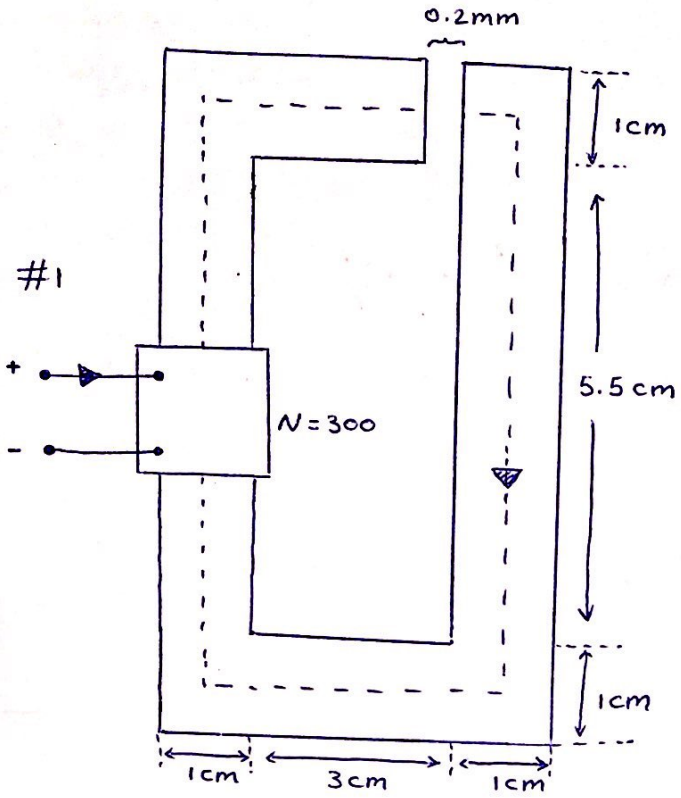
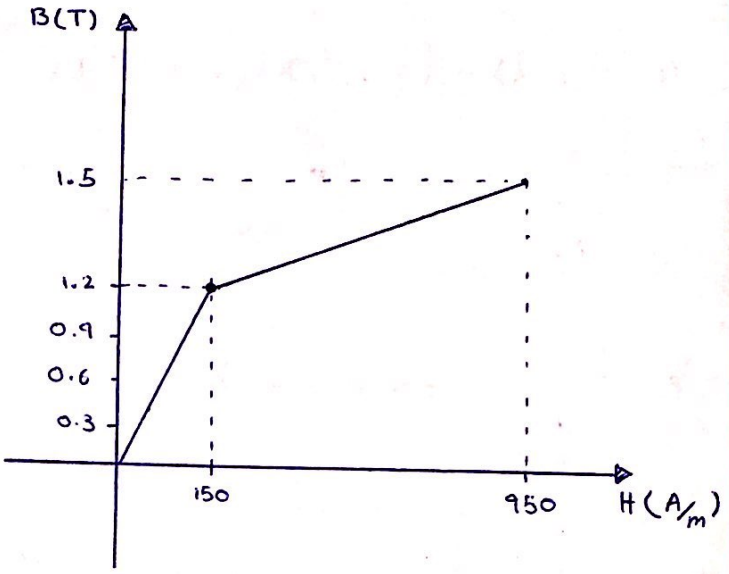
یا علی

رضا دینه پور
۹۸۱۴۳۰۳
امتحان پایانترم پائیز ۱

#1





الف) if $B = 0.6\ T \longrightarrow \begin{cases} i = ? \\ w = ? \end{cases}$

با توجه به منحنی B-H : $H_1 = 75\ AT/m$

$B_c = B_g = 0.6\ T$

$H_g = \frac{B_g}{\mu_0} = \frac{0.6}{4\pi \times 10^{-7}} = 0.47 \times 10^7\ AT/m$

$N.i = H_1 L_1 + H_g \cdot g \Rightarrow 300i = 75 \times 21 \times 10^{-2} + 0.47 \times 10^7 \times 2 \times 10^{-3}$

$\Rightarrow i = \frac{9415.75}{300} \simeq \underline{31.40\ A}$,

$L_1 = 2(5.5 + 0.5 \times 2) + 2(3 + 0.5 \times 2) = 21\ cm$

$A = 10^{-2} \times 10^{-2} = 10^{-4} = 1\ cm^2$

$\varphi = AB = 0.6 \times 1 \times 10^{-4} = 0.06\ mWb$

$\lambda = N\varphi = 300 \times 0.06 \times 10^{-3} = 18 \times 10^{-3}$ $\Rightarrow L = \frac{\lambda}{i} = \frac{0.018}{31.40} = 0.573\ mH = 573 \times 10^{-3}\ mH$

$\Rightarrow W = \frac{1}{2} L i^2 = \frac{1}{2} (573 \times 10^{-3} \times 10^{-3} \times (31.40)^2) \simeq 282 \times 10^{-3}\ J$

ب) $B = 1.5\ T \xrightarrow[\text{B-H منحنی}]{\text{با توجه به}} H_1 = 950\ AT/m$, $B_c = B_g = 1.5\ T$, $H_g = \frac{B_g}{\mu_0} = \frac{1.5}{4\pi \times 10^{-7}} = 0.119 \times 10^{+7}$

$300i = 950 \times 10^{-2} \times 21 + 0.119 \times 10^7 \times 21 \times 10^{-3} \Rightarrow i = \frac{2579.5}{300} \simeq \underline{8.6\ A}$

$\varphi = 1.5 \times 10^{-4} = 0.15\ mWb$, $L = \frac{\lambda}{i} = \frac{N\varphi}{i} = \frac{300 \times 0.15 \times 10^{-3}}{8.6} = 5.23\ mH$

$\Rightarrow W = \frac{1}{2} L i^2 = \frac{1}{2} \times 5.23 \times 10^{-2} \times (8.6)^2 = 1.95\ J$

رضا کیمیایی پور
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#2 $i = a\lambda^2 + b\lambda(x-d)^2 \longrightarrow f = ?$

$$W_f = \int i\, d\lambda = \int [a\lambda^2 + b\lambda(x-d)^2]\, d\lambda = \frac{a}{3}\lambda^3 + \frac{b}{2}\lambda^2(x-d)^2$$

$$f = \frac{-\partial}{\partial x}(W_{f(\lambda,x)})\Big|_{\lambda = \text{ثابت}} = \frac{-\partial}{\partial x}\left(\frac{a}{3}\lambda^3 + \frac{b}{2}\lambda^2(x-d)^2\right) = \frac{-b}{2}\lambda^2 \times 2(x-d)$$

$$= -b\lambda^2(x-d)$$

If $\begin{cases} a=1 \\ b=2 \\ d=3 \\ x=0.5 \end{cases} \Rightarrow f = -2\lambda^2(0.5-3) = 5\lambda^2$ N

#3 $\begin{cases} L(\theta) = 0.02 - 0.04\cos 2\theta - 0.03\cos 4\theta \\ \theta = \omega_m t + \theta_0 \\ f = 50\ Hz \\ I_{RMS} = 5 \\ \omega_m = ? \end{cases}$

$$T = \frac{1}{2} i_s^2 \frac{dL_{ss}}{d\theta} + \frac{1}{2} i_r^2 \frac{dL_{rr}}{d\theta} + i_s i_r \frac{dL_{sr}}{d\theta}$$

$$i_s = I_{sm} \sin \omega t$$

$$T = \frac{1}{2} i_s^2 \frac{dL_{ss}}{d\theta} = \frac{1}{2} \times I_{RMS}^2 \sin^2 \omega t \cdot \frac{d}{d\theta}(0.02 - 0.04\cos 2\theta - 0.03\cos 4\theta)$$

$$= \frac{1}{2} \times 5^2 \times \left(\frac{1-\cos 2\omega t}{2}\right) \times (0.08 \sin 2\theta + 0.12 \sin 4\theta)$$

$$\Rightarrow T = \sin 2(\omega_m t + \theta_0) + 1.5 \sin 4(\omega_m t + 5) - 0.5 \sin[(2\omega_m + 2\omega)t + 2S] - 0.5 \sin[(2\omega_m - 2\omega)t + 2S]$$

$$- 0.75 \sin[(4\omega_m + 2\omega)t + 4S] - 0.75[(4\omega_m - 2\omega)t + 4S]$$

$\Rightarrow 2\omega_m + 2\omega = 0 \Rightarrow \omega_m = -\omega = -2\pi f = -2\pi \times 50 = -314.16$ rad/s

$\Rightarrow 2\omega_m - 2\omega = 0 \Rightarrow \omega_m = \omega = 2\pi f = 2\pi \times 50 = 314.16$ rad/s

$\Rightarrow 4\omega_m + 2\omega = 0 \Rightarrow \omega_m = \frac{-1}{2}\omega = -\pi \times 50 = -157.08$ rad/s

$\Rightarrow 4\omega_m - 2\omega = 0 \Rightarrow \omega_m = \frac{\omega}{2} = 157.08$ rad/s

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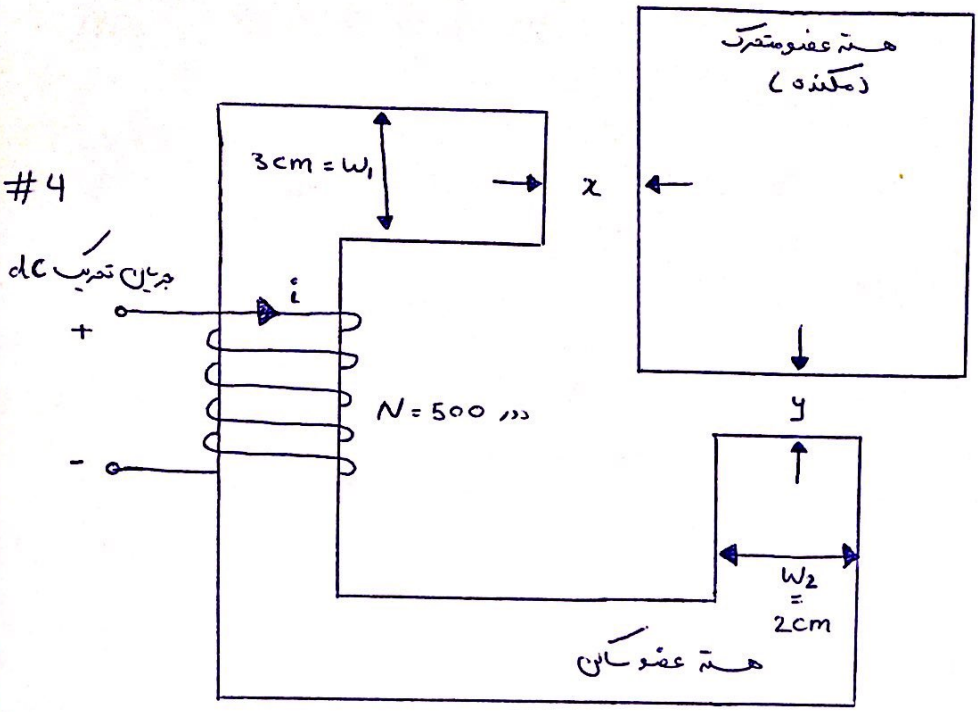
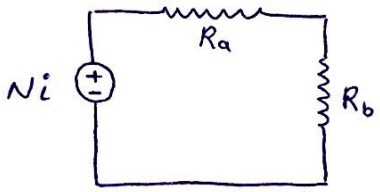
#4



ضخامت = D = 1cm

الف) $\begin{cases} \mu_r \to \infty \\ R_c \to 0 \end{cases}$



$A_a = w_1 \times D = 3\times10^{-2}\times10^{-2} = 3\,cm^2$

$A_b = w_2 \times D = 2\times10^{-2}\times10^{-2} = 2\,cm^2$

$$R_a = \frac{a}{\mu_\circ A_a} = \frac{a}{3\mu_\circ \times 10^{-4}}, \quad R_b = \frac{b}{\mu_\circ A_b} = \frac{b}{2\mu_\circ \times 10^{-4}} \Rightarrow R_{eq} = R_a + R_b$$

$$= \frac{a}{3\mu_\circ \times 10^{-4}} + \frac{b}{2\mu_\circ \times 10^{-4}} = \frac{2a+3b}{6\mu_\circ \times 10^{-4}}, \quad Ni = R_{eq}\varphi \Rightarrow \varphi = \frac{Ni}{R_{eq}} = \frac{500i}{\frac{2a+3b}{6\mu_\circ\times10^{-4}}}$$

$$\Rightarrow \varphi = \frac{0.3\mu_\circ i}{2a+3b}$$

ب) $W_f = \frac{1}{2}\lambda i = \frac{1}{2}N\varphi i = \frac{1}{2}\times500\times\frac{0.3\mu_\circ i^2}{2a+3b} = \frac{75\mu_\circ i^2}{2x+3y}$ سیستم خطی است $\Rightarrow W_f = W_f'$

$$\Rightarrow W_f' = \frac{75\mu_\circ i^2}{2x+3y}$$

$$f = \frac{\partial}{\partial a}W_f' + \frac{\partial}{\partial b}W_f' = \frac{-2\times75\mu_\circ i^2}{(2a+3b)^2} - \frac{3\times75\mu_\circ i^2}{(2a+3b)^2} = \frac{-150\times4\pi\times10^{-7}\times5^2}{(2\times10^{-3}+3\times2\times10^{-3})^2} - \frac{225\times4\pi\times10^{-7}\times5^2}{(2\times1\times10^{-3}+3\times2\times10^{-3})^2}$$

$$= \frac{-375\pi}{16} - \frac{1125\pi}{32} \cong -184\ N$$

رضا آذین‌پور
۹۸۱۴۳۰۳
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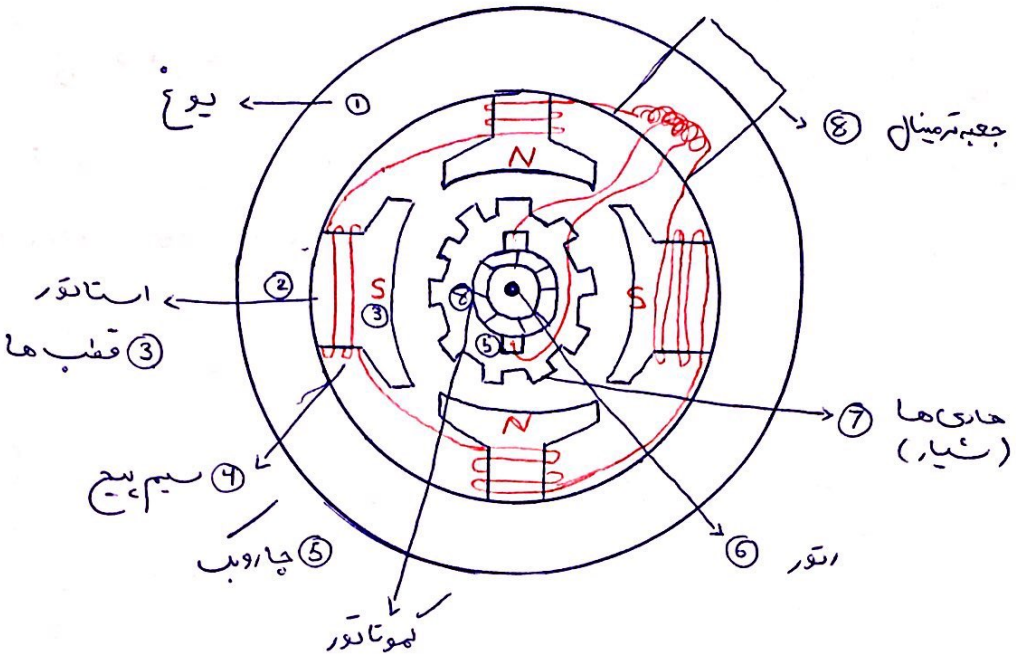
#5



#6

$$\begin{cases} \bar{V}_t = 400\angle 0^\circ \\ I_L = 200\ A \\ R_A = 0.06\ \Omega \\ R_f = 100\ \Omega \\ P_{core} + P_{mis} = 2\times10^3\ W \\ P_{in} = ? \end{cases}$$

$$P_{out} = \bar{V}_t\ I_L = 400 \times 200 = 80000\ W = 80\ KW$$

$$I_f = \frac{V_T}{R_f} = \frac{400}{100} = 4\ A$$

$$I_A = I_L + I_f = 200 + 4 = 204\ A$$

$$P_{cu} = R_A I_A^2 + R_f I_f^2 = 0.06 \times (204)^2 + 100 \times 4^2$$

$$= 4096.96\ W$$

$$\Delta P = P_{mis} + P_{core} + P_{cu} = 200 + 4096.96 = 6096.96\ W$$

$$P_{in} = P_{out} + \Delta P = 80000 + 6096.96 = 86096.96\ W$$

$$P_{cu} = P_f + P_{mec} + P_{core} \quad , \quad R_a I_a^2 = R_f I_f^2 + 2000 \Rightarrow 0.06\ I_a^2 = 100 \times 4^2 + 2000$$

$$\Rightarrow I_a^2 = \frac{3600}{0.06} \Rightarrow I_a = \left(\frac{3600}{0.06}\right)^{1/2} \approx \underline{245\ A}$$

رضا ادیب‌پور
۹۸۱۴۳۰۳
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#7

$$\begin{cases} n = 700 \text{ rpm} \\ P_{out} = 8 \text{ hp} = 8 \times 746 = 5968 \text{ W} \\ R_a + R_S = 3.5 \Omega \\ P_{mec} + P_{core} = 450 \text{ W} \end{cases}$$

$$\frac{P_m}{P_G} = \left(\frac{n_m}{n_G}\right)^3 \Rightarrow \frac{5968}{P_G} = \left(\frac{700}{600}\right)^3 \Rightarrow P_G = 3758.27 \text{ W}$$

$$\frac{E_{Am}}{E_{AG}} = \frac{n_m}{n_G} \Rightarrow \frac{E_{Am}}{458} = \frac{700}{600} \Rightarrow E_{Am} = 534.33 \text{ V}$$

$E_{Am} = \frac{700}{600} \times 434 = 506.33 \text{ V}$ ✗ ; $E_{Am} = \frac{700}{600} \times 393 = 458.5 \text{ V}$ طبق جدول $\rightarrow I_L = 10.5 \text{ A}$

$\Rightarrow I_A = I_L = I_f = 10.5 \text{ A}$, $P_{cu} = (R_a + R_c) I_A^2 = 3.5 \times (10.5)^2 = 385.875 \text{ W}$

$P_{in} = P_{out} + P_{cu} + P_{core} + P_{mec} = 5968 + 385.875 + 450 = 6803.875 \text{ W}$

$E_{A2} = V_t - (R_A + R_S) I_A = 5000 - 3.5 \times 10.5 = 463.25 \text{ V}$

$$\Rightarrow \frac{E_{A2}}{E_{Am}} = \frac{n_2}{n_m} \Rightarrow \frac{463.25}{458.5} = \frac{n_2}{700} \Rightarrow n_2 = 707.25 \text{ rpm}$$