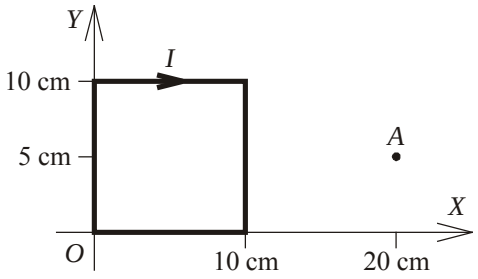
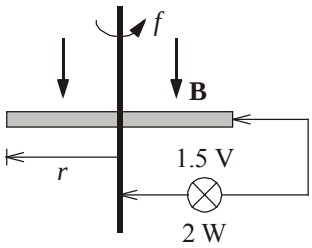
OSNOVE ELEKTROTEHNIKE II (VSŠ)
izpit, 12. junij 2001

1. V kvadratnem ovoju teče enosmerni tok $I = 30\,\mathrm{A}$. Izračunajte vektor $\vec{B}$ v točki *A*, ki leži na ravnini ovoja!

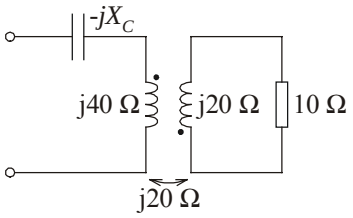


2. Koncentrično skozi železno cev dolžine 10 metrov, notranjega premera 20 cm, debeline stene 1 cm in permeabilnosti $8000\mu_0$ povlečemo vodnik, ki vodi tok 10 A. Kolikšen bo magnetni fluks v cevi?

3. Os vrtečega bakrenega diska polmera 20 cm sovpada s smerjo homogenega magnetnega polja gostote 200 mT. S kolikšno frekvenco mora rotirati disk, da bo žarnica pravilno napajana?



4. Določite vrednost kapacitivne reaktance X_c, da bo dvopol predstavljal čisto ohmsko breme! Kolikšna bo takrat rezistanca dvopola?



5. Termoakumulacijska peč nazivne moči 3500 W ima tri grela vezana v zvezdo brez ničlovoda (ničlovod je prekinjen). Kolikšna bo moč peči, če eno grelo pregori?

OSNOVE ELEKTROTEHNIKE II (VSŠ)
izpit, 12. junij 2001
Rešitve

1. Po superpoziciji seštejemo prispevke štirih tokovnih daljic, ki sestavljajo ovoj; začnimo npr. pri zgornji in nadaljujmo v smeri toka:

$$\vec{B}(A)=\frac{\mu_0 I}{4\pi}\left[-\vec{e}_z\frac{1}{5\text{ cm}}\left(\frac{20}{\sqrt{20^2+5^2}}-\frac{10}{\sqrt{10^2+5^2}}\right)+\vec{e}_z\frac{1}{10\text{ cm}}\left(\frac{5}{\sqrt{5^2+10^2}}-\frac{-5}{\sqrt{5^2+10^2}}\right)-\right.$$

$$\left.-\vec{e}_z\frac{1}{5\text{ cm}}\left(\frac{-10}{\sqrt{10^2+5^2}}-\frac{-20}{\sqrt{20^2+5^2}}\right)-\vec{e}_z\frac{1}{20\text{ cm}}\left(\frac{5}{\sqrt{5^2+20^2}}-\frac{-5}{\sqrt{5^2+20^2}}\right)\right]$$

$$=\vec{e}_z\frac{\mu_0 I}{4\pi(5\text{ cm})}\left[\frac{1}{\sqrt{425}}\left(-20-20-\frac{10}{4}\right)+\frac{1}{\sqrt{125}}\left(10+\frac{10}{2}+10\right)\right]$$

$$=\vec{e}_z\frac{\mu_0 I}{4\pi(5\text{ cm})}\left[\frac{1}{5\sqrt{17}}\left(-\frac{85}{2}\right)+\frac{1}{5\sqrt{5}}25\right]=\vec{e}_z\frac{\mu_0 I}{4\pi(5\text{ cm})}\left(-\frac{\sqrt{17}}{2}+\sqrt{5}\right)$$

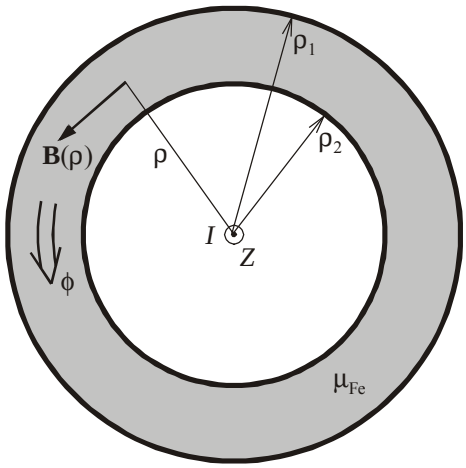
$$\doteq\vec{e}_z\frac{10^{-7}\,\frac{\text{Vs}}{\text{Am}}\cdot 30\text{ A}}{5\text{ cm}}\cdot 0.175\doteq\vec{e}_z 10.5\,\mu\text{T}$$

2. Os Z valjnega koordinatnega sistema postavimo v os vodnika:

$$\vec{B}(\rho)=\vec{e}_\varphi\frac{\mu_{\text{Fe}} I}{2\pi\rho}\;;\;\rho_1<\rho\le\rho_2$$

$$\phi=\int_{\rho_1}^{\rho_2}B(\rho)l\,\text{d}\rho=\frac{\mu_{\text{Fe}} I}{2\pi}l\ln\frac{\rho_2}{\rho_1}$$

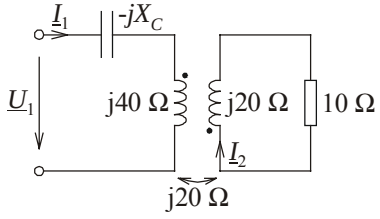
$$=8000\cdot 2\cdot 10^{-7}\,\frac{\text{Vs}}{\text{Am}}\cdot 10\text{ A}\cdot 10\text{ m}\cdot\ln\frac{11}{10}\doteq 15.2\text{ mWb}$$



3. Da bo žarnica pravilno napajana, se mora med centrom in obodom diska inducirati napetost 1.5 V:

$$U_{\text{ind.}}=fB\pi r^2=1.5\text{ V}\Rightarrow f=\frac{1.5\text{ V}}{\pi\cdot(20\text{ cm})^2\cdot 200\cdot 10^{-3}\text{ Vs/m}^2}\doteq 59.7\text{ Hz}$$

4.



$$\underline{U}_1=(-jX_c+j\cdot 40\,\Omega)\underline{I}_1+j\cdot 20\,\Omega\cdot\underline{I}_2$$

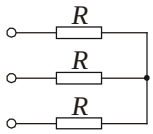
$$j\cdot 20\,\Omega\cdot\underline{I}_1+(10\,\Omega+j\cdot 20\,\Omega)\underline{I}_2=0\Rightarrow\underline{I}_2=-\frac{j20}{10+j20}\underline{I}_1$$

$$\underline{Z}_{\text{vh}}=\frac{\underline{U}_1}{\underline{I}_1}=(-jX_c+j\cdot 40\,\Omega)+\frac{400\,\Omega}{10+j20}$$

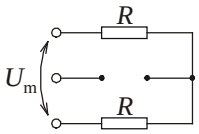
$$=-jX_c+j\cdot 40\,\Omega+\frac{40\,\Omega}{1+j2}=8\,\Omega+j(24\,\Omega-X_c)$$

$$\underline{Z}_{\text{vh}}=R_{\text{vh}}+jX_{\text{vh}}\;;\;X_{\text{vh}}=0\Rightarrow X_c=24\,\Omega\;;\;R_{\text{vh}}=8\,\Omega$$

5.



$$P_1=3\frac{U_{\text{f}}^2}{R}=\frac{U_{\text{m}}^2}{R}=3500\text{ W}$$



$$P_2=\frac{U_{\text{m}}^2}{2R}=\frac{P_1}{2}=1750\text{ W}$$