Z_5-2kol

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#ZADATAK 05
#Prema sintaksi koristenog softvera veliko ili malo slovo I ('I' ili\
    'i') je oznaka imaginarne jedinice
#Definiranje varijabli za simbolicki izracun, sve su kompleksni \
    brojevi osim
var('U_i1','U_i2','U_i3','U','U_00','Z_1','Z_2','Z_3','Z','Z_0','\
    U_t1','U_t2','U_t3','I_1','I_2','I_3')
assume(U,'real',Z,'real')
```

(U_i1, U_i2, U_i3, U, U_00, Z_1, Z_2, Z_3, Z, Z_0, U_t1, U_t2, U_t3, I_1, I_2, I_3)

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#Kako je trosilo nesimentricno prvo se odredi napon izmedju \
    zvjezdista trosila i izvora
#Ovaj se napon moze odrediti primjenom Millmanovog teorema kao:
U_00=(U_i1/Z_1+U_i2/Z_2+U_i3/Z_3)/(1/Z_1+1/Z_2+1/Z_3+1/Z_0);U_00;\
    show('U00= ',U_00)
```

(U_i1/Z_1 + U_i2/Z_2 + U_i3/Z_3)/(1/Z_0 + 1/Z_1 + 1/Z_2 + 1/Z_3)

$$U00= \frac{\frac{U_{i_1}}{Z_1} + \frac{U_{i_2}}{Z_2} + \frac{U_{i_3}}{Z_3}}{\frac{1}{Z_0} + \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3}}$$

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#Fazni naponi na fazama trosila sada su:
U_t1=U_i1-U_00;show('Ut1= ',U_t1)
```

$$Ut1= U_{i_1} - \frac{\frac{U_{i_1}}{Z_1} + \frac{U_{i_2}}{Z_2} + \frac{U_{i_3}}{Z_3}}{\frac{1}{Z_0} + \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3}}$$

```
U_t2=U_i2-U_00;show('Ut2= ',U_t2)
```

$$Ut2= U_{i_2} - \frac{\frac{U_{i_1}}{Z_1} + \frac{U_{i_2}}{Z_2} + \frac{U_{i_3}}{Z_3}}{\frac{1}{Z_0} + \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3}}$$

```
U_t3=U_i3-U_00;show('Ut3= ',U_t3)
```

$$Ut3= U_{i_3} - \frac{\frac{U_{i_1}}{Z_1} + \frac{U_{i_2}}{Z_2} + \frac{U_{i_3}}{Z_3}}{\frac{1}{Z_0} + \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3}}$$

```
#Fazne (linijske) struje su:
I_1=U_t1/Z_1;show(I_1)
```

$$\frac{U_{i_1} - \frac{\frac{U_{i_1}}{Z_1} + \frac{U_{i_2}}{Z_2} + \frac{U_{i_3}}{Z_3}}{\frac{1}{Z_0} + \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3}}}{Z_1}$$

```
I_2=U_t2/Z_2;show(I_2)
```

$$\frac{U_{i_2} - \frac{\frac{U_{i_1}}{Z_1} + \frac{U_{i_2}}{Z_2} + \frac{U_{i_3}}{Z_3}}{\frac{1}{Z_0} + \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3}}}{Z_2}$$

```
I_3=U_t3/Z_3;show(I_3)
```

$$\frac{U_{i_3} - \frac{\frac{U_{i_1}}{Z_1} + \frac{U_{i_2}}{Z_2} + \frac{U_{i_3}}{Z_3}}{\frac{1}{Z_0} + \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3}}}{Z_3}$$

```
#Slijedi izracun za zadane podatke
U_i1=U/sqrt(3); U_i2=U/sqrt(3)*e^(I*(-2*pi/3));U_i3=U/sqrt(3)*e^(I\
   *2*pi/3); show('Ui1= ',U_i1,'Ui2= ',U_i2,'Ui3= ',U_i3)
```

$$\text{Ui1}= \frac{1}{3}\sqrt{3}U \quad \text{Ui2}= \frac{1}{3}\sqrt{3}Ue^{\left(-\frac{2}{3}i\pi\right)} \quad \text{Ui3}= \frac{1}{3}\sqrt{3}Ue^{\left(\frac{2}{3}i\pi\right)}$$

```
Z_1=Z;Z_2=Z*e^(-I*pi/6);Z_3=Z*e^(I*pi/6);show('Z1= ',Z_1,'Z2= ',Z_2,\
   'Z3= ',Z_3)
```

$$\text{Z1}= Z \quad \text{Z2}= Ze^{\left(-\frac{1}{6}i\pi\right)} \quad \text{Z3}= Ze^{\left(\frac{1}{6}i\pi\right)}$$

```
U_00=U_00.subs(Z_1=Z,Z_2=Z*e^(-I*pi/6),Z_3=Z*e^(I*pi/6),U_i1=U/sqrt\
   (3), U_i2=U/sqrt(3)*e^(I*(-2*pi/3)),U_i3=U/sqrt(3)*e^(I*2*pi/3))
show('U00= ',U_00)
```

$$\text{U00}= \frac{\sqrt{3}U}{3Z\left(\frac{e^{\left(\frac{1}{6}i\pi\right)}}{Z} + \frac{e^{\left(-\frac{1}{6}i\pi\right)}}{Z} + \frac{1}{Z} + \frac{1}{Z_0}\right)}$$

```
U_00=U_00.simplify_full();show('U00= ',U_00)
```

$$\text{U00}= \frac{UZ_0}{Z_0(\sqrt{3}+3) + \sqrt{3}Z}$$

```
#Kako se vidi napon U00 ima samo realnu komponentu
#Naponi na fazama trosila su:
U_t1=U_t1.subs(Z_1=Z,Z_2=Z*e^(-I*pi/6),Z_3=Z*e^(I*pi/6),U_i1=U/sqrt\
   (3), U_i2=U/sqrt(3)*e^(I*(-2*pi/3)),U_i3=U/sqrt(3)*e^(I*2*pi/3));\
   U_t1=U_t1.simplify_full();show('Ut1= ',U_t1)
#Fazni pomak ovog napona je 0:
show(arg(U_t1).simplify_full())
```

$$\text{Ut1}= \frac{\sqrt{3}UZ + 3UZ_0}{3\left(Z_0(\sqrt{3}+1) + Z\right)}$$

$$\arctan\left(0, \sqrt{3}UZ + 3\,UZ_0\right) + \arctan\left(0, \frac{Z_0(\sqrt{3}+1)+Z}{\sqrt{2\,Z_0^2(\sqrt{3}+2)+2\,ZZ_0(\sqrt{3}+1)+Z^2}}\right)$$

```
U_t2=U_t2.subs(Z_1=Z,Z_2=Z*e^(-I*pi/6),Z_3=Z*e^(I*pi/6),U_i1=U/sqrt\
    (3), U_i2=U/sqrt(3)*e^(I*(-2*pi/3)),U_i3=U/sqrt(3)*e^(I*2*pi/3));\
    U_t2=U_t2.simplify_full();show('Ut2= ',U_t2)
#Fazni pomak ovog napona je -3*pi/4 rad ili -135.FFED]
show(arg(U_t2).simplify_full())
```

$$\text{Ut2}= -\frac{UZ_0\left((3i+3)\,\sqrt{3}+3i+3\right)+UZ\left(\sqrt{3}+3i\right)}{6\left(Z_0(\sqrt{3}+1)+Z\right)}$$

$$\pi+\arctan\left(0, \frac{Z_0(\sqrt{3}+1)+Z}{\sqrt{2\,Z_0^2(\sqrt{3}+2)+2\,ZZ_0(\sqrt{3}+1)+Z^2}}\right)+\arctan\left(3\,UZ_0\left(\sqrt{3}+1\right)+3\,UZ, 3\,UZ_0\left(\sqrt{3}+1\right)\right.$$

```
U_t3=U_t3.subs(Z_1=Z,Z_2=Z*e^(-I*pi/6),Z_3=Z*e^(I*pi/6),U_i1=U/sqrt\
    (3), U_i2=U/sqrt(3)*e^(I*(-2*pi/3)),U_i3=U/sqrt(3)*e^(I*2*pi/3));\
    U_t3=U_t3.simplify_full();show('Ut3= ',U_t3)
#Fazni pomak ovog napona je 3*pi/4 rad ili +135.FFED]
show(arg(U_t3).simplify_full())
```

$$\text{Ut3}= -\frac{UZ\left(\sqrt{3}-3i\right)-UZ_0\left((3i-3)\,\sqrt{3}+3i-3\right)}{6\left(Z_0(\sqrt{3}+1)+Z\right)}$$

$$\pi+\arctan\left(0, \frac{Z_0(\sqrt{3}+1)+Z}{\sqrt{2\,Z_0^2(\sqrt{3}+2)+2\,ZZ_0(\sqrt{3}+1)+Z^2}}\right)-\arctan\left(3\,UZ_0\left(\sqrt{3}+1\right)+3\,UZ, 3\,UZ_0\left(\sqrt{3}+1\right)\right.$$

```
#Fazne (linijske) struje su
I_1=U_t1/Z_1;I_1=I_1.subs(Z_1=Z);I_1=I_1.simplify_full();show('I1= '\
    ,I_1)
# a fazni je pomak strtuje:
show(arg(U_t1).simplify_full()-arg(Z_1).simplify_full())
```

$$\text{I1}= \frac{\sqrt{3}UZ + 3\,UZ_0}{3\left(ZZ_0(\sqrt{3}+1)+Z^2\right)}$$

$$\arctan\left(0, \sqrt{3}UZ + 3\,UZ_0\right)-\arctan\left(0, Z\right)+\arctan\left(0, \frac{Z_0(\sqrt{3}+1)+Z}{\sqrt{2\,Z_0^2(\sqrt{3}+2)+2\,ZZ_0(\sqrt{3}+1)+Z^2}}\right)$$

```
I_2=U_t2/Z_2;I_2=I_2.subs(Z_2=Z*e^(-I*pi/6));I_2=I_2.simplify_full()\
    ;show('I2= ',I_2)
# a fazni je pomak strtuje:
show(arg(U_t2).simplify_full()-arg(Z_2).simplify_full())
```

$$\text{I2}= -\frac{UZ_0\left(3i\,\sqrt{3}+6i+3\right)+2i\,\sqrt{3}UZ}{6\left(ZZ_0(\sqrt{3}+1)+Z^2\right)}$$

$$\frac{7}{6}\,\pi-\arctan\left(0, Z\right)+\arctan\left(0, \frac{Z_0(\sqrt{3}+1)+Z}{\sqrt{2\,Z_0^2(\sqrt{3}+2)+2\,ZZ_0(\sqrt{3}+1)+Z^2}}\right)+\arctan\left(3\,UZ_0\left(\sqrt{3}+1\right)+3\,UZ,\right.$$

```
I_3=U_t3/Z_3;I_3=I_3.subs(Z_2=Z*e^(I*pi/6));I_3=I_3.simplify_full();\
    show('I3= ',I_3)
# a fazni je pomak strtuje:
show(arg(U_t3).simplify_full()-arg(Z_3).simplify_full())
```

$$I3= \frac{UZ_0\left(3i\sqrt{3}+6i-3\right)+2i\sqrt{3}UZ}{6\left(ZZ_0\left(\sqrt{3}+1\right)+Z^2\right)}$$

$$\frac{5}{6}\pi-\arctan\left(0,Z\right)+\arctan\left(0,\frac{Z_0\left(\sqrt{3}+1\right)+Z}{\sqrt{2Z_0^2\left(\sqrt{3}+2\right)+2ZZ_0\left(\sqrt{3}+1\right)+Z^2}}\right)-\arctan\left(3UZ_0\left(\sqrt{3}+1\right)+3UZ,\right.$$

```
#Slijedi izracun za zadane numericke podatke:
U_00=(U_00.subs(U=250,Z=10,Z_0=1)).n();U_00
```
11.3365528836565

```
U_t1=(U_t1.subs(U=250,Z=10,Z_0=1)).n();U_t1
```
133.001014413750

```
U_t2=(U_t2.subs(U=250,Z=10,Z_0=1)).n();U_t2
```
-83.5053365323598 - 125.000000000000*I

```
U_t3=(U_t3.subs(U=250,Z=10,Z_0=1)).n();U_t3
```
-83.5053365323598 + 125.000000000000*I

```
I_1=(I_1.subs(U=250,Z=10,Z_0=1)).n();I_1
```
13.3001014413750

```
I_2=(I_2.subs(U=250,Z=10,Z_0=1)).n();I_2
```
-0.981774278859229 - 15.0005843739235*I

```
I_3=(I_3.subs(U=250,Z=10,Z_0=1)).n();I_3
```
-0.981774278859229 + 15.0005843739235*I

```
S_1=U_t1*conjugate(I_1);S_1
```
1768.92698350865

```
S_2=U_t2*conjugate(I_2);S_2
```
1957.05643829539 - 1129.90706146913*I

```
S_3=U_t3*conjugate(I_3);S_3
```
1957.05643829539 + 1129.90706146913*I

```
S_uk=S_1+S_2+S_3;S_uk
```
5683.03986009943