Università degli Studi Roma Tre
Dipartimento di Matematica

II Prova di Esonero
FS2, Fisica 2
Elettromagnetismo
A.A. 2002/2003

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SOLUZIONI

1) $U_i = \frac{1}{2\,\mu_0} B_0^2\, S\, d$ $\qquad$ $U_f = \frac{1}{2\,\mu_0\,\mu_r} B_0^2\, S\, d = \frac{B_0^2}{2\,\mu_0\,(1+\chi)} S\, d$

$$\Delta U = U_f - U_i = \frac{B_0^2\, S\, d}{2\,\mu_0}\left(\frac{1}{1+\chi} - 1\right) = \frac{B_0^2\, S\, d}{2\,\mu_0}\left(\frac{-\chi}{1+\chi}\right) = -\,0.64\ \text{mJ}$$

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2) $dS = \frac{\omega\, l^2\, dt}{2} = \pi\, v\, l^2\, dt$ $\qquad$ $d\Phi(\vec{B}) = \mu_0\ \mu_r\ H\, \pi\, v\, l^2\, dt$

$$|f| = \left| -\frac{d\Phi(\vec{B})}{dt} \right| = \mu_0\ \mu_r\ H\, \pi\, v\, l^2$$

$$H = \frac{|f|}{\mu_0\ \mu_r\ \pi\, v\, l^2} = \frac{4.07 \cdot 10^{-5}}{12.56 \cdot 10^{-7} \cdot 3.14 \cdot 1.9 \cdot (0.45)^2} = 26.82\ \text{A/m}$$

3-a) $\text{rot}\,\vec{H} = \frac{\partial \vec{D}}{\partial t}$ (poiché $\vec{J} = 0$) $\qquad$ $\text{rot}\,H = \frac{d}{dt}\frac{Q_0\ \text{sen}^2\ \omega t}{4\,\pi\, x^2} = \frac{\omega\, Q_0\ \text{sen}\ 2\omega t}{4\,\pi\, x^2}$

La variazione percentuale per x = r ed x = r+d è:

$$\Delta = \frac{\text{rot}_{r+d} H - \text{rot}_r H}{\text{rot}_r H} \cdot 100 = \frac{\frac{\omega\, Q_0}{4\,\pi\,(r+d)^2} - \frac{\omega\, Q_0}{4\,\pi\, r^2}}{\frac{\omega\, Q_0}{4\,\pi\, r^2}} \cdot 100 = \left[\left(\frac{r}{r+d}\right)^2 - 1\right] \cdot 100 = \left[\left(\frac{45}{45+5}\right)^2 - 1\right] \cdot 100 = -19\ \%$$

3-b) $\oint \vec{H} \cdot d\vec{l} = \int_S \text{rot}\,\vec{H} \cdot \hat{n}\, dS$

$$\oint \vec{H} \cdot d\vec{l} = \frac{\omega\, Q_0\ \text{sen}\,(2\omega t_1)\, S}{4\,\pi\, r^2} = \frac{35 \cdot 3.14 \cdot 1.9 \cdot 10^{-7} \cdot \text{sen}\left(2 \cdot 35 \cdot \pi \cdot \frac{1}{250}\right) \cdot 5 \cdot 10^{-2}}{4 \cdot 3.14 \cdot (0.45)^2} = 3.16 \cdot 10^{-7}\ \text{A}$$