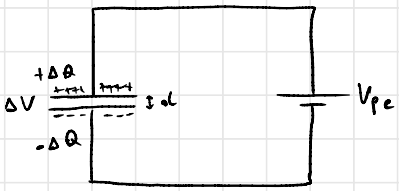
Condensatori

Condensatore Piano

30/03/19



$$C = \varepsilon_0 \varepsilon_r \frac{A}{d}$$ → ε_r numero puro

$$\varepsilon_0 = 8{,}854 \cdot 10^{-12}\ C^2/Nm^2$$

Rigidità Dielettrica

→ Massimo $\vec{E}$ che il dielettrico può sopportare $\left(\frac{kV}{mm}\right)$

$$|\Delta V| = E \cdot d \quad \rightarrow \quad |\Delta V_{max}| = R \cdot G \cdot Diel \cdot d$$

$$U = \frac{1}{2} \Delta Q \Delta V = \frac{1}{2} C \Delta V^2 = \frac{1}{2} \frac{\Delta Q^2}{C}$$

$$\varepsilon_r = \frac{E_0}{E} \geq 1 \qquad e \qquad E_0 = E \text{ nel vuoto}$$

Es. 16-10

$A = 1{,}00\ m^2$

$d = 0{,}500\ mm$

$\varepsilon_r = 4{,}9$

Rig. Diel $= 18\ kV/mm$

?, C, ΔQ_{max}

allora:

→ sol che: $C = \varepsilon_0 \varepsilon_r \frac{A}{d} = 8{,}854 \cdot 10^{-12} \cdot 4{,}9 \cdot \frac{1}{5 \cdot 10^{-4}}$

$= 86{,}8\ nF$

→ $|\Delta V_{max}| = $ Rig. Diel. $\cdot\ d$

$= 18000 \frac{V}{mm} \cdot 0{,}5\ mm = 9\ kV$

$\Delta Q_{max} = C \cdot \Delta V_{max} = 9000 \cdot 8{,}68 \cdot 10^{-8}$

$= 7{,}8 \cdot 10^{-4}\ C = 0{,}78\ mC$

Es. 16-12

$A = 0{,}24\ m^2$

$d = 8{,}00\ mm$

$\Delta V = 0{,}8\ kV = 800\ V$

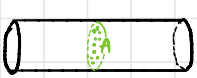
è sempre dielettrico

$C = \varepsilon_0 \frac{A}{d} = 8{,}854 \cdot 10^{-12} \frac{0{,}24}{8 \cdot 10^{-3}} = 0{,}266\ nF$

$U = \frac{1}{2} C (\Delta V)^2 = \frac{1}{2}$ ... ✓

Corrente Elettrica

$I = \frac{\Delta Q}{\Delta t} = n e A v_D$



$[I] = $ Ampere $= A$

$1\ A = \frac{1\ C}{1\ s}$

$n =$ num. elettroni di conduzione $/m^3$

$e = 1{,}602 \cdot 10^{-19}\ C$

$v_D =$ velocità di Deriva

Es. 17.2

Argento

$d = 2{,}888$ mm

$n = 5{,}80 \cdot 10^{28}$ $\frac{\text{Elettr. cond.}}{m^3}$

$\Delta V = 1{,}50$ V

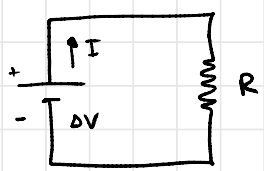
$\Delta Q = 880$ C, $\Delta t = 45 \text{ min} = 2700$ s

① $I = \frac{\Delta Q}{\Delta t} = \frac{880}{2700\ s} = 0{,}326$ A

② $v_D = \frac{I}{neA} = \frac{0{,}326}{5{,}8 \cdot 10^{28} \cdot 1{,}602 \cdot 10^{-19} \cdot 5{,}253 \cdot 10^{-6}} = 6{,}7 \cdot 10^{-6}$ m/s

tempo breve elettroni si muovono in onde

I° LEGGE OHM



$R = \frac{\Delta V}{I}$

$[R] = \text{OHM} = \Omega$

$1\ \Omega = \frac{1V}{1A}$

2° LEGGE DI OHM

$R = \rho \frac{l}{A}$

l = lunghezza filo [m]

A = area sezione filo [m^2]

ρ resistività [$\Omega \cdot m$]
- dipende dal materiale
- dipende da T°

$T_0 = 20°C \longrightarrow \rho_0$

$T \longrightarrow \rho$

$\rho_T = \rho_0 [1 + \alpha (T - T_0)]$

$\rho = \alpha \cdot T$

$[\alpha]$ α dipende dal materiale $[°C^{-1}]$

es. 17_3

tung steno

$l = 0{,}04\ m$
$d = 0{,}02\ mm$
$T_0 = 20\ °C$
α tung ; $\rho_0 = 5{,}4 \cdot 10^{-8}\ \Omega\, m$

$A = \left(d/2\right)^2 \pi = \left(1 \cdot 10^{-5}\right)^2 \cdot 3{,}14 = 3{,}14 \cdot 10^{-10}\ m^2$

① $R = \rho_0 \frac{l}{A} = 5{,}4 \cdot 10^{-8} \frac{0{,}04}{3{,}14 \cdot 10^{-10}} = 6{,}9\ \Omega$

verifica 17_4

$R_T = 225\ \Omega$

$T_0 = 20\ °C$

$R_T = 448\ \Omega$

$T = ?$

① $R_T = \rho_T \frac{l}{A} = \rho_0 \left[1 + \alpha (T - T_0)\right]$

$R_0 = \rho_0 \frac{l}{A}$

$\rho_0 = \frac{R_0 A}{l}$

$R_T = \frac{R_0 A}{l} \cdot \left[1 + \alpha (T - T_0)\right] \cdot \frac{l}{A}$

$R_T = R_0 + R_0 \alpha (T - T_0)$

$\left(\frac{R_T}{\alpha R_0} - \frac{1}{\alpha}\right) + T_0 = T$

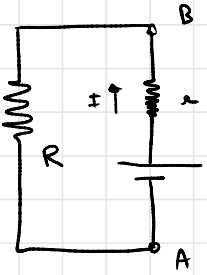
$T = 20 + \left(\frac{448}{3{,}64 \cdot 10^{-3} \cdot 225} - \frac{1}{3{,}64 \cdot 10^{-3}}\right)$

$T = 252\ °C$

Corrente Alternata

→ tensione oscillante

Forza elettromotrice



$\mathcal{E}$ = forza elettromotrice (senza corrente) (f.e.m)

→ senza corrente $\Delta V = V_B - V_A = \mathcal{E}$

→ con corrente $\Delta V = V_B - V_A = \mathcal{E} - r I$

r = resistenza interna

Verifica 17_5

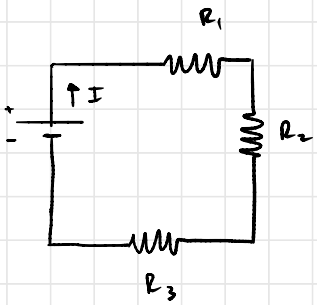
$\mathcal{E} = 1{,}5$ kV

$r = 0{,}200\ \Omega$

$I = 50{,}0$ mA

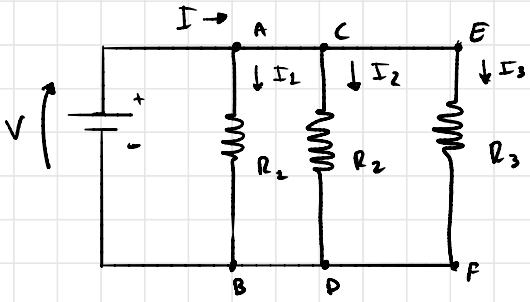
① $\Delta V = \mathcal{E} - r I = 1{,}5 - (0{,}2 \cdot 50 \cdot 10^{3}) = 1{,}495$ V

Resistenze in Serie



→ $R_{TOT} = R_1 + R_2 + R_3$

Resistenze Parallelo

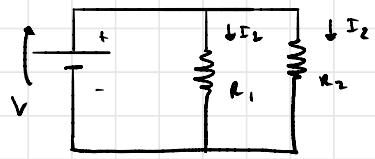


→ $V = V_{AB} = V_{CD} = V_{EF}$

→ $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_N}$

$R_{eq} < R_1$

Esempio 17_6

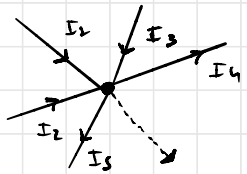


→ $R_{eq} = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{20 \cdot 40}{60} = 13{,}3\,\Omega$

$R_1 = 20\ \Omega$

$R_2 = 40\ \Omega$

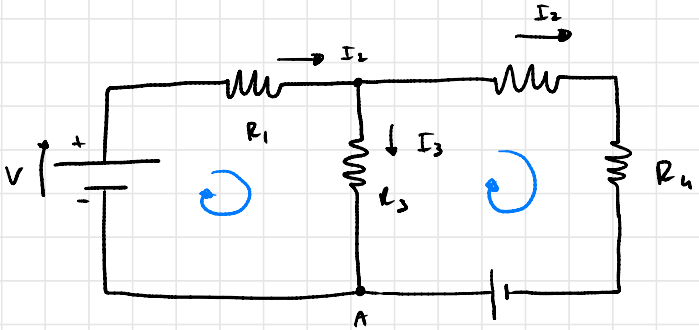
1° LEGGE DI KIRCHOFF



→ $\sum I_{entranti} = \sum I_{uscenti}$

Es: $I_1 + I_2 + I_3 = I_4 + I_5$

2° LEGGE DI KIRCHOFF

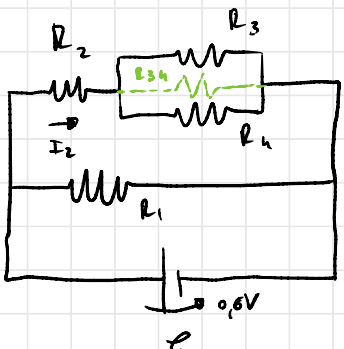


1. scelgo versi correnti
2. percorrendo una maglia, considero segni tensioni. La somma deve essere 0.
3. uso un segno maglia

ES. 17_7

$R_1 = 2{,}0\ \Omega$
$R_2 = 1{,}0\ \Omega$
$R_3 = R_4 = 2{,}0\ \Omega$

$\mathcal{E} = 0{,}6\ V$



a) R_{eq}

b) I_2

a) $R_3 \,//\, R_4$

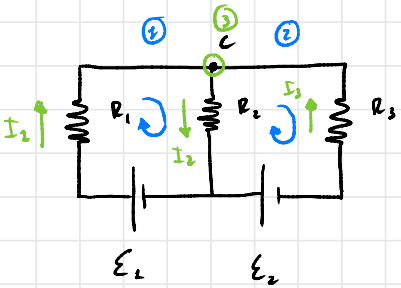
$$R_{34} = \frac{R_3 \cdot R_4}{R_3 + R_4} = \frac{4}{4} = 1{,}0\ \Omega$$

$$R_{234} = R_2 + R_{34} = 2{,}0\ \Omega$$

$$R_{1234} = \frac{R_{234} \cdot R_4}{R_{234} + R_4} = 1{,}0\ \text{OHM}$$

b) $I_2 = \frac{V_{234}}{R_{234}} = \frac{0{,}6}{2} = 0{,}3\ V$

es. 17_8



$R_1 = 4{,}0\ \Omega$
$R_2 = 6{,}0\ \Omega$
$R_3 = 3{,}0\ \Omega$
$\mathcal{E}_1 = 1{,}5\ V$
$\mathcal{E}_2 = 3{,}0\ V$

$$\begin{cases} -R_1 I_1 - R_2 I_2 + \mathcal{E}_1 = 0 & (1) \\ R_3 I_3 + R_2 I_2 + \mathcal{E}_2 = 0 & (2) \\ I_2 = I_1 + I_3 & (3) \end{cases} \qquad \begin{cases} -4 I_1 - 6 I_2 + 1{,}5 = 0 \\ 6 I_2 + 3 I_3 + 3 = 0 \\ I_3 = I_2 - I_1 \end{cases}$$

$$\begin{cases} -4 I_1 - 6 I_2 + 1{,}5 = 0 \xrightarrow{(\dots)} -4(3 I_2 + 1) - 6 I_2 + 1{,}5 = 0 \\ 6 I_2 + 3 I_2 - 3 I_1 + 3 = 0 \rightarrow I_1 = 3 I_2 + 1 \\ I_3 = I_2 - I_1 \end{cases}$$

$$\begin{cases} -12 I_2 - 4 - 6 I_2 + 1{,}5 = 0 \rightarrow -18 I_2 = 2{,}5 \rightarrow I_2 = -\frac{2{,}5}{18} = -0{,}139\ A \\ // \rightarrow I_1 = 1 - (3)(0{,}139) = 0{,}583\ A \\ // \rightarrow I_3 = -0{,}139 - 0{,}583 = -0{,}722\ A \end{cases}$$

è in verso opposto da quello fissato