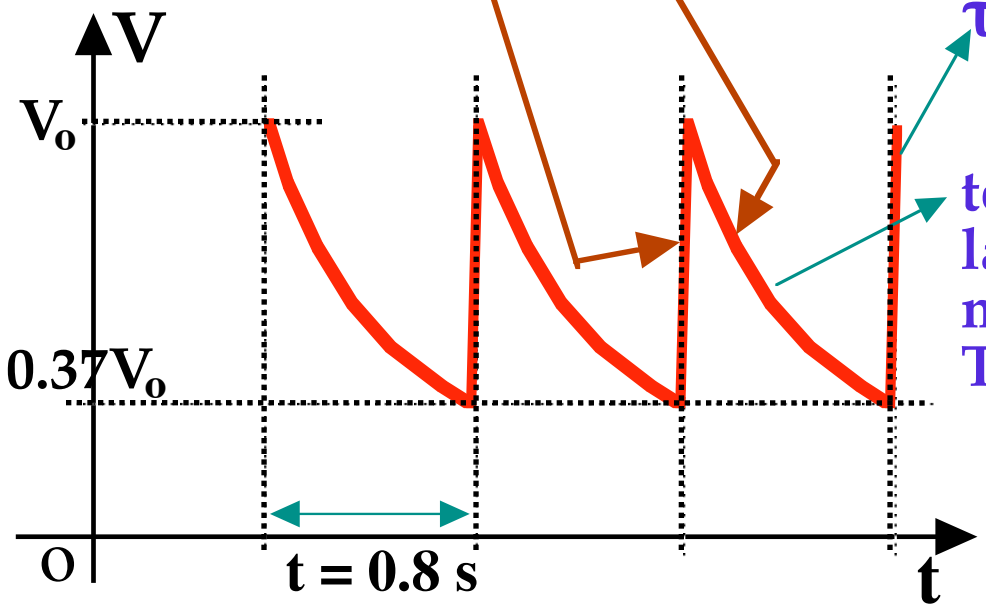
SCARICA DEL CONDENSATORE



$$V_C(t) = \frac{q(t)}{C} = V_o\,(1 - e^{-\frac{t}{RC}})$$

STIMOLATORE CARDIACO





tempo di salita rapido

$\tau_2 = r\,C = 10^4\ \Omega\ \ 0.4\ \mu F = 4\ ms$

tempo di scarica che fornisce la cadenza di 75 impulsi al minuto primo al trasduttore T collegato al cuore

$\tau_1 = RC = 2\ 10^6\ \Omega\ 0.4\ \mu F =$

$= 0.8\ s \equiv \frac{60\ s}{75}$