

Autoinduzione

I in un circuito genera un campo magnetico

Da Biot-Savart $\rightarrow \vec{B}_{\text{FIO}} = \frac{\mu_0 I}{4\pi} \oint \frac{d\vec{\ell} \wedge \Delta\vec{z}}{|\Delta\vec{z}|^3}$

$\Rightarrow \phi_B = \int_S \frac{\mu_0 I}{4\pi} \oint \frac{d\vec{\ell} \wedge \Delta\vec{z}}{|\Delta\vec{z}|^3} \cdot \vec{n} dS$ ✓

flusso di \vec{B} generato da I
AUTOFLUSSO

↳ Tutto dipende dalla geometria del circuito, Tranne I

$\Rightarrow \phi_B = \underbrace{L}_{\text{INDUTTANZA}} \cdot I$

Se $B \neq \text{cost}$

Se $B \neq \text{cost} \rightarrow \phi_B \neq \text{cost} \Rightarrow \frac{d\phi_B}{dt} \neq 0$

$\Rightarrow \frac{d\phi_B}{dt} = L \frac{dI}{dt}$

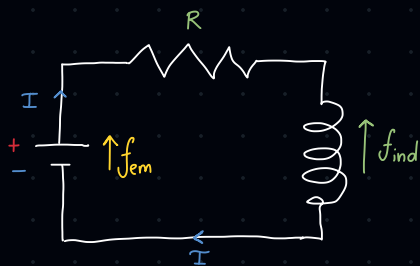
ma $f_{em} = -\frac{d\phi_B}{dt} \Rightarrow$

$f_{em} = -L \frac{dI}{dt}$

Forza elettromotrice
Autoindotta

Circuito RI

Secondo la legge di Ohm generalizzata



$$\sum_i f_{em} = I \cdot \sum_i R_i \Rightarrow f_{em} - f_{ind} = R \cdot I$$

$$\Rightarrow f_{em} = f_{em} + R \cdot I \quad \text{ma} \quad f_{ind} = -L \frac{dI}{dt}$$

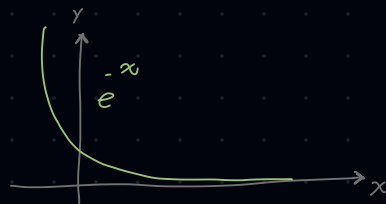
$$\Rightarrow f_{em} = RI + L \frac{dI}{dt} \quad \text{Equazione differenziale con soluzione del tipo: } I = Ae^{\lambda t} + D$$

$$\Rightarrow \frac{dI}{dt} = A \lambda e^{\lambda t} \Rightarrow f_{em} = L \lambda A e^{\lambda t} + R A e^{\lambda t} + R D \quad f_{em} = 0 \Rightarrow f_{em} = R D \Rightarrow D = \frac{f}{R}$$

$$\text{per cui } L A \lambda e^{\lambda t} + R A e^{\lambda t} = 0 \Rightarrow A e^{\lambda t} (\lambda L + R) = 0 \Rightarrow \lambda L + R = 0 \Rightarrow \lambda = -\frac{R}{L}$$

$$\Rightarrow I(t) = A e^{-\frac{R}{L}t} + \frac{f}{R} \quad \text{Troviamo } A$$

$$\Rightarrow f(0) = 0 \Rightarrow A e^{-\frac{R}{L} \cdot 0} + \frac{f}{R} = 0 \Rightarrow A + \frac{f}{R} = 0 \Rightarrow A = -\frac{f}{R}$$



$$\Rightarrow I(t) = -\frac{f}{R} e^{-\frac{R}{L}t} + \frac{f}{R}$$

$$\text{Se } t \rightarrow \infty \quad \lim_{t \rightarrow \infty} -\frac{f}{R} e^{-\frac{R}{L}t} + \frac{f}{R} = \lim_{t \rightarrow \infty} \frac{f}{R} \left(1 - e^{-\frac{R}{L}t} \right)$$

$$\hookrightarrow I = \frac{f}{R} \quad \text{CORRENTE DI REGIME}$$