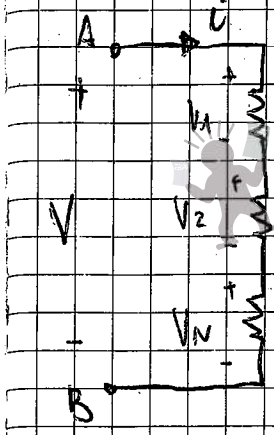
DIMOSTRAZIONI

① BIPOLI CONNESSI IN SERIE



$V = f(i)$?

$V_1 = iR_1$

$V_2 = iR_2$

$V_N = iR_N$

$V = V_1 + V_2 + \dots + V_N =$

$= i(R_1 + R_2 + \dots + R_N)$

$R_{eq} = \sum_{k=1}^{N} R_k$

② PARTITORE DI TENSIONE

① N RESISTORI IN SERIE

② V AI CAPI DELLA SERIE

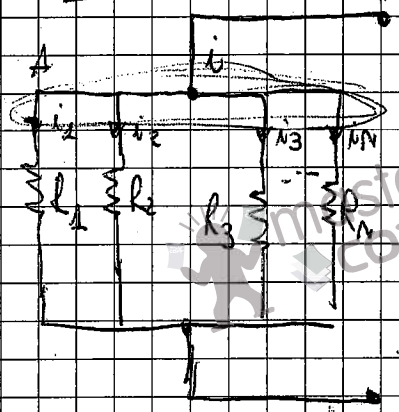
$V_k = iR_k$, ma i ma posso esprimerla in funzione della V totale

$V_k = R_k \frac{V}{R_{eq}} = V \frac{R_k}{R_1 + R_2 + \dots R_N}$

rapporto di partizione

- NUM = R sulla quale cerco la tensione
- DEN = somma delle R

• RESISTORI IN PARALLELO



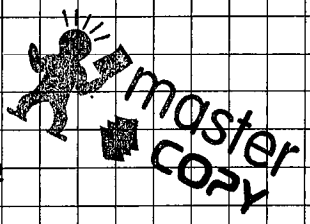
$V = f(i)$?

$i_1 = V_{R_1}/R_1$

$i_2 = V_{R_2}/R_2$

$\vdots$

$i_N = V/R_N$



LKC nodo A $\quad i = i_1 + i_2 + \dots + i_N$

$$i = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \dots \frac{1}{R_N}\right) \Rightarrow V = \frac{i}{\frac{1}{R_1} + \frac{1}{R_2} + \dots \frac{1}{R_N}} = R_{eq}\, i$$

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

• PARTITORE DI CORRENTE

① N RESISTORI IN PARALLELO ② CONOSCO LA i TOTALE

$$i_K = \frac{V}{R_K} \qquad i = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_N}\right)$$

$$i_K = \frac{1}{R_K} \cdot \frac{i}{\frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_N}} = \frac{i \cdot \frac{1}{R_K}}{\frac{1}{R_1} + \frac{1}{R_2} + \dots \frac{1}{R_N}}$$

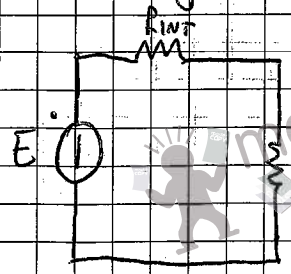
rapporto di partizione

NUM = conduttanza del ramo dove cerco la corrente

DEN = Conduttanza totale

Rendimento

Caso gen. reale di tensione con carico R



$$\eta = \frac{P_{UTILE}}{P_{EROG}} = \frac{P_{ECAR}}{P_E} = \frac{P_{RCAR}}{P_{RCAR} + P_{PERDITE}}$$

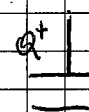
$$= \frac{R_{CAR} i^2}{R_{CAR} i^2 + R_{IN} i^2} = \frac{R_{CAR}}{R_{CAR} + R_{IN}}$$

MAX POTENZA $\Rightarrow$ $R_{CAR} = R_{IN}$ $\Rightarrow$ $\eta = \frac{1}{2} = 50\%$

$\eta \simeq 1 \Rightarrow \frac{R_{CAR}}{R_{CAR} + R_{INT}} \simeq 1 \Rightarrow R_{INT} \ll R_{CAR}$

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IL CONDENSATORE È UN ELEMENTO CON MEMORIA



$$Q^+ = CV$$

$$\bullet \quad \frac{dQ}{dt} = C\frac{dV}{dt} \quad (C = cost)$$

$$\bullet \quad \frac{dQ}{dt} = \frac{dC}{dt}V + C\frac{dV}{dt} = i(t)$$

$\frac{dC}{dt} = 0$

REL. COST

$$\left.\begin{aligned} i(t) &= C\frac{dV(t)}{dt} \\ Q^+ &= CV \end{aligned}\right\}$$ bipolo dinamico: rel. cost di tipo differenziale

RELAZIONE OPPOSTA

$$V(t) = \frac{1}{C}\int_{-\infty}^{t} i(\tau)d\tau = \frac{1}{C}\int_{-\infty}^{t_0} i(\tau)d\tau + \frac{1}{C}\int_{t_0}^{t} i(\tau)d\tau$$

$$V(t) = \frac{Q(t_0)}{C} + \frac{1}{C}\int_{t_0}^{t} i(\tau)d\tau = V(t_0) + \frac{1}{C}\int_{t_0}^{t} i(\tau)d\tau$$

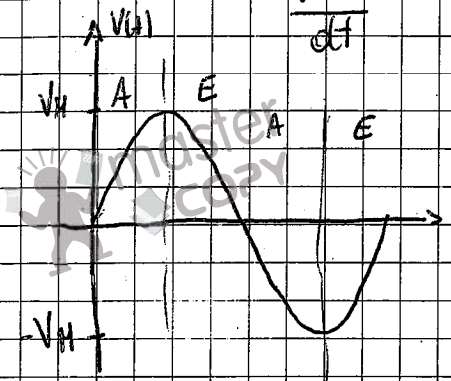
elemento con memoria

Per ottenere tensione all'istante t

- devo conoscere la tensione in un istante $t_0 < t$
- devo conoscere l'andamento della corrente da t_0 a t

IL CONDENSATORE È UN ELEMENTO PASSIVO E CONSERVATIVO

$$p(t) = v(t)\,i(t) = Cv(t)\frac{dv(t)}{dt}$$



eroga energia ≤ energia precedentemente assorbita

⇓

BIPOLO PASSIVO

$$\Delta W(t_0, t) = \int_{t_0}^{t} p(\tau)\,d\tau$$

$$\Delta W(t_0, t) = \int_{t_0}^{t} Cv(\tau)\frac{dv(\tau)}{d\tau}\,d\tau = \frac{1}{2}Cv^2(\tau)\Big|_{t_0}^{t}$$

$d\tau$ differenziale

$$\Delta W(t_0, t) = \frac{1}{2}Cv^2(t) - \frac{1}{2}Cv^2(t_0)$$

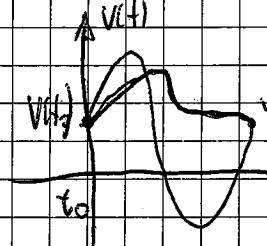
estremo

$$\Delta w(t_0, t) = w(t) - w(t_0) \rightarrow$$ GRANDEZZA CONSERVATIVA: compaiono solo gli estremi

⇓

energia istantanea

NON SI DISSIPA ENERGIA SE TORNO ALLA STESSA TENSIONE



se $v(t_0) = v(t) \rightarrow \Delta W(t_0, t) = \phi$

ENERGIA ISTANTANEA: $w(t) = \frac{1}{2}Cv^2(t)$ (≥ 0)

se $w(t_0) = \phi \rightarrow t_0$ ISTANTE STAZIONARIO

E MAX $\Delta W(t_0, t) = \frac{1}{2}Cv^2(t)$

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