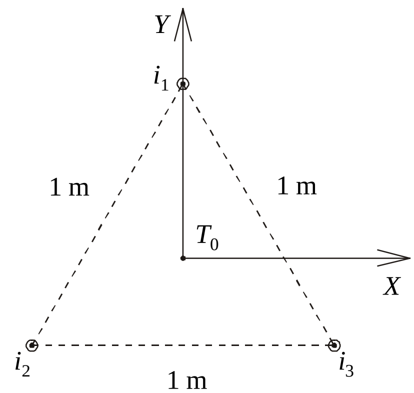
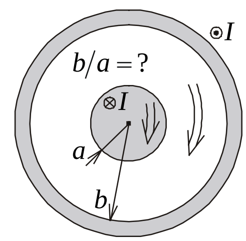
OSNOVE ELEKTROTEHNIKE II (VSŠ)
izpit, 14. 6.1999

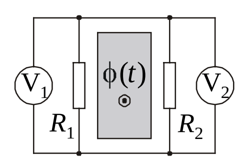
1. Tri vzporedne daljnovodne vrvi so simetrično razmeščene ena do druge na oddaljenosti 1 m. Določite vektor gostote magnetnega pretoka v težiščni točki T_0 trikotnika v trenutku, ko imajo tokovi vrednosti:
$i_1 = -2i_2 = -2i_3 = 300$ A!



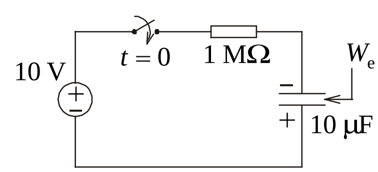
2. Kolikšno bi moralo biti razmerje $(b/a = ?)$ radijev izolacije v koaksialnem kablu, da bi bila magnetna fluksa okrog osi kabla v žili in v izolaciji enaka?



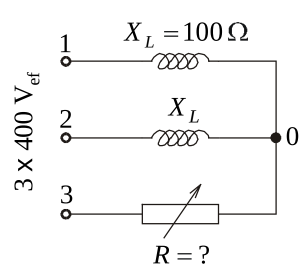
3. Zanka dveh uporov upornosti $R_1 = 100\,\Omega$ in $R_2 = 300\,\Omega$ objame feromagnetni steber, v katerem se magnetni fluks spreminja po časovni funkciji $\phi(t)/\mathrm{Wb} = 0.1\cos(1000t)$. Kolikšna sta odčitka obeh voltmetrov, ki merita efektivno vrednost? Pojav samoindukcije je zanemarljiv!



4. Določite časovni trenutek $t_1 > 0$, ob katerem bo $W_e(t_1) = 0$, če ob trenutku $t = 0$ vključimo stikalo, pred tem pa je bil kondenzator naelektren z nabojem $Q_0 = 100\,\mu\mathrm{C}$, kot kaže označba polaritet!



5. Določite največjo delovno moč P, ki jo more spremenljiv upornik prejemati iz simetričnega trifaznega omrežja $3\times 400\ \mathrm{V_{ef}}$!



OSNOVE ELEKTROTEHNIKE II (VSŠ)
Izpit, 14. 06. 1999, Rešitve

1.

$$\vec{B}(T_0)=\vec{B}_1(T_0)+\vec{B}_2(T_0)+\vec{B}_3(T_0) \quad , \quad \vec{B}_1(T_0)=\frac{\mu_0 i_1}{2\pi(1/\sqrt{3}\ \mathrm{m})}\vec{\mathrm{e}}_x$$

$$\vec{B}_2(T_0)=\frac{\mu_0 i_2}{2\pi(1/\sqrt{3}\ \mathrm{m})}(-\vec{\mathrm{e}}_x\cos 60^\circ+\vec{\mathrm{e}}_y\sin 60^\circ) \ , \ \vec{B}_3(T_0)=\frac{\mu_0 i_3}{2\pi(1/\sqrt{3}\ \mathrm{m})}(-\vec{\mathrm{e}}_x\cos 60^\circ-\vec{\mathrm{e}}_y\sin 60^\circ)$$

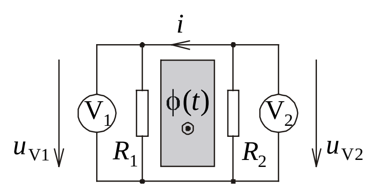
$$i_2=i_3=-150\ \mathrm{A} \quad , \quad \vec{B}(T_0)=\frac{\mu_0}{2\pi(1/\sqrt{3}\ \mathrm{m})}(150\ \mathrm{A})\left[\vec{\mathrm{e}}_x\left(2+2\cdot\frac{1}{2}\right)+\vec{\mathrm{e}}_y\cdot 0\right]\cong\vec{\mathrm{e}}_x\cdot 1.56\cdot 10^{-4}\ \mathrm{T}$$

2.

$$\phi_{\mathrm{v\ zili}}=\int_0^a\frac{\mu_0 I}{2\pi a^2}\rho l\cdot\mathrm{d}\rho=\frac{\mu_0 Il}{4\pi} \quad , \quad \phi_{\mathrm{v\ izolaciji}}=\int_a^b\frac{\mu_0 I}{2\pi\rho}l\cdot\mathrm{d}\rho=\frac{\mu_0 Il}{2\pi}\ln\frac{b}{a}$$

$$\phi_{\mathrm{v\ zili}}=\phi_{\mathrm{v\ izolaciji}} \ \Rightarrow\ \frac{1}{2}=\ln\frac{b}{a} \ \Rightarrow\ \frac{b}{a}=\mathrm{e}^{1/2}\cong 1.65$$

3.



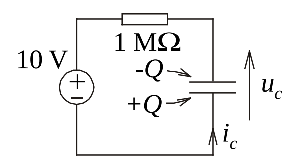
$$u_i(t)=-\frac{\mathrm{d}\phi}{\mathrm{d}t}=(R_1+R_2)\cdot i(t) \ \Rightarrow$$

$$i(t)=\frac{1}{R_1+R_2}(0.1\,\mathrm{Vs})\cdot(1000\,\mathrm{s}^{-1})\cdot\sin 1000t$$

$$i(t)=0.25\sin 1000t\ \mathrm{A} \quad , \quad u_{\mathrm{V1}}=R_1 i \quad , \quad u_{\mathrm{V2}}=-R_2 i$$

$$U_{\mathrm{V1}}=\frac{I_{\max}}{\sqrt{2}}R_1\cong 17.7\ \mathrm{V_{ef}} \quad , \quad U_{\mathrm{V2}}=\frac{I_{\max}}{\sqrt{2}}R_2\cong 53\ \mathrm{V_{ef}}$$

4.



$$u_c(t<0)=\frac{Q_0}{C}=10\ \mathrm{V}$$

$$t>0:\ \ Ri_c+u_c+10\ \mathrm{V}=0 \quad , \quad i_c=\frac{\mathrm{d}Q}{\mathrm{d}t}=\frac{\mathrm{d}}{\mathrm{d}t}(Cu_c)=C\frac{\mathrm{d}u_c}{\mathrm{d}t}$$

$$RC\frac{\mathrm{d}u_c}{\mathrm{d}t}+u_c+10\ \mathrm{V}=0 \ \Rightarrow\ \frac{\mathrm{d}u_c}{\mathrm{d}t}=-\frac{u_c+10\ \mathrm{V}}{RC}$$

$$\frac{\mathrm{d}u_c}{u_c+10\ \mathrm{V}}=-\frac{\mathrm{d}t}{RC} \ \Rightarrow\ \int_{10\ \mathrm{V}}^{u_c}\frac{\mathrm{d}u_c}{u_c+10\ \mathrm{V}}=\int_0^t-\frac{\mathrm{d}t}{RC} \ \Rightarrow\ \ln\frac{u_c+10\ \mathrm{V}}{20\ \mathrm{V}}=-\frac{t}{RC} \ \Rightarrow$$

$$u_c(t)=(20\ \mathrm{V})\mathrm{e}^{-t/RC}-10\ \mathrm{V} \quad , \quad \tau=RC=10\,\mathrm{s}$$

$$W_{\mathrm{e}}(t_1)=0 \ \Rightarrow\ u_c(t_1)=0 \ \Rightarrow\ (20\ \mathrm{V})\mathrm{e}^{-t_1/\tau}-10\ \mathrm{V}=0 \ \Rightarrow\ t_1=\tau\ln\frac{20\ \mathrm{V}}{10\ \mathrm{V}}\cong 6.93\,\mathrm{s}$$

5.

$$\underline{U}_{12}=400\cdot\mathrm{e}^{\mathrm{j}120^\circ}\ \mathrm{V_{ef}} \quad , \quad \underline{U}_{23}=400\cdot\mathrm{e}^{\mathrm{j}0^\circ}\ \mathrm{V_{ef}}$$

$$\underline{U}_{03\mathrm{T}}=\underline{U}_{23}+\frac{1}{2}\underline{U}_{12}=200\sqrt{3}\cdot\mathrm{e}^{\mathrm{j}30^\circ}\ \mathrm{V_{ef}} \quad , \quad \underline{Z}_{03\mathrm{T}}=\mathrm{j}X_L\|\mathrm{j}X_L=\mathrm{j}50\,\Omega$$

$$R=|\underline{Z}_{03\mathrm{T}}|=50\,\Omega \quad , \quad P_{\max}=\frac{|\underline{U}_{03\mathrm{T}}|^2}{|\underline{Z}_{03\mathrm{T}}+R|^2}\cdot R=\frac{(200\sqrt{3}\ \mathrm{V})^2}{|50\,\Omega+\mathrm{j}50\,\Omega|^2}\cdot(50\,\Omega)=1200\ \mathrm{W}$$