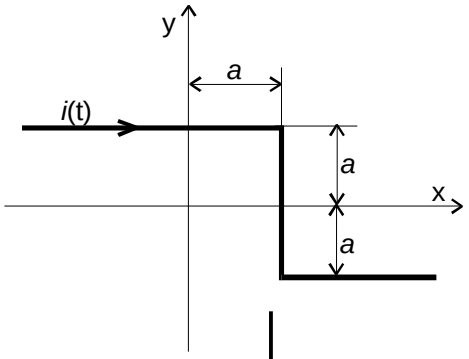
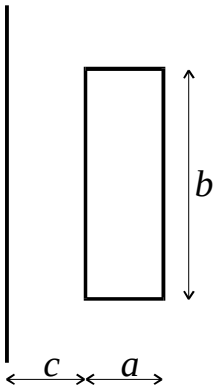
OSNOVE ELEKTROTEHNIKE II (UNI)

Izpit 7.12.2000

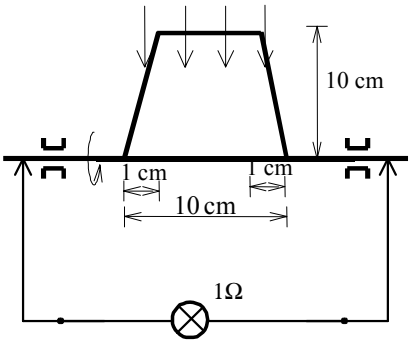
2. 1. Kolikšna je gostota magnetnega pretoka v koordinatnem izhodišču, če se tok ‚v vodniku spreminja sinusno s frekvenco 50 Hz in amplitudo 5A? (a=1m)



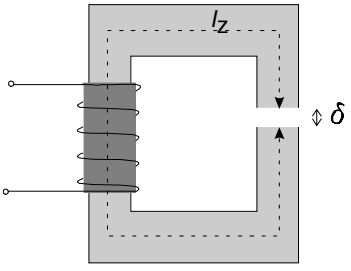
3. Izračunajte medsebojno induktivnost med dolgim premim vodnikom ter pravokotno zanko! (a=20 cm, b=30cm, c=10 cm)



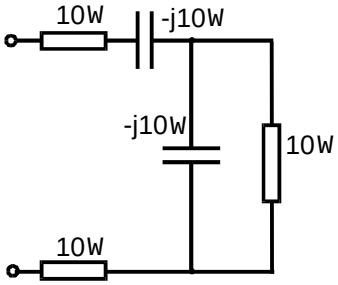
3. S kolikšno kotno hitrostjo moramo vrteti zanko s 500 ovoji v homogenem magnetnem polju 0.2T, da bo žarnica upornosti 1Ω gorela z močjo 15 W. Upornost enega ovoja navitja je 10^{-3} Ω. Pojav samoindukcije zanemarimo.



4. Dano je magnetno jedro s srednjo dolžino magnetne poti 0,3m in prerezom 10cm^2 ter zračno režo širine 0,5 mm. Koliko energije mora vložiti zunanji vir, da bi v reži dosegli gostoto magnetnega pretoka 1T? Relativna permeabilnost jedra je 2000.



5. Določite delovno moč v vezju, če je vezje vzbujano z napetnostnim signalom u(t)=100.sin(500t+45^0)V.



REŠITVE IZPITA IZ OSNOV ELEKTROTEHNIKE II (UNI)
7.12.2000

1) Polje se spreminja v smeri osi z velikostjo

$$B_z = -\frac{\mu_0 I}{4\pi a}\left[\left(\cos(0)-\cos(3\pi/4)\right)+\left(\cos(\pi/4)-\cos(3\pi/4)\right)-\left(\cos(3\pi/4)-\cos(\pi)\right)\right]$$

$$B_z = -\frac{\mu_0 I}{4\pi a}\left(\cos(\pi/4)-3\cos(3\pi/4)\right)=\frac{\mu_0 I}{\sqrt{2}\pi a}$$

$$\vec{B} = -\vec{1}_z.\frac{4\pi.10^{-7}\,\mathrm{H/m}}{\sqrt{2}\pi.1\mathrm{m}}.5.\sin(2\pi.50t)\mathrm{A} \simeq -\vec{1}_z.14{,}14.10^{-7}.\sin(314.t)\mathrm{T}$$

2)

$$M_{21}=\frac{\Phi_{21}}{I_1}$$

$$\Phi=\int_A B.dA=\frac{\mu_0 I_1.b}{2\pi}\int_c^{a+c}\frac{dr}{r}=\frac{\mu_0 I_1 b}{2\pi}\ln\frac{a+c}{c}$$

$$M_{21}=\frac{4\pi 10^{-7}.0{,}3.I_1}{2\pi.I_1}\ln\frac{3}{1}\mathrm{H}=6{,}5.10^{-8}\mathrm{H}$$

3)

$$u = -N.\frac{d}{dt}\left(A.B.\cos(\omega t)\right)=N.A.B.\omega.\sin(\omega t)=U_m.\sin(\omega t)$$

$$A=0{,}09.0{,}1\,\mathrm{m}^2=9.10^{-3}\ \mathrm{m}^2$$

$$P_b=0{,}5.I_m^2.R_b=0{,}5.\frac{U_m^2}{(R_{ov}+R_b)^2}.R_b\ \Rightarrow\ U_m=\sqrt{\frac{2P_b}{R_b}(R_{ov}+R_b)^2}$$

$$U_m=\sqrt{\frac{2.15\mathrm{W}}{1\Omega}(1\Omega+500.10^{-3}\Omega)^2}=8{,}22\mathrm{V}$$

$$\omega=\frac{U_m}{N.A.B}=\frac{8{,}22\mathrm{V}}{500.9.10^{-3}\mathrm{m}^2.0{,}2\mathrm{T}}=9{,}13\,\mathrm{rad/s}$$

4.

$$W=W_z+W_\delta$$

$$\Phi_z=\Phi_\delta\ \Rightarrow\ B_z=B_\delta$$

$$W_z=A.l_z.\int H.dB=A.l_z.\frac{B^2}{2\mu_{rz}.\mu_0}$$

$$W_\delta=A.l_\delta.\frac{B^2}{2.\mu_0}$$

$$W=A.\frac{B^2}{2.\mu_0}\left(\frac{l_z}{\mu_{rz}}+\frac{l_\delta}{1}\right)=10.10^{-4}\mathrm{cm}^2.\frac{(1\mathrm{T})^2}{2.4\pi 10^{-7}\mathrm{H/m}}.\left(\frac{0{,}3\mathrm{m}}{2000}+5.10^{-4}\mathrm{m}\right)$$

$$W=0{,}26\mathrm{J}$$

5.

$$\underline{U}=\frac{100}{\sqrt{2}}.e^{j(-\pi/2+\pi/4)}\mathrm{V}$$

$$\underline{Z}=10\Omega\|(-j10\Omega)-j10\Omega+20\Omega=(25-j15)\Omega$$

$$P=\mathrm{Re}\left(\frac{|\underline{U}|^2}{Z^*}\right)=\mathrm{Re}\left(\frac{10^4}{2.(25+\mathrm{j}15)}\right)\mathrm{W}=\mathrm{Re}\left(\frac{10^4(25-j15)}{2.850}\right)\mathrm{W}$$

$$P=147\mathrm{W}$$