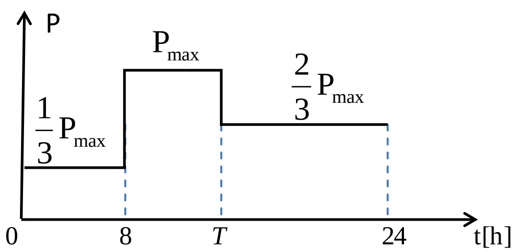
ELEKTRIJADA 2012 – Power System Analysis

Annotation: Answer the questions by encircling one of the given answers. Only ONE of the given answers in each problem is correct. Number of points for each correct answer is given in brackets. If you encircle more than one answer, it will be treated as incorrect. You should submit these papers as well as papers on which calculations were carried out.

1. (5 points) One consumption area is presented in the figure. If the equivalent duration time of maximum power is T_e=14,667h, calculate time T in the figure.



a) T=11h
b) T=12h
c) T=13h
d) None of the above answers is correct.

2. (5 points) In order to limit fault current, serial inductor can be used. Considering voltage drops during normal operation, this solution is most acceptable:

a) When normal operating load is mostly active
b) When normal operating load is mostly reactive
c) When normal operating load has power factor $1/\sqrt{2}$
d) None of the above answers is correct.

3. (8 points) Power line data are:

$U_n = 220$ kV; $f = 50$ Hz

$r_v = 0{,}125\ \Omega/\text{km}$; $x_v = 0{,}4\ \Omega/\text{km}$;

$g_v = 0{,}1 \cdot 10^{-6}$ S/km; $c_v = 9 \cdot 10^{-9}$ F/km;

$L_v = 500$ km

If voltage at the power line beginning is U_1=1 r.j., calculate voltage at the end of the power line when it is opened (idle).

a) U_2=1,160 r.j.
b) U_2=1,105 r.j.
c) U_2=0,862 r.j.
d) None of the above answers is correct.

4. (8 points) Data on the transformer's plate are:

$x_{12} = 7\%$; $x_{13} = 21\%$; $x_{23} = 15\%$;

$S_{n1} = 60$ MVA; $S_{n2} = 60$ MVA; $S_{n3} = 35$ MVA

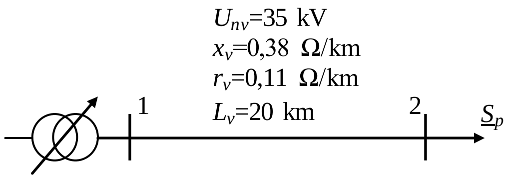
$m_T = 110/36{,}75/10$ kV/kV/kV

These parameters are calculated according to transient power. The transformer's tertiary reactance calculated for primary voltage is:

a) X_3=72,60 Ω
b) X_3=51,88 Ω
c) X_3=55,17 Ω
d) None of the above answers is correct.

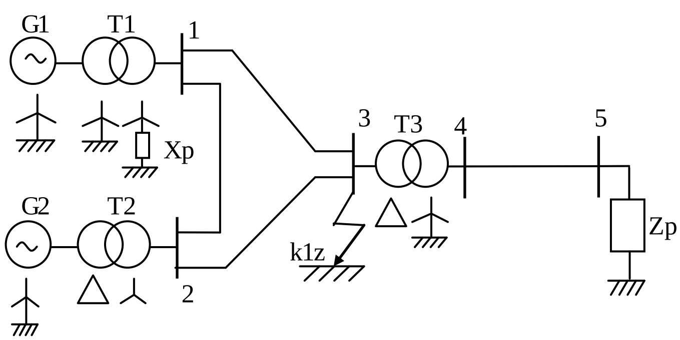
Note: $S_{ij}^{transient} = \min\{S_i, S_j\}$

5. (10 points) Load on the bus 2 can be presented as constant power $\underline{S}_p$=(20+j8) MVA. Calculate change of power loss on the line 1-2 when the bus 1 voltage decreases 5% according to the case when bus 2 voltage was U_2=34 kV. Ignore the phase component of voltage drop.



a) $\Delta\underline{S}\gamma$=(0,2+j0,5) MVA
b) $\Delta\underline{S}\gamma$=(0,2+j0,6) MVA
c) $\Delta\underline{S}\gamma$=(0,15+j0,6) MVA
d) None of the above answers is correct.

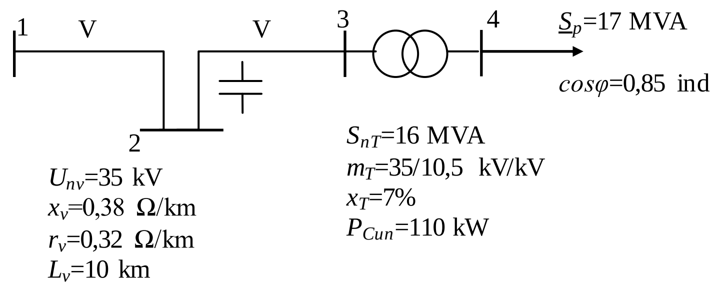
6. (10 points) Calculate equivalent zero-sequence impedance in case of single phase to ground fault at bus 3.



	G1, G2	T1, T2, T3	Xp	line 1-2	line 1-3	line 2-3	line 4-5	Zp
X_0 [r.j.]	0,1	0,1	0,05	0,9	1,3	1,5	1,2	2

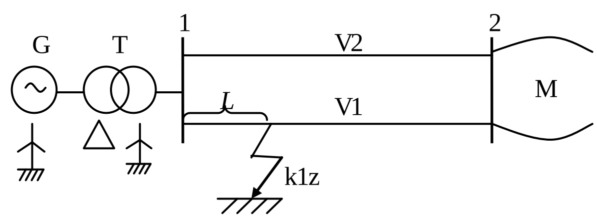
a) $\underline{Z}_o$=j1,09 r.j.
b) $\underline{Z}_o$=j1,19 r.j.
c) $\underline{Z}_o$=j1,29r.j.
d) None of the above answers is correct.

7. (12 points) Calculate power of serial capacitor bank at bus 2, between section 2-3, in order to increase voltage at bus 4 from 9,5 kV to 10,3 kV. Voltage at bus 1 is constant. Ignore the phase component of voltage drop.



a) Q_{bk}=2,2 Mvar
b) Q_{bk}=2,1 Mvar
c) Q_{bk}=2 Mvar
d) None of the above answers is correct.

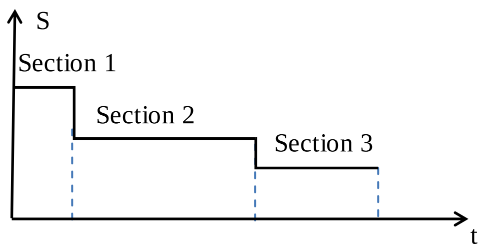
8. (12 points) Calculate the distance from bus 1 where single phase to ground fault occurs at line V1. Equivalent zero-sequence impedance is $\underline{Z}_0$=j0,105 r.j..



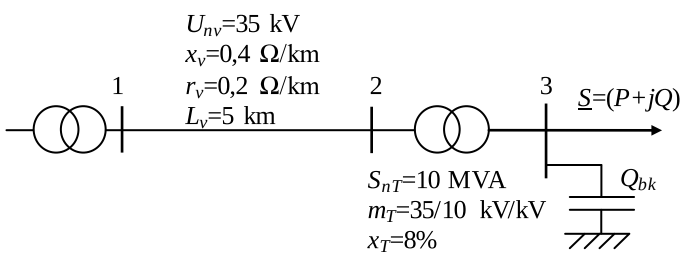
	G	T	V1	V2	M
X_0 [r.j.]	0,05	0,06	0,3	0,3	0,06

a) L=40 km
b) L=50 km
c) L=30 km
d) None of the above answers is correct.

9. (15 points) Consumption on bus 3 can be presented as constant power. Annual consumption diagram is presented below. Table shows data for each Section of the diagram. Voltage at bus 1 is constant U_1=36 kV. Calculate the difference between maximum active powers at bus 1 in cases with and without capacitor bank on bus 3. Capacitor bank has constant power of 2 Mvar.

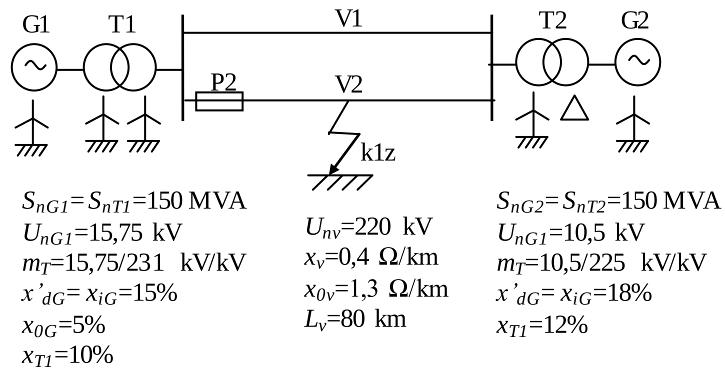


	Section 1	Section 2	Section 3
$(P+jQ)$ [MVA]	(8+j3)	(6+j3)	(5+j3)
duration [h]	60	4300	4400



a) ΔP=10 kW
b) ΔP=12 kW
c) ΔP=14 kW
d) None of the above answers is correct.

10. (15 points) For the power system shown, when single phase to ground fault occurs at phase A in the middle of line V2, calculate current of phase A through the breaker P2. Phase voltage before fault occurred was $220/\sqrt{3}$ kV.



a) $\underline{I}_{aP2}$=-j1,197 kA
b) $\underline{I}_{aP2}$=-j0,794 kA
c) $\underline{I}_{aP2}$=-j2,382kA
d) None of the above answers is correct.