Aalto-yliopisto
Teknillinen korkeakoulu

Exercise 7

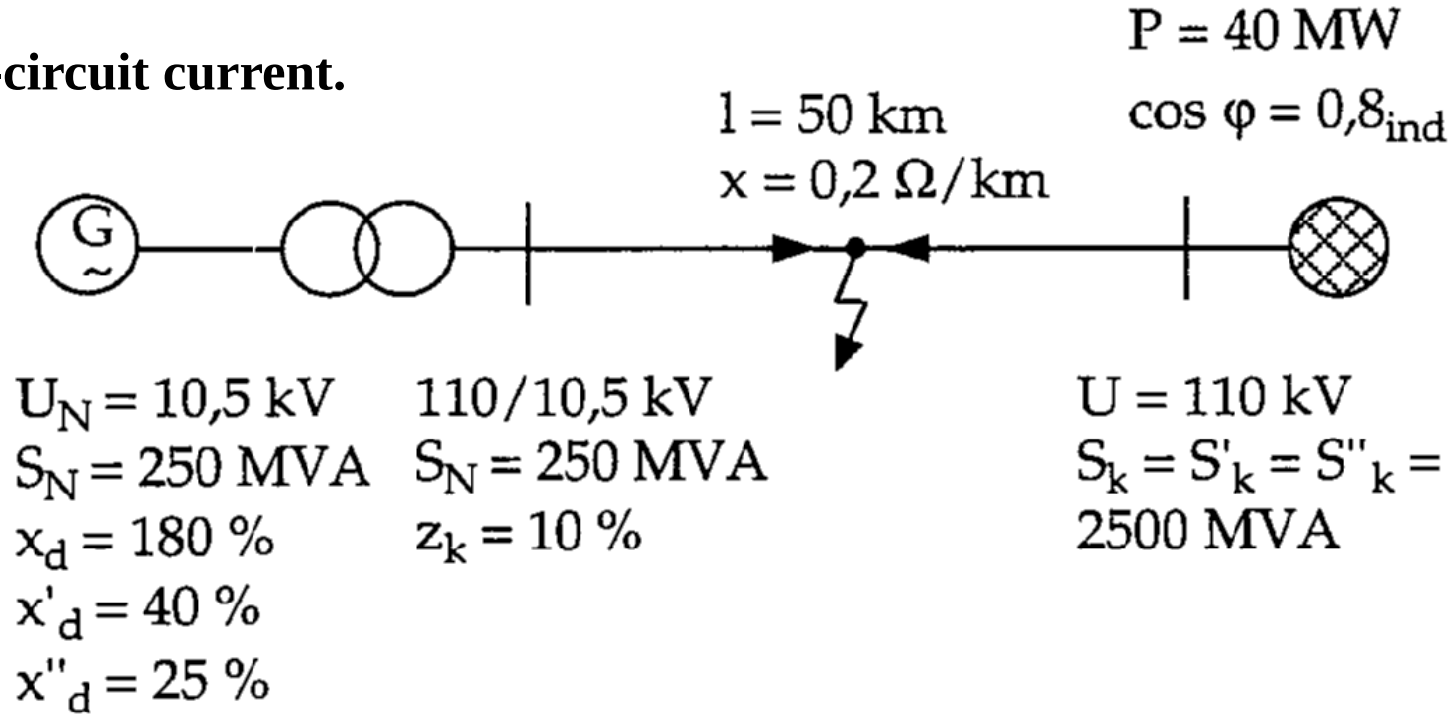
Power systems

Question 1

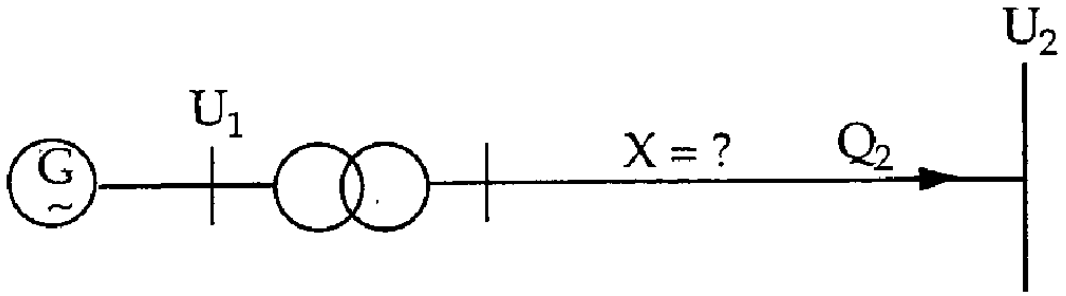
In the middle of the line there is a zero resistance three-phase short circuit. **What is the voltage at the fault location prior to the fault?** Calculate

a) sub-transient
b) transient
c) steady state

short-circuit current.



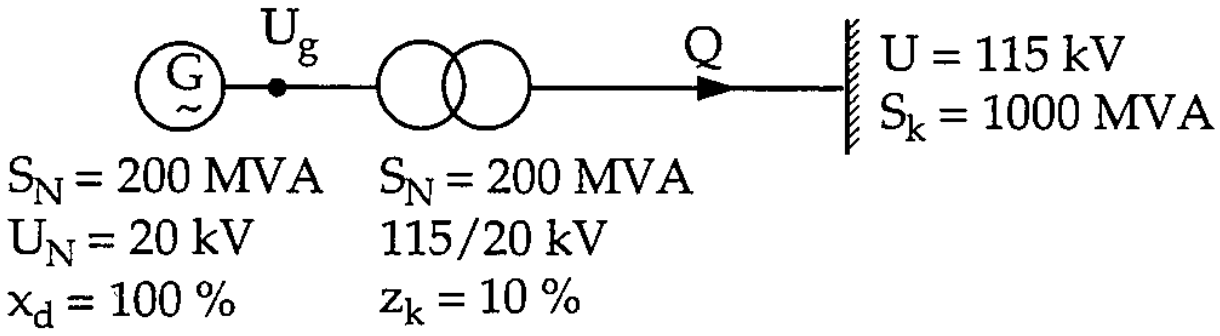
Question 2



Generator	Transformer
$P_N = 880$ MW	$S_N = 1000$ MVA
$S_N = 980$ MVA	410/20 kV
$U_N = 20$ kV	$z_k = 0{,}15$

Starting from the power-angle equations, **define the maximum line reactance X so that the power plant can feed its full active power P_N without exceeding the maximum apparent power S_N.** Voltage of the transmission network is constant $U_2 = 410$ kV and it doesn't consume any reactive power, that is $Q_2 = 0$.

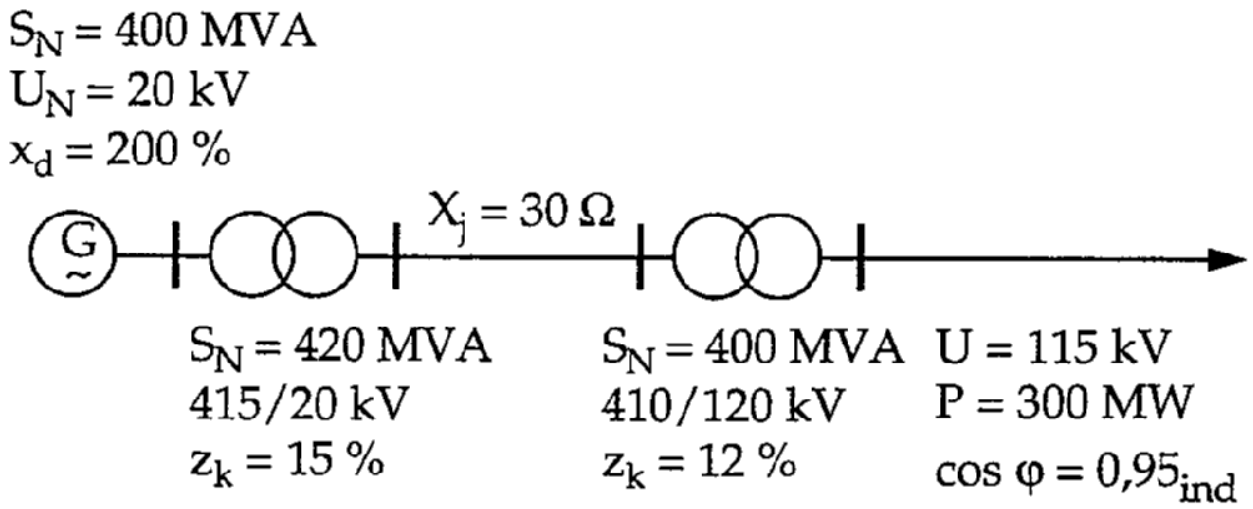
Question 3



A synchronous generator is synchronized through a transformer to a bus.
At the bus, the short circuit power is 1000 MVA and the voltage is 115 kV.
After synchronizing, the generator's power is increased to 100 MW without changing the excitation.
Calculate the generator's terminal voltage U_g and reactive power Q.

When synchronizing, the voltages of the generator are first tuned to same frequency, amplitude and phase order as in power system. Then connecting switch is then closed. At this moment the generator internal emf, terminal voltage and system bus V are same.

Question 4



For the transmission system shown in the picture, calculate **generator's load current and terminal voltage**

a) by reducing the network to generator's voltage level

b) by using per-unit values