Problème 1 :

$V_{ll} = 230\,000$ V

$f = 60$ Hz

$D = 250$ Km

$S_{direct} : \quad Z = 0{,}2j \ \Omega/Km$

$Y_{shunt} = 6{,}5 \cdot 10^{-6} j$ en S/Km

a) $0{,}2j = j\omega L \qquad 6{,}5 \cdot 10^{-6} = j\omega C$

$\frac{0{,}2 \cdot 250}{360 \cdot 60} = L = 0{,}002314$ H $\qquad C = 0{,}000\,000\,075$

$Z_c = 175{,}38$

$SIL_{30} = \frac{230000^2}{175{,}38} = 301\,629\,491{,}4$ W

b) $I = \frac{S}{\sqrt{3}\, V_{nominal}} \qquad I = \frac{530\,000\,000}{\sqrt{3}\, 0{,}83 \cdot 230000} = 1583{,}82$

$A = 1 + \frac{0{,}001626j\,(50j)}{2} = 0{,}959375$

$B = 50j$

$V_s = 0{,}959375 \cdot 0{,}83 \cdot \frac{230000}{\sqrt{3}} + 50j \cdot 1583{,}82$

$V_s = 105\,738{,}63 + 79191j =$

c) $\frac{0{,}84 \cdot \frac{230000}{\sqrt{3}} - 105\,738{,}63 + 79191j}{0{,}84 \cdot \frac{230000}{\sqrt{3}}} = \frac{5\,805{,}43 + 79191j}{111544 \angle 0} = \frac{}{111544} = 0{,}09745 \angle 57{,}72°$

d) $\frac{111544 - 105\,738{,}63 + 9191j}{105\,738{,}63 + 9191j} = \frac{10\,870{,}94 \angle 57{,}72}{106137{,}32 \angle 4{,}96} = 0{,}1024 \angle 52{,}76$

Problème 2 :

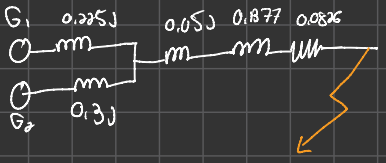
$$Z_{nom} = \frac{33000^2}{30\,000\,000} = 36.3$$

$$L_{gne} = (0.0826 + 0.1877J)\,Pu$$

$$G_1 = 0.15 \cdot \frac{30}{20} = 0.225$$

$$G_2 = 0.10 \cdot \frac{30}{10} = 0.3$$

a)



b) $(0.0255 // 0.3J) + (0.1877J + 0.0826)$

$$\frac{0.0255J \cdot 0.3J}{0.3255J} = \frac{0.00765}{0.3255}J = 0.1286 \cdot J$$

$$0.31627J + 0.0826 = Z$$

$$\frac{1}{\sqrt{0.31627^2 + 0.0826^2}} = 3.059\ Pu \angle -75°$$

$$I_{base} = \frac{30000000}{\sqrt{3}\ 33000} = 524.86$$

$$I = 3.059 \cdot 524.86 = 1605.55A$$

Problème 3

$V_{LL} = 230\,000\,V$

$f = 60\,Hz$

distance = 200 Km

$GMR_a = 0.01228344\,m$

$L_a = 2 \cdot 10^{-7} \ln \frac{GMD}{GMR'}$

$GMR_b' = 0.00956634\,3$

$d = 0.5\,m$

$\left(\sqrt[4]{0.00956634 \cdot 0.5^3}\right) \cdot 1.09$

$GMR' = 0.20287976\,9$

$GMD = \sqrt[3]{24 \cdot 4\sqrt{2} \cdot 4\sqrt{2}} = 15.6594$

$L_a = 2 \cdot 10^{-7} \ln \frac{15.6594}{0.20287976\,9}$

$L_a = 0.000000869\,H/m$

b) $\frac{0.000000869\,H}{1\,m} \cdot \frac{1000\,m}{1\,Km} \cdot 200\,Km = 0,173848\,H$

$X = j\omega L = j \cdot 2\pi \cdot 60 \cdot 0.173848$

$X = 65.54\,j\ \Omega$

c) $C_{an} = \frac{2\pi \cdot 8.854 \cdot 10^{-9}}{\ln\left(\frac{15.6594}{0.2596}\right)} = 1,29 \cdot 10^{-11}\ F/m$

d) $= 0.00000258\,F \quad \frac{1}{j 2\pi 60 \cdot 0.000}$

$X_C = -1028,13\,j\ \Omega$

$Y_C = 0,000972637\,j\ S$

e) On peut diminuer la distance entre les fils pour diminuer

Problema 4

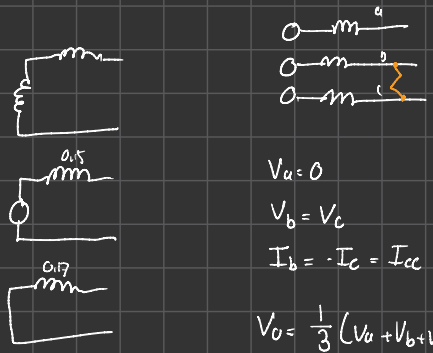
$S = 100\,000\,000$ VA

$V_{ll} = 13\,800$ V

$X_0 = 0,05$ Pu

$X_1 = 0,15$ Pu

$X_2 = 0,17$ Pu



$V_a = 0$

$V_b = V_c$

$I_b = -I_c = I_{cc}$

$V_0 = \frac{1}{3}(V_a + V_b + V_c)$

$V_1 = \frac{1}{3}(V_a + aV_b + a^2V_c) = \frac{1}{3}(V_a + (a+a^2)V_c) = \frac{1}{3}(V_a - V_c)$

$V_2 = \frac{1}{3}(V_a + a^2V_b + aV_c) = \frac{1}{3}(V_a + (a^2+a)V_c) = \frac{1}{3}(V_a - V_c)$

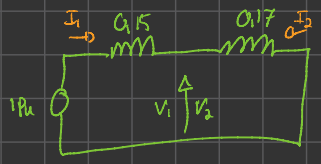
$V_1 = V_2$

$I_0 = \frac{1}{3}(I_a + I_b + I_c)$

$I_1 = \frac{1}{3}(I_a + aI_b + a^2I_c) = \frac{1}{3}(I_a + (a-a^2)I_b)$

$I_2 = \frac{1}{3}(I_a + a^2I_b + aI_c) = \frac{1}{3}(I_a + (a^2-a)I_b)$

$I_1 = -I_2$



$$I_1 = \frac{1}{0,15j + 0,17j} = -3,125j \text{ pu}$$

$I_2 = -I_1 = 3,125j$ pu

$I_b = I_0 + a^2I_1 + aI_2$

$I_{cc} = (a^2 - a)I_1$

$I_{cc} = -1,732j \cdot -3,125j$

$I_{cc} = -5,4125$ pu

b) $$V_1 = \frac{0,17j}{(0,17+0,15)j} = 0,53125 \text{ pu}$$

$V_a = 2V_1$

$V_a = 2 \cdot 0,53125 = 1,0625$ Pu

$V_1 = \frac{1}{3}(V_a - V_b) = V_b = V_a - 3V_1 = 2V_1 - 3V_1 = -V_1$

$V_b = -0,53125$ pu

$V_c = -V_b = 0,53125$ pu

Problème 1 :

a) $0,2\Omega = j\omega$ $\qquad 65 \cdot 10^{-6}\Omega = j\omega C$

$\frac{0,2\Omega}{j \cdot 2\pi 60} = L$ $\qquad \frac{65 \cdot 10^{-6}\Omega}{j \cdot 2\pi 60} = C$

$L = 0,132629$ $\qquad C = 0,000000431$

$Z_c = \sqrt{\frac{0,132629}{0,000000431}} = 175,41\,\Omega$

b) $V_s = AV_R + BI_R$

$I_R = \frac{P}{3 \cdot V_R} = \frac{530\,000\,000}{3 \cdot 0,84 \cdot \frac{230\,000}{\sqrt{3}}} = 1583,82\,A$

$V_s = 0,959375\left(0,83 \cdot \frac{230\,000}{\sqrt{3}}\right) + 50\Omega\,(1583,82)$

$V_s = 105\,736,63 + 74\,191\Omega = 132\,105\,\angle 36,83°$

c) $V_s = \frac{132\,105 - 111544}{132\,105} = 0,155\,\%$ $\qquad = \frac{74\,403\,\angle -85°}{111544\,\angle 0}$

d) V_r à vide $= I_R = 0$

$V_s = AV_R$

$\frac{V_s}{A} = V_R = \frac{132\,105}{0,959375} = 137\,699$

$RT = \frac{137\,699 - 111\,544}{111\,544} = 0,2344$

e) $0,05 = \frac{132\,105 - V_R}{132\,105}$

$V_R = 125\,499,75\ V$

$Q_R = 3\frac{V_{R2}V_{R3}}{X'}\cos(90-\delta) - 3A\frac{V_{R3}^2}{X'}\cos(\alpha)$

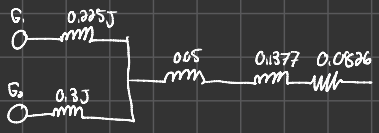
$530\,000\,000 = \frac{125\,499,75 \cdot 137\,699}{50}\sin(\delta)$

$\delta = 30,74°$

$Q_R = \frac{125\,499 \cdot 137\,699}{50}\cos(90-30,74) - \frac{A\,125\,499^2}{50}\cos(90)$

Problème 2 :

a)



b) $(0,12857 + 0,05 + 0,1377)J + 0,0826$

$0,31627\,J + 0,0826$

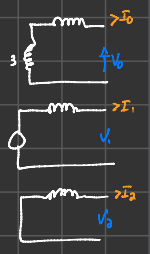
$$I_{cc} = \frac{1}{\sqrt{0,31627^2 + 0,0826^2}} = 3.05 \text{ pu}$$

$$I_{base} = \frac{30\,000\,000}{\sqrt{3}\ 33000}$$

$$I_{base} = 524.86 \cdot 3.05$$

$$I = 1600 \text{ A}$$

Problème 4 :



Court-circuit entre b et c donc

$V_a = 0$
$I_a = 0$
$V_b = V_c$
$I_b = -I_c$

$$V_0 = \frac{1}{3}(V_a + V_b - V_b)$$

$$V_1 = \frac{1}{3}(V_a + aV_b + a^2V_c)$$
$$V_1 = \frac{1}{3}(V_a + aV_b + a^2V_b)$$
$$V_1 = \frac{1}{3}(V_a + (a+a^2)V_b)$$
$$V_1 = \frac{1}{3}(V_a - V_b)$$

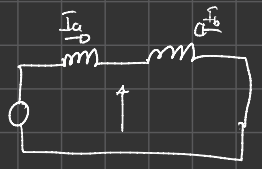
$V_1 = V_2$

$$V_2 = \frac{1}{3}(V_a + a^2V_b + aV_c)$$
$$V_2 = \frac{1}{3}(V_a - V_b)$$

$I_0 = 0$

$$I_1 = \frac{1}{3}(I_a + aI_b + a^2I_c)$$
$$I_1 = \frac{1}{3}(I_a + (a-a^2)I_b) =$$

$$I_2 = \frac{1}{3}(I_a + (a^2-a)I_b) = \frac{1}{3}(I_a - (a-a^2)I_b)$$



$$I_1 = \frac{1}{0,17+0,15j} = -3,125\,j$$

$I_b = -I_c = 3,125\,j$

$$I_{cc} = I_b = I_0 + a^2I_1 + aI_2$$
$$I_{cc} = (a^2 - a)I_1$$
$$I_{cc} = (-1,73j)(-3,125j)$$

$I_{cc} = 5,412$ Pu

b) $V_1 = V_b + V_c$
$V_1 = 2V_b$

$$\frac{0,17}{0,17+0,15} = 0,53125 \text{ Pu}$$

$$V_b = \frac{0,53125}{2}$$

$V_b = V_c$
$V_a = 0$