ELEKTRIJADA 2010 – Power System Analysis

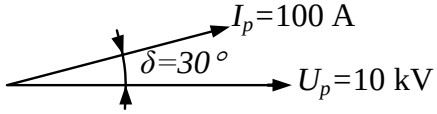
ANNOTATION: You must chose only one of given answers for problems. Right answers worth given number of points. Wrong answers worth -25 % of given points. For answer "I don't know" there are no negative points.

1. (5 points) Official unit for reactive power is:
a) VAr
b) VAR
c) var
d) No one of given answers
e) I don't now

2. (5 points) Lossless transmission line (r=0, g=0) with no load at one end is given. Voltages at ends of line are $\underline{U}_1 = U_1 e^{j\delta_1}$ and $\underline{U}_2 = U_2 e^{j\delta_2}$. One of following statement is true. The answer is:
a) $U_1=U_2$, $\delta_1=\delta_2$
b) $U_1\neq U_2$, $\delta_1=\delta_2$
c) $U_1=U_2$, $\delta_1\neq\delta_2$
d) No one of given answers
e) I don't now

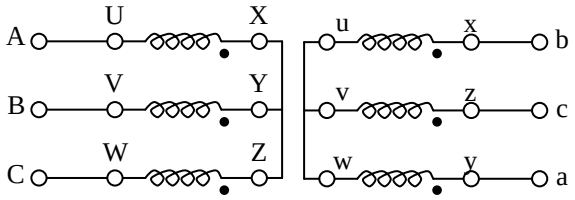
3. (8 points) Transmission line (U_n=220 kV, f_n=50 Hz) with parameters:
r_v=0,125 Ω/km; x_v=0,4 Ω/km;
g_v=0,1·10^{-6} S/km; c_v=9·10^{-9} F/km;
L_v=100 km,
is given. Find characteristic impedance for transmission line. The answer is:
a) $\underline{Z}_c = 384{,}87 e^{j7{,}66°}\,\Omega$
b) $\underline{Z}_c = 356{,}9 e^{-j5{,}86°}\,\Omega$
c) $\underline{Z}_c = (381{,}43 - j51{,}33)\,\Omega$
d) No one of given answers
e) I don't now

4. (8 points) Voltage and current phasor diagram of one single phase consumer is shown on the figure. Find consumer power.



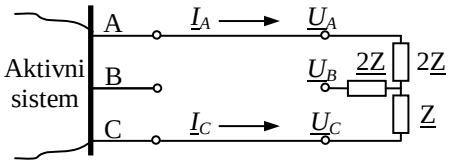
The answer is:
a) $\underline{S}_p = (500\sqrt{3} + j500)\,kVA$
b) $\underline{S}_p = (1000 - j500\sqrt{3})\,kVA$
c) $\underline{S}_p = 1000 e^{j30°}\,kVA$
d) No one of given answers
e) I don't now

5. (10 points) For transformer, given at the figure, find vector group.



The answer is:
a) 2
b) 8
c) 10
d) No one of given answers
e) I don't now

6. (10 points) Active network supply nonsymmetrical consumption (see figure). There are known: $\underline{I}_A = 2e^{j60°}$ p.u., $\underline{I}_C = 2e^{-j120°}$ p.u. $\underline{U}_B = \sqrt{3}$ p.u.. and $\underline{Z} = 1{,}5e^{j30°}$ p.u. Find consumer voltage zero sequence component.



The answer is:
a) $\underline{U}_o = (3\sqrt{3} + j3)$ p.u.
b) $\underline{U}_o = 2e^{j30°}$ p.u.
c) $\underline{U}_o = (\sqrt{3}/3 + j1)$ p.u.
d) No one of given answers
e) I don't now

7. (12 points) At the end of transmission line, with parameters R=0,02 p.u., X=0,08 p.u., B=0,16 p.u., is conected passive consumption area. Voltage magnitude at the beginning and the end of line are U_1=1.1 p.u. i U_2=1 p.u. respectively. Phase difference between voltage phasors is δ=9°. Find active and reactive power of consumption area. The answer is:

a) $\underline{S}_p = (2{,}28 + j0.51)$ p.u.

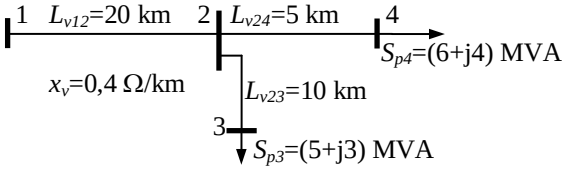
b) $\underline{S}_p = (2{,}28 + j0.43)$ p.u.

c) $\underline{S}_p = (2{,}28 + j0.59)$ p.u.

d) No one of given answers

e) I don't now

8. (12 points) Radial network is given on the figure.



With shunt capacitor bank on the buses 3 and 4 with same reactive power, voltage magnitudes at buses 3 and 4 are U_3=U_4=10 kV. Find that reactive power of shunt capacitor bank. The answer is:

a) $\underline{S}_{BK} = jQ_{BK} = j1{,}95\ MVA$

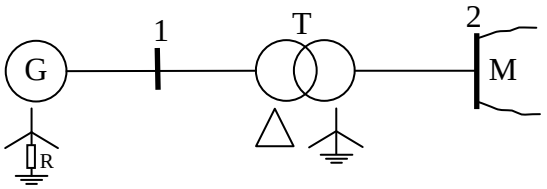
b) $\underline{S}_{BK} = jQ_{BK} = j2{,}63\ MVA$

c) $\underline{S}_{BK} = jQ_{BK} = j2{,}32\ MVA$

d) No one of given answers

e) I don't now

9. (15 points) Simply power system with data is shown on the figure.



G: S_{nG}=50 MVA, U_{nG}=10 kV,
x'_{dg}= x_{ig}=30 %, x_{og}=10 %
T: S_{nT}=S_{nG}, m_T=220/10 kV/kV, x_T=10 %
M: Strong network with "∞" power.

Find value of resistance R which limits single phase to ground current at bus 1 at value 1000 A. Voltage at bus 1 before fault was equal to generator nominal voltage. The answer is:

a) R=5,77 Ω

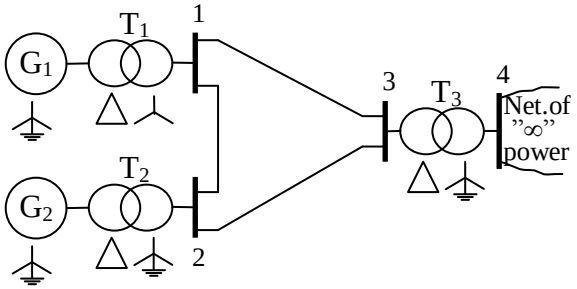
b) R=10 Ω

c) R=17,31 Ω

d) No one of given answers

e) I don't now

10. (15 points) Simply power system is shown on the figure. System data are given in the table.



	G_1	G_2	T_1	T_2	T_3	*Lines*
X_d (p.u.)	0.14	0.14	0.06	0.06	0.05	0.1
X_i (p.u.)	0.14	0.14	0.06	0.06	0.05	0.1
X_o (p.u.)	0.05	0.05	0.06	0.06	0.05	0.3

In the case of single phase to ground fault of phase A at bus 3, find phase A current for transformer T_2. Voltage at bus 3 before fault was U_{3fr}=1 p.u. The answer is:

a) $\underline{I}_{AT2} = -j2{,}941\ p.u.$

b) $\underline{I}_{AT2} = -j3{,}731\ p.u.$

c) $\underline{I}_{AT2} = -j3{,}517\ p.u.$

d) No one of given answers

e) I don't now