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Question No 1.

Solution:

$Z = 0.0165 + j0.3306 = 0.3310\angle 87.14^\circ \ \Omega/Km$

$Y = j4.674 \times 10^{-6} = 4.674 \times 10^{-6} \angle 90^\circ \ S/Km$

* The characteristic impedance

$$Z_c = \sqrt{\frac{Z}{Y}} = \sqrt{\frac{0.3310\angle 87.14^\circ}{4.674 \times 10^{-6} \angle 90^\circ}} = 266.1\angle -1.43^\circ \ \Omega$$

* The propagation constant

$\gamma l = \sqrt{zy} \times l$

$= \sqrt{(0.3310\angle 87.14^\circ)(4.674 \times 10^{-6} \angle 90^\circ)} \times 300$

$= \sqrt{1.547 \times 10^{-6} \angle 177.14^\circ} \times 300$

$= 0.3731\angle 88.57^\circ$

$= 0.00931 + j0.3730 \ p.u.$

$e^{\gamma l} = e^{0.00931} e^{j0.3730} = 1.0094\angle 0.3730$ radians

$= 0.9400 + j0.3678$

$e^{-(\gamma l)} = e^{-0.00931} e^{-j0.3730} = 0.9907\angle -0.3730$ radians

$= 0.9226 - j0.3610$

$$\cosh \gamma l = \frac{e^{\gamma l} + e^{-\gamma l}}{2}$$

$$= \frac{0.9400 + j0.3678 + 0.9226 - j0.3610}{2}$$

$= 0.9313 + j0.0034$

$= 0.9313 \angle -0.209^\circ$

$\sinh \gamma l = \dfrac{e^{\gamma l} + e^{-\gamma l}}{2}$

$= \dfrac{0.9400 + j0.3678 - (0.9226 - j0.3610)}{2}$

$= 0.0087 + j0.3664$

$= 0.3645 \angle 88.63^\circ$

* The ABCD parameter

$A = D = \cosh \gamma l = 0.9313 \angle -0.209^\circ$ p.u.

$B = Z_c \sinh \gamma l = (266.1 \angle -1.43^\circ)(0.3645 \angle 88.63^\circ)$

$= 97 \angle 87.2^\circ \Omega$

$C = \dfrac{1}{Z_c} \sinh \gamma l = \dfrac{(0.3645 \angle 88.63^\circ)}{(266.1 \angle -1.43^\circ)} = 1.37 \times 10^{-3}$

$\angle -90.06^\circ S$

* The equivalent π model

$Z = zl = (0.3310 \angle 87.14^\circ)(300) = 99.3 \angle 87.14^\circ \Omega$

$Z' = Z \dfrac{\sinh \gamma l}{\gamma l} = (99.3 \angle 87.14^\circ) \dfrac{0.3645 \angle 88.63^\circ}{0.3731 \angle 88.57^\circ}$

$= 97 \angle 87.2^\circ \Omega$

$\dfrac{Y'}{2} = \dfrac{Y}{2} \dfrac{\tan(\gamma l/2)}{\gamma l/2} = \dfrac{Y}{2} \dfrac{\cosh \gamma l - 1}{\frac{\gamma l}{2} \sinh \gamma l}$

$\dfrac{Y}{2} = \dfrac{yl}{2} = \dfrac{4.674 \times 10^{-6} \angle 90^\circ \times 300}{2} = 7.011 \times 10^{-4}$

$\angle 90^\circ S$

$$\frac{\cosh \gamma l - 1}{\frac{\gamma l}{2}\sinh \gamma l} = \frac{0.9313 + j\,0.0034 - 1}{\frac{0.3731\angle 88.57^\circ \times (0.3645\angle 88.63^\circ)}{2}}$$

$$= \frac{0.06878\angle 177.17^\circ}{0.06800\angle 177.20^\circ}$$

$$= 1.012\angle -0.03^\circ \text{ p.u.}$$

$$\frac{Y'}{2} = (7.011\times 10^{-4}\angle 90^\circ)(1.012\angle -0.03^\circ)$$

$$= 7.095\times 10^{-4}\angle 89.97^\circ \text{ S}$$

$$= 3.7\times 10^{-7} + j\,7.095\times 10^{-4} \text{ S}$$

Question No 2.

(a)

Answer:

The surge Impedance (usually written Z_0) of a uniform transmission line is the ratio of the amplitudes of voltage and current of a single wave propagating along the line; that is, a wave travelling in one direction in the absence of reflections in the other direction.

Also It is the input Impedance of a transmission line when its length is Infinite. It is determined by the geometry and materials of the transmission line and, for a uniform line, is not dependent on its length. the SI unit of surge impedance is the ohm.

Question No 2.

(b)

Answer:

Reactive power (VAR) compensation is defined as the management of reactive power to improve the performance of ac systems.

There are two aspects:

(a) Load compensation:

→ To increase the power factor of the system.

→ To balance the real power drawn from the system.

→ Compensate voltage regulation.

→ to eliminate current harmonics.

(b) Voltage Support:

→ To decrease the voltage fluctuation at a given terminal of transmission line.

Notes:

Therefore the VAR compensation improves the stability of AC system by increasing the maximum active power that can be transmitted.

* Techniques:

→ Shunt compensation.
→ Series compensation.
→ Synchronous condensers.
→ Static VAR compensators.
→ Static compensators.

Question No 4.

(a).

Answer: Busbar:

An electrical bus bar is defined as conductor or a group of conductor used for collecting electric power from the incoming feeders and distributes them to the outgoing feeders. In other words, It is a type of electrical Jonction in which all the incoming and outgoing electrical current meets. thus, It collects the electric power at one location.

It consists of the insolator and the circuit breaker. On the occurence of a fault, the circuit breaker is tripped off and the faulty section of the busbar is easily disconneted from the circuit.

→ It is available in rectangular, cross-sectional, round and many other shapes.

→ The rectangular bus bar is mostly used in power system.

Note:

The copper & aluminium are used for the manufacturing of electrical busbar.

→ The most common of busbars are 40×4mm ($160mm^2$): 40×5mm ($200mm^2$) 50×6 mm ($300mm^2$); 60×8 mm ($480mm^2$) these various arrangement are used in power system.

* Types:

→ Single bus-Bar Arrangement.

→ Single bus-Bar Arrangement with bus Sectionalizing.

→ Main and transfer Bus Arrangement.

→ Double bus Double Breaker Arrangement.

→ Sectionalized Double bus Arrangement.

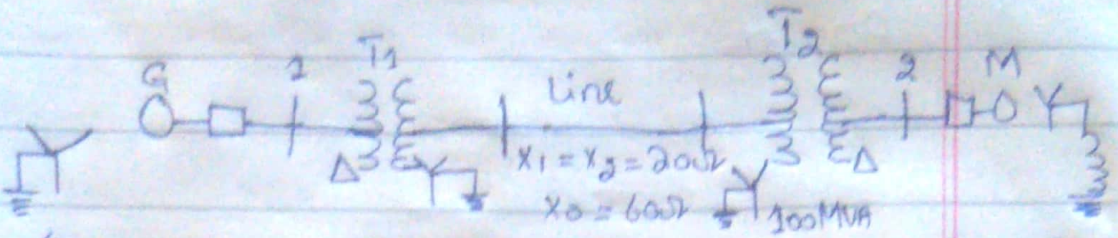
→ One & a Half Breaker Arrangement.

→ Ring Main Arrangement.

→ Mesh Arrangement.

Question No 5.

Solution:

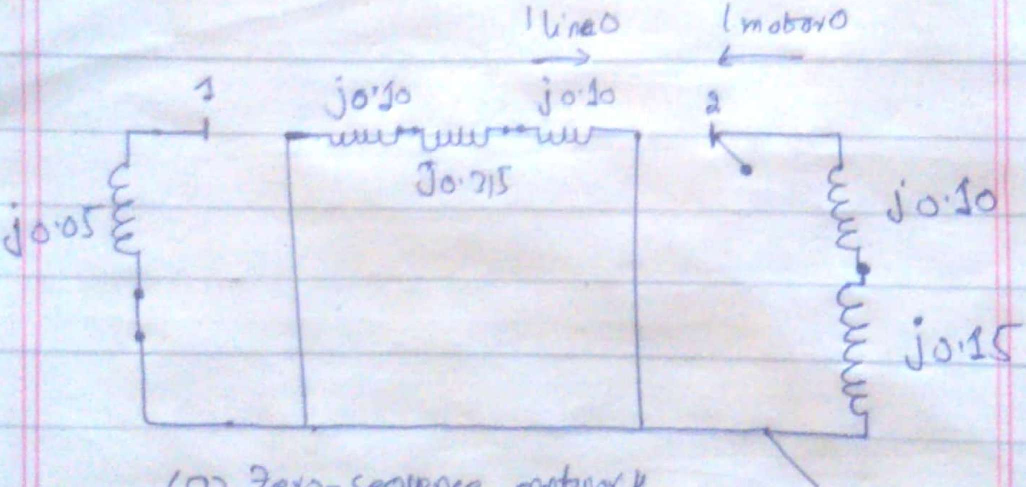


100 MVA
13.8 KV
$X'' = 0.15$
$X_2 = 0.17$
$X_0 = 0.05$ per Unit

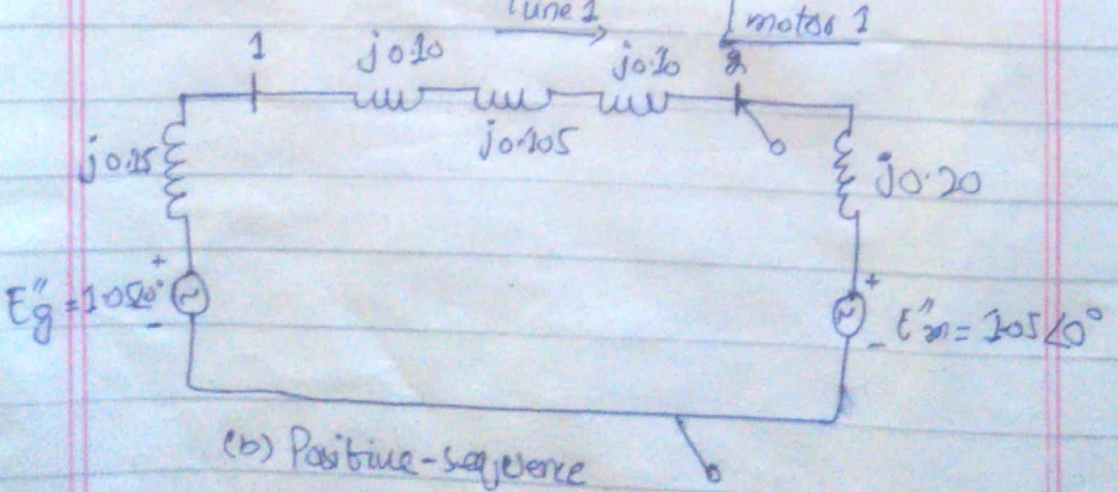
100 MVA
138-KV Δ/138-KV Y
$X = 0.10$ per unit

138-KV Y/138-KV Δ
$X = 0.10$ per unit

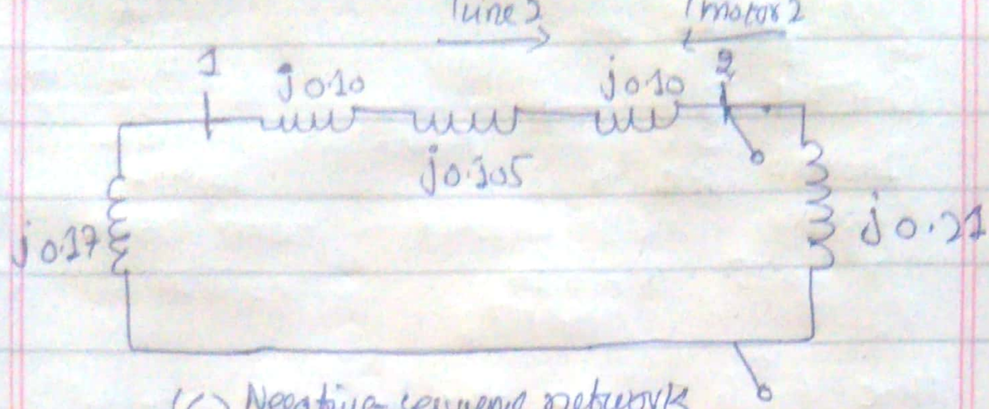
100 MVA
13.8 KV
$X'' = 0.20$
$X_2 = 0.21$
$X_0 = 0.10$
$X_n = 0.05$ per unit



(a) Zero-sequence network

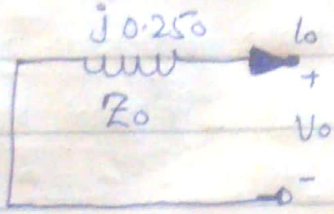


(b) Positive-sequence network

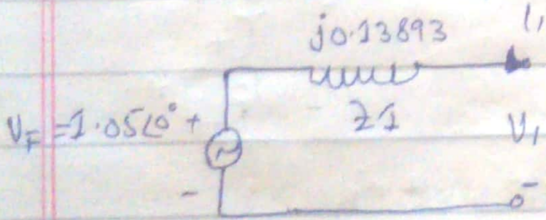


(c) Negative sequence network

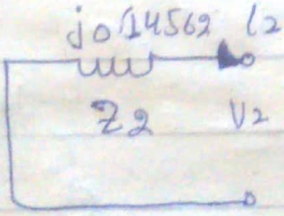
* Thevenin equivalents:



(a) Zero-sequence network



(b) Positive-sequence network



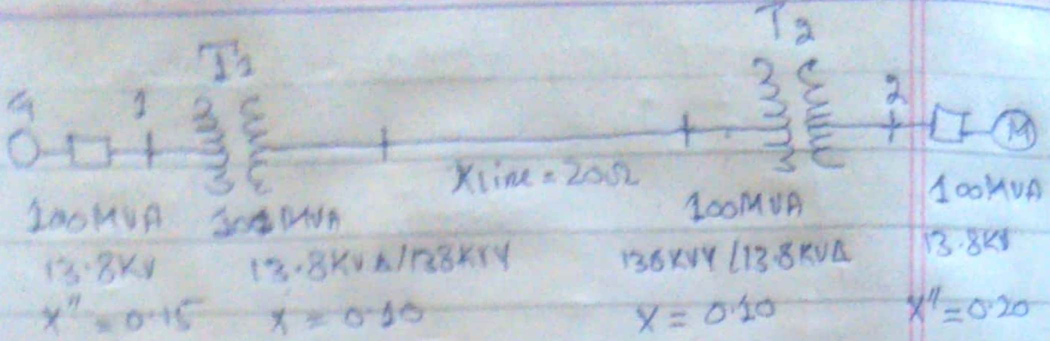
(c) Negative sequence network

Q No. 5 "END"

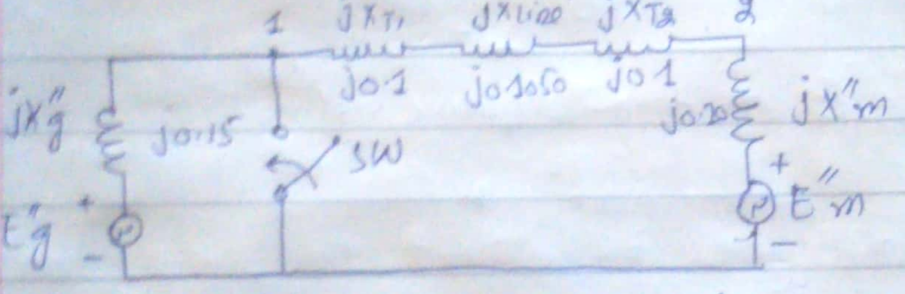
Question No 3. (a).

Solution:

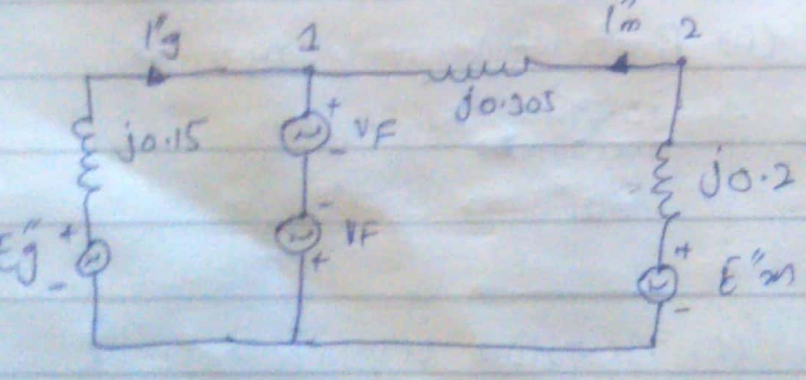
P-T-O



Here E_g'' & E_m'' are the prefault internal voltages behind the sub-transient reactances of machines, the fault is represented by two opposing voltage sources with equal phasor values V_F.

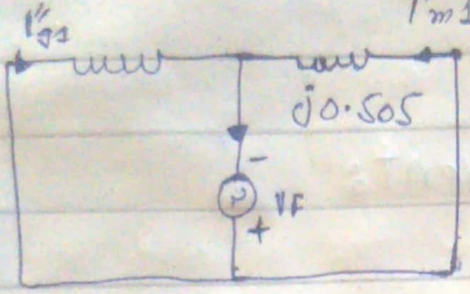


(a) Three phase short circuit.

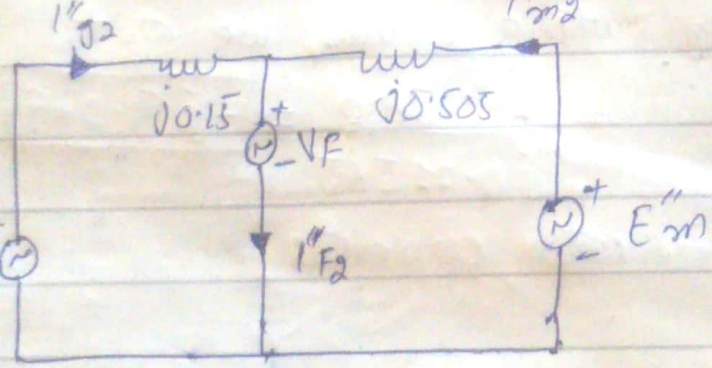


(b) Short circuit represented by two opposing voltage sources.

→ If V_F equals the prefault voltage at the fault, second circuit represent before the fault occurs. $I''_{F_2} = 0$ and V_F. Which has no no effect, can be removed from the second circuit.

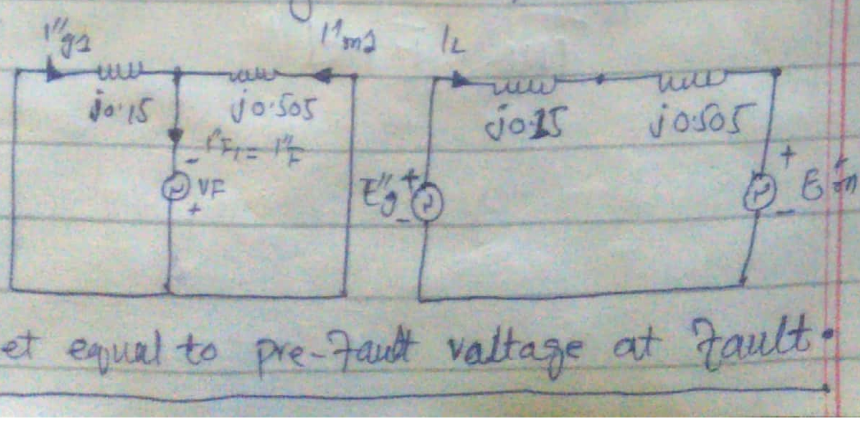


→ represents the system before the fault occurs.



→ Which has no effect, can be removed from the second circuit, a sub-transient fault current is then determined from the first circuit where $I''_F = I''_{F1}$.

→ The contribution to the fault from the generator is $I''_g = I_{g1} + I_{g2} = I_{g1} + I_L$ wher I_L is the prefault generator current. Similarly $I''_m = I''_{m1} - I_L$



→ VF set equal to pre-fault voltage at fault.

Question No3.

(b).

Solution:

1) Fault current:

$$I''_F = \frac{V_F}{Z_{TH}}$$

by putting values, we get.

$$= \frac{1.05\angle 0^\circ}{j0.11565} = \boxed{-j9.079}$$

2) Generator current:

$$I_L = \frac{100}{(\sqrt{3})(1.05 \times 13.8)} \angle -\cos^{-1} 0.95$$

$$= 3.9845\angle -18.19^\circ \text{ Kv}$$

putting values, we get.

$$= \frac{3.9845\angle -18.19^\circ}{4.1837} = 0.9524\angle -18.19^\circ$$

$$= \boxed{0.9048 - j0.2974}$$

"The End"