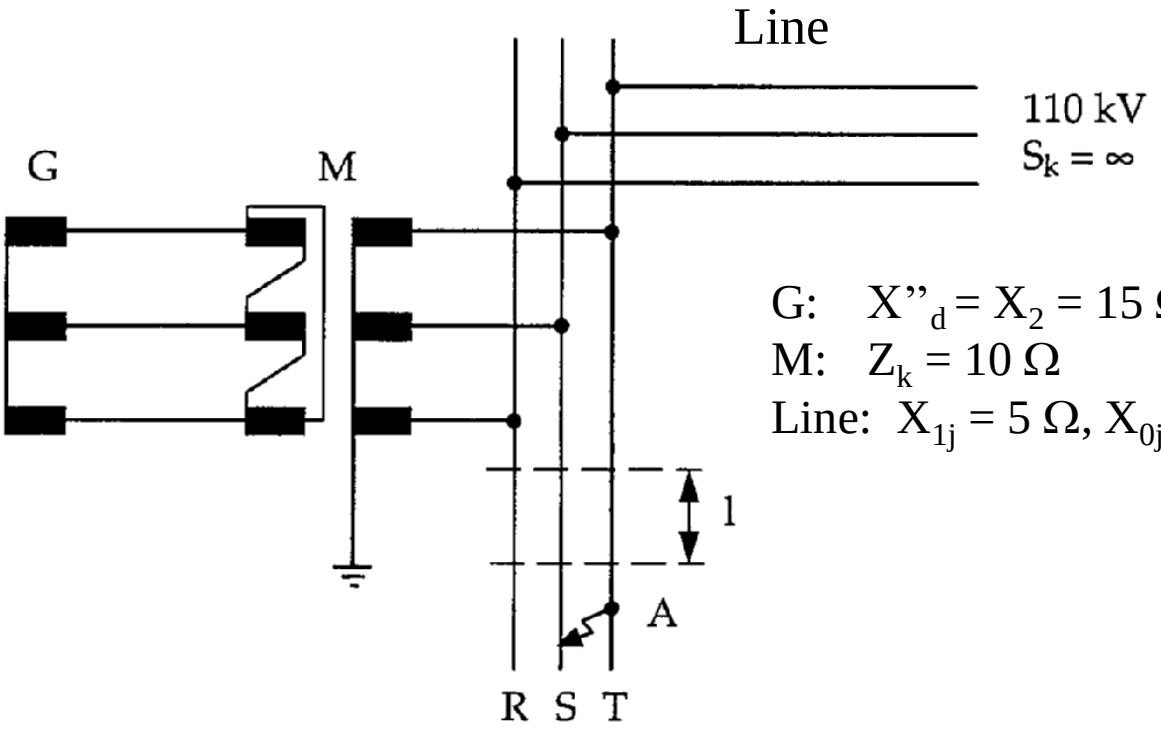
Aalto-yliopisto
Teknillinen korkeakoulu

Exercise 9

Power systems

Question 1



G: $X''_d = X_2 = 15\ \Omega$, $X_0 = 10\ \Omega$

M: $Z_k = 10\ \Omega$

Line: $X_{1j} = 5\ \Omega$, $X_{0j} = 16\ \Omega$

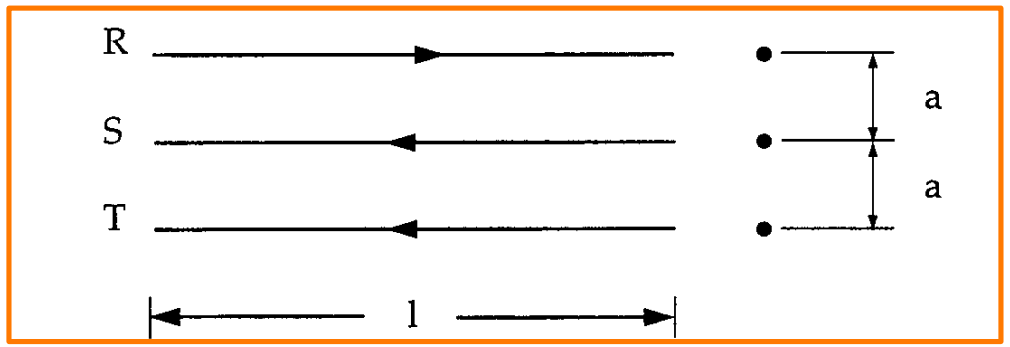
Voltage C Factor table		
Voltage Level	Cmax	Cmin
Low Voltage (< 1 kV)	1.05	0.95
High Voltage (> 1 kV)	1.1	1

http://help.easypower.com/ezp/9.6/content/06_IEC_Short_Circuit/Setting_the_Short_Circuit_Method.htm

A two-phase zero-impedance fault occurs at point A. The distance between phases in the bus bar system is 2.5 m. **Calculate the maximum peak force affecting each phase (per length) in area 1**. Apply the IEC recommended voltage correction factor (C factor) to calculate the maximum short circuit current.

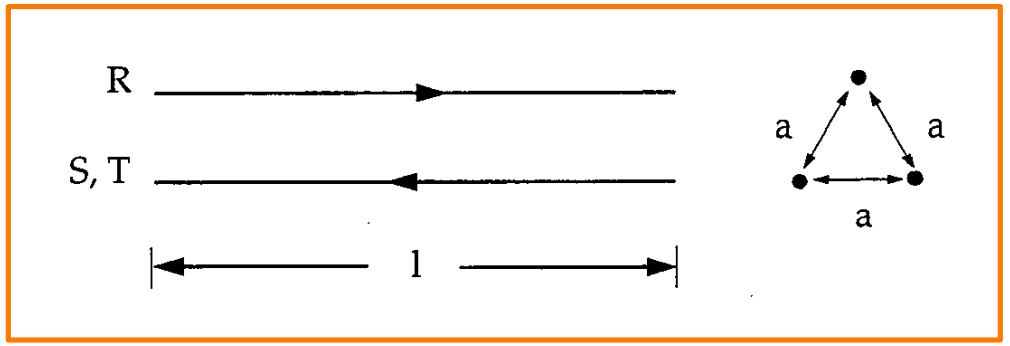
Question 2

a)



$a = 0.3$ m

b)



A short circuit occurs in a 24-kV bus bar system. The phase current instantaneous values are $i_R = 30$ kA, $i_S = 15$ kA and $i_T = 15$ kA.

Calculate the forces (per length) that affect each bus bar for the

a) Upper system
b) Lower system

Question 3

Two identical transformers each have a nominal or no-load ratio of 33/11 kV and a reactance of 2 Ω referred to the 11-kV side; resistance may be neglected. The transformers operate in parallel and supply a load of 9 MVA, 0.8 p.f. lagging. **Calculate the current taken by each transformer when they operate five tap steps apart (each step is 1.25 per cent of the nominal voltage).**

Question 4

Three 11-kV, 100-MVA generators are connected to common busbars. Each is connected via a 100-MVA inductor and an identical circuit breaker. The inductors have reactances of 0.15pu, 0.20pu and 0.30pu.

If the generators each have a transient reactance of 0.25pu, **what is the minimum circuit-breaker rating to protect the generators against a fault on the common busbars**?