Esercitazione 7 - Legge di Ampere

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ESERCIZIO

Un conduttore cilindrico di raggio $r = 1\,cm$ ha un campo magnetico $\bar{H} = \frac{10^4}{\pi_0}\left(\frac{1}{\varrho^2}\sin(\varrho\pi_0) - \frac{\pi}{\varrho}\cos(\varrho\pi_0)\right)\hat{\phi}\ \left[\frac{1}{m}\right]$

$\varrho = \frac{\pi}{2\pi_0}$ Calcola $I = ?$

$$I = \int \bar{H}\cdot d\bar{l} = \int_0^{2\pi} \frac{10^4}{\pi_0}\left(\frac{1}{\varrho^2}\sin(\varrho\pi_0) - \frac{\pi}{\varrho}\cos(\varrho\pi_0)\right)\hat{\phi}\,\hat{\phi}\,\pi\,d\phi \Rightarrow$$

$d\bar{l} = \hat{\phi}\,\pi\,d\phi$

$$\Rightarrow \frac{10^4}{\pi_0}\left(\frac{1}{\left(\frac{\pi}{2\pi_0}\right)^2}\sin\left(\frac{\pi}{2\pi_0}\pi_0\right) - \frac{0{,}02}{\left(\frac{\pi}{2\pi_0}\right)}\cos\left(\frac{\pi}{2\pi_0}\pi_0\right)\right)0{,}01\cdot 2\pi =$$

$$\Rightarrow \frac{10^4}{\pi_0}\left(\frac{1}{\left(\frac{\pi}{2\pi_0}\right)^2}\sin\left(\frac{\pi}{2}\right) - \frac{0{,}02}{\frac{\pi}{2\pi_0}}\cos\left(\frac{\pi}{2}\right)\right)0{,}01\cdot 2\pi$$

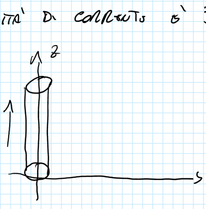
$$= \frac{10^4}{\pi_0}\,\frac{1}{\left(\frac{\pi}{2\pi_0}\right)^2}\cdot 0{,}01\cdot 2\pi = \frac{10^4}{\pi_0}\cdot\frac{4\pi_0^2}{\pi^2}\cdot 1\cdot 2\pi = \frac{4\cdot 10^4\pi_0\cdot\pi\cdot 2}{\pi}$$

$$= \frac{8\cdot 10^4\pi_0\cdot 0{,}01}{\pi} = \frac{8\cdot 10^2\pi_0}{\pi}\ [A]$$

ESERCIZIO

Nella regione $0 \le r \le 0{,}5$ di un conduttore cilindrico la densità di corrente è $\bar{J} = \hat{z}\,4{,}5\,e^{-2r}\ \left[\frac{A}{m^2}\right]$

$\bar{H} = ?$



$I = \int \bar{H}\,d\bar{l}\ [A]$

$H = \hat{\phi}\,H_\phi$

$$I = \int_0^{2\pi} \hat{\phi}\,H_\phi\,\hat{\phi}\,r\,d\phi = H_\phi\cdot r\cdot 2\pi =$$

$$\Rightarrow H_\phi = \frac{I}{2\pi r}$$

$$I = \int \bar{J}\cdot\hat{n}\,dS = \int_0^{0{,}5}\int_0^{2\pi} \bar{J}\cdot r\,\hat{z}\,dr\,d\phi =$$

$$\int_0^{0{,}5}\int_0^{2\pi} -\hat{z}\,4{,}5\,e^{-2r}\cdot\hat{z}\,r\,dr\,d\phi =$$

$$4{,}5\int_0^{0{,}5} e^{-2r}\,r\,dr\int_0^{2\pi} d\phi = 4{,}5\cdot 2\pi\cdot 0{,}066 = 1{,}86\,[A]$$

$$H = \hat{\phi}\,\frac{I}{2\pi r} = \hat{\phi}\,\frac{0{,}6\pi}{2\pi r} = \frac{0{,}6}{2\cdot r} = \hat{\phi}\,\frac{0{,}6}{2r}\left[\frac{A}{m}\right]$$

ESERCIZIO

Trovare la forza magnetica che agisce su un conduttore lungo $l = 50\,cm$ percorso da una corrente $I = 3{,}5\,[A]$ verso $\hat{y}$ con $\bar{B} = -\hat{x}\,7{,}5\,[T]$ Trova $\bar{F}_m$

$$F_m = I(\bar{l}\times\bar{B}) = 3{,}5\left(0{,}5\hat{y}\times -\hat{x}\,7{,}5\right) = \hat{z}\,13{,}125\ [N]$$

ESERCIZIO

Considerando un condensatore a 4 piatti quadrati e parallelo calcolare la ε_r del mezzo tra i due piatti sapendo che $C = 13\,pF$ l'area è $A = 0{,}008\,m^2$, $d = 10\,mm$

$$C = \frac{\varepsilon A}{d} \quad \varepsilon = \frac{d\cdot C}{A\cdot\varepsilon_0} = \frac{0{,}01\cdot(13\cdot 10^{-12})}{0{,}008\cdot 8{,}85\cdot 10^{-12}} = 1{,}83$$

ESERCIZIO

Abbiamo un condensatore a piastre parallele rettangolari di lato $a = 2\,cm$ e $b = 6\,cm$ $d = 7\,mm$ Abbiamo $V = 80\,[V]$ e $\varepsilon_r = 3$ $\bar{E} = ?$ $\bar{Q} = ?$ $W_e = ?$

$$\bar{E} = -\hat{z}\,E_z = -\hat{z}\,12{,}8\cdot 10^3\left[\frac{V}{m}\right]$$

$$E_z = \frac{V}{d} = \frac{80}{0{,}0007} = 12{,}8\cdot 10^3\left[\frac{V}{m}\right]$$

$$Q = V\cdot C = 4{,}5\cdot 10^{-12}\cdot 80 = 4{,}05\cdot 10^{-10}\ [C]$$

$$C = \frac{\varepsilon A}{d} = \frac{\varepsilon_0\varepsilon_r\cdot A}{d} = 4{,}5\cdot 10^{-12}\ [F]$$

$A = 6\cdot 2 = 12$

$$W_e = \frac{1}{2}\,C\cdot V^2 = 1{,}84\cdot 10^{-8}\ [J]$$