P2 - ELE 344 - GTDE

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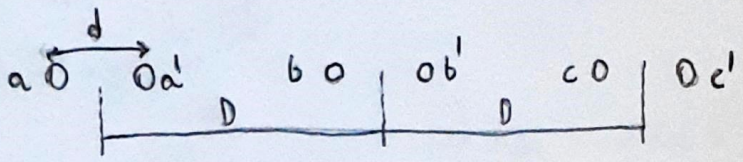
Matrícula: 96709 Data: 24/2/22

Questão 1



Linha trifásica

$r = 0.03\ m$

$d = 0.4\ m$

$D = 6\ m$

• DMG entre os fases:

$D_{ab} = D_{a'b'} = 6\ m$

$D_{a'b} = 5.6\ m$

$D_{ab'} = 6.4\ m$

$DMG_{ab} = \sqrt[4]{6 \times 6 \times 5.6 \times 6.4} = 5.9933$

$D_{ac} = 12 = D_{a'c'}$

$D_{a'c} = 11.6\ m$

$D_{ac'} = 12.4\ m$

$DMG_{ac} = \sqrt[4]{12 \times 12 \times 11.6 \times 12.4} = 11.9967\ m$

$DMG_{bc} = DMG_{ab}$

$$D_{eq} = (DMG_{ab}\, DMG_{bc}\, DMG_{ca})^{1/3} = 7.5532\ m$$

• RMG:

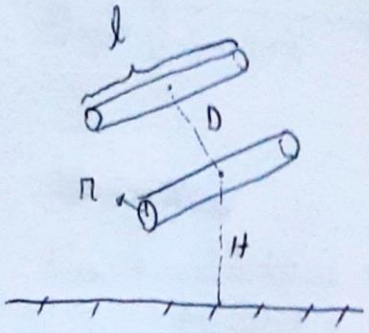
$$RMG = \sqrt[4]{(0.7788 \times 0.03)^2 \times 0.4^2} = 0.0967\ m$$

$$L = \frac{\mu_0}{2\pi} \ln\left(\frac{7.5532}{0.0967}\right) = 0.872\ \mu H/m$$

Portanto a indutância por fase é de $0.872\ \mu H/m$.

Questão 2) Linha monofásica

$l = 20\,km$, $H = 10\,m$, $r = 0.01\,m$, $D = 4\,m$



a) $C_{ab} = \dfrac{2\pi\varepsilon_0}{\ln\left(\frac{D^2}{r^2} \times \frac{(2H)^2}{(2H)^2 + D^2}\right)} = \dfrac{2\pi\varepsilon_0}{\ln\left(\frac{6400}{0.0416}\right)} = 4.658\,pF/m$

b) $C_{an} = 2\,C_{ab} = 9.316\,pF/m$

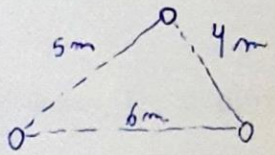
c) Desprezando o efeito do solo, temos que:

$C'_{ab} = \dfrac{\varepsilon_0 \pi}{\ln(D/r)} = \dfrac{\varepsilon_0 \pi}{\ln\left(\frac{4}{0.01}\right)} = 4.643\,pF/m$

d) $I_{car} = \dfrac{V_{an}}{X_c} = V \times 2\pi f\, C_{ab} = (2\pi \times 50)\left(4.658\,\frac{pF}{m} \times 20\,km\right)(33\,kV) = 0.966\,A$

Questão 3) Linha transmissão trifásico

$r = 0.0125\ m$, linha transposta,

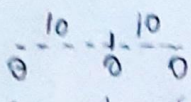


$$D_{eq} = \sqrt[3]{5 \times 4 \times 6} = \sqrt[3]{120} = 4.9324\ m$$

$$C_{on} = \frac{2\pi\varepsilon_0}{\ln\left(\frac{D_{eq}}{r}\right)} = 9.306\ pF/m$$

Questão 4)

Caso I - Linha trifásica, 50 Hz, transporte, ACSR Moose, $r = 0.0159\,m$, $D = 10\,m$



$$D_m = \sqrt[3]{10 \times 10 \times 20} = 12.5992\,m$$

$$D_s^L = 0.7788 \times r = 0.0124\,m$$

$$D_s^C = r = 0.0159\,m$$

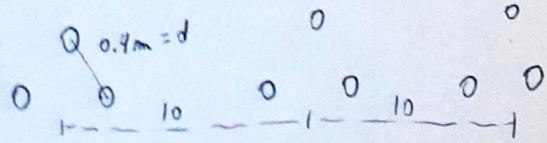
$$L = \frac{\mu_0}{2\pi} \ln\left(\frac{D_m}{D_s^L}\right) = 1.385\,\frac{\mu H}{m} = 1.385\,\frac{H}{Km}$$

$$X_L = 2\pi f L = 100\pi \times 1.385\,m = 0.435\,\frac{\Omega}{m} \text{ por fase}$$

$$C = \frac{2\pi\varepsilon_0}{\ln\left(\frac{D_m}{D_s^C}\right)} = 8.3344\,p\frac{F}{m} = 8.3344\,n\frac{F}{Km}$$

$$X_C = \frac{1}{2\pi f C} = \frac{1}{100\pi \times 8.3344\,n} = 381.924\,K\Omega.Km \text{ por fase}$$

Caso II - Linha trifásica, 50 Hz, transporte, ASCR Lynx, $r = 0.0098\,m$, $D = 10\,m$



$D_m \cong 12.6\,m$ (o mesmo do caso I)

$$D_s^L = \sqrt[3]{(0.7788\,r) \times d^2} = 0.1069\,m$$

$$D_s^C = \sqrt[3]{r \times d^2} = 0.1162\,m$$

$$L = \frac{\mu_0}{2\pi} \ln\left(\frac{D_m}{D_s^L}\right) = 9.540 \times 10^{-7}\,\frac{H}{m} = 0.954\,m\,\frac{H}{Km} \rightarrow X_L' = 2\pi f L = 0.2997\,\frac{\Omega}{Km} \text{ por fase}$$

$$C = \frac{2\pi\varepsilon_0}{\ln\left(\frac{D_m}{D_s^C}\right)} = 11.872\,p\,\frac{F}{m} = 11.872\,n\,\frac{F}{Km} \rightarrow X_C' = \frac{1}{2\pi f C} = 268.121\,K\,\Omega.Km \text{ por fase}$$

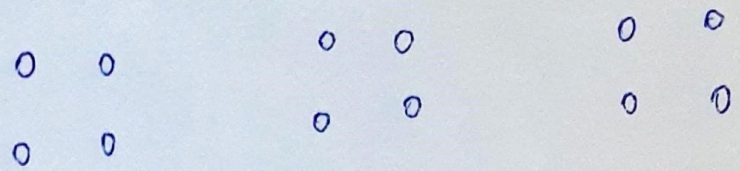
As reatâncias capacitivas e indutivas diminuíram, aproximadamente 30%.

Questão 5) L e C ? em Km

Linha trifásica de circuito duplo. Linha transposta. $r = 0.0125$

$d = 0.35\ m$

$D = 8\ m$



$$D_s^L = \left(0.7788 \times 0.0125 \times 0.35^3 \times \sqrt{2}\right)^{1/4} = 0.1558\ m$$

$$D_{eq} = \left(D_{ab}\, D_{bc}\, D_{ca}\right)^{1/3} = \left(8 \times 8 \times 16\right)^{1/3} = 10.0794\ m$$

$$L = \frac{\mu_0}{2\pi} \ln\left(\frac{D_{eq}}{D_s^L}\right) = 833.935\ n\frac{H}{m} = 0.834\ m\frac{H}{Km}$$

~~[illegible]~~

$$D_s^C = \left(0.0125 \times 0.35^3 \times \sqrt{2}\right)^{1/4} = 0.1659\ m$$

$$C = \frac{2\pi\varepsilon_0}{\ln\left(\frac{D_{eq}}{D_s^C}\right)} = 13.546\ n\frac{F}{m} = 13.546\ n\frac{F}{Km}$$