VE230 Hw 6 周维凯 518021911039

P6-27. a). $R_g = \frac{l_g}{\mu_0 S} = \frac{3\times 10^{-3}}{4\pi\times 10^{-7}\times(\pi\times 0.025)^2} = 1.21\times 10^6\ H^{-1}$

$R_c = \frac{2\pi\times 0.08 - 0.03}{3000\times 4\pi\times 10^{-7}\times(\pi\times 0.025)^2} = 6.75\times 10^4\ H^{-1}$

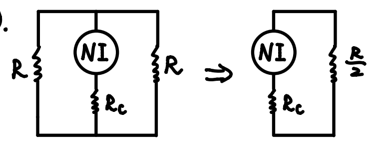
b). $\vec{B_g} = \vec{B_c} = \frac{10^{-5}}{\pi\times 0.025^2}\hat{a_\phi} = 5.09\times 10^{-3}\hat{a_\phi}$ T

$\vec{H_g} = \frac{1}{\mu_0}\vec{B_g} = 4.05\times 10^3\hat{a_\phi}$ A/m

$\vec{H_c} = \frac{1}{\mu_0\mu_r}\vec{B_c} = 1.35\hat{a_\phi}$ A/m

c). $NI = \Phi(R_g + R_c) \Rightarrow I = \frac{1}{N}\Phi(R_g + R_c) = 0.0256$ A.

P6-28 a).



$R_c = \frac{0.002}{\mu_0 S} - \frac{0.24 - 0.002}{\mu_0\mu_r S} = 1.6\times 10^6\ H^{-1}$

$R = \frac{0.24 + 0.4}{\mu_0\mu_r S} = 0.1\times 10^6\ H^{-1}$

$\Phi_c = \frac{NI}{R_c + \frac{R}{2}} = 3.63\times 10^{-4}$ Wb

$\Phi_R = \Phi_L = \frac{\Phi_c}{2} = 1.82\times 10^{-4}$ Wb

b). $H_{cg} = \frac{1}{\mu_0 S}\Phi_c = 28.9\times 10^4$ A/m

$H_{cc} = \frac{1}{\mu_0\mu_r S}\Phi_c = 57.8$ A/m

$H_L = H_R = \frac{1}{\mu_0\mu_r S}\Phi_R = 28.9$ A/m

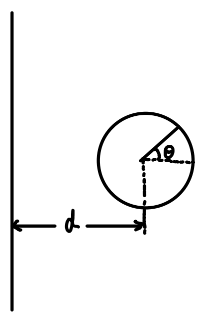
P6-31 $\mu_1 H_{1n} = \mu_2 H_{2n}$

$\mu_1\frac{\partial V_{m1}}{\partial n} = \mu_2\frac{\partial V_{m2}}{\partial n}$

Also: $H_{1t} = H_{2t}$

$V_{m1} = V_{m2}$

P6-39

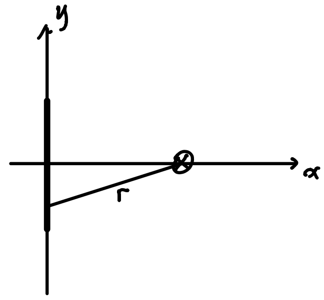


$\Lambda = \int_0^b\int_0^{2\pi}\frac{\mu_0 I}{2\pi(d + r\cos\theta)}r\,d\theta\,dr$

$= \mu_0 I\left(d - \sqrt{d^2 - b^2}\right)$

$L = \frac{\Lambda}{I} = \mu_0\left(d - \sqrt{d^2 - b^2}\right)$

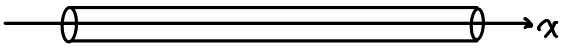
P6-43 $dH = \frac{dI}{2\pi r} = \frac{I}{2\pi w r} dy$



$\vec{H} = \hat{a_y} \int_W \frac{ID}{2\pi W r^2} dy = \hat{a_y} \int_W \frac{ID}{2\pi w (y^2+D^2)} dy = \hat{a_y} \frac{1}{\pi W} \arctan\left(\frac{W}{2D}\right)$

$\vec{F} = \vec{I} \times \vec{B} = \hat{a_x} \frac{\mu_0 I^2}{\pi W} \arctan\left(\frac{W}{2D}\right)$

P6-48



$\Phi = x \int_a^b \frac{\mu_0 I}{2\pi r} dr = \frac{\mu_0 I x}{2\pi} \ln\frac{b}{a}$

$L = \frac{\Phi}{I} = \frac{\mu_0 x}{2\pi} \ln\frac{b}{a}$

$W_m = \frac{1}{2} L I^2 = \frac{\mu_0 x}{4\pi} \ln\frac{b}{a} I^2$

$\vec{F} = \hat{a_x} \frac{\partial W_m}{\partial x} = \hat{a_x} \frac{\mu_0 I^2}{4\pi} \ln\frac{b}{a}$

P6-53 $W_m = \frac{1}{2} \int \mu H^2 dv$

$W_m(x+\Delta x) = W_m(x) + \frac{1}{2} \int_{S\Delta x} (\mu - \mu_0) H^2 dv$

$= W_m(x) + \frac{1}{2} \mu_0 (\mu_r - 1) n^2 I^2 S \Delta x$

$F = \frac{1}{2} \mu_0 (\mu_r - 1) n^2 I^2 S$. direction: to the right.