P=U·I

ISPIT - GRUPA B

① T_1

$S_n = 150\ MVA$

$U_k = 11\%$

$a_1 = \frac{209}{110}$

T_2

$S_n = 150$

$U_k = 11$

$a_2 = \frac{220}{110}$

$U_2 = 109\ kV = 0,9909$

$S_2 = -130 - j20\ MVA = -1,3 - j0,2$

$S_B = 100\ MVA$

$\uparrow I_2 = \left(\frac{S_2}{U_2}\right)^* = -1,31193 + j0,20159$

T_1

$z_1 = \frac{S_B}{S_n} \cdot jU_k = \frac{100}{150} \cdot j0,11 = j0,07333$

$y_T = -j13,63636$

$a_1 = 0,95$

$y_{12}' = \frac{y_T}{a_1} = -j14,35406$

$y_{01}' = \frac{y_T}{a_1}\left(\frac{1}{a_1} - 1\right) = -j0,75548$

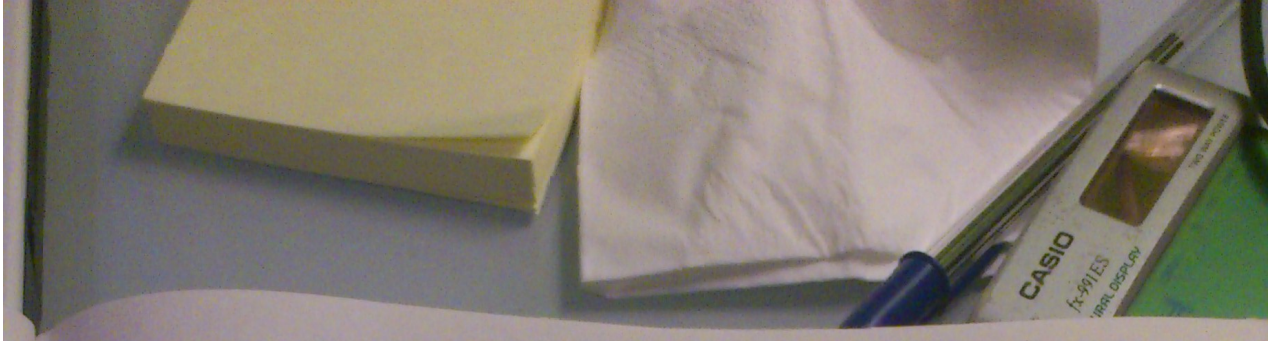
$y_{02}' = y_T\left(1 - \frac{1}{a_1}\right) = j0,7177$

$a_2 = 1$ I_2

$y_T = -j13,63636$

$y_{12}'' = -j13,63636$

$$Y = \begin{vmatrix} -j28,7455 & j27,99042 \\ j27,99042 & -j27,27272 \end{vmatrix}$$



$I_1 = -j28,7459 \cdot U_1 + j27,99042 \cdot U_2$

$-1,31193 + j0,20183 = j27,99042 \cdot U_1 - j27,27272 \cdot 0,99091$

$U_1 = 0,97271 + j0,04687$

$U_1 = 213,99683 + j10,31155 \ kV$

$P = \frac{U^2}{R} \Rightarrow R = \frac{U^2}{P} \cdot \frac{S}{U^2}$

② $U_n = 110kV$ $\quad x_{1-2} = j5\,\Omega \cdot \frac{S_B}{U_n^2} = j0,04132$

$x_{1-4} = j10\,\Omega = j0,08264$

$x_{2-3} = j5\,\Omega$

$x_{3-4} = j10\Omega$

$P_{t,1} = 15\,MW = -15 \Rightarrow P_1 = -0,15$ p.u.

$P_{t2} = 10\,MW = -10$ $\quad P_{g2} = 25\,MW \Rightarrow P_2 = 0,15$ p.u.

$P_{t3} = 30\,MW = -30 \Rightarrow P_3 = -0,3$ p.u.

$y_{1-2} = -j24,2$

$y_{1-4} = -j12,1$

$y_{2-3} = -j24,2$

$y_{3-4} = -j12,1$

4-Knotenbus

$$y = \begin{vmatrix} -j36,3 & j24,2 & 0 \\ j24,2 & -j48,4 & j24,2 \\ 0 & j24,2 & -j36,3 \end{vmatrix}$$

$$z = j \begin{vmatrix} 0,0551 & 0,04132 & 0,02755 \\ 0,04132 & 0,06198 & 0,04132 \\ 0,02755 & 0,04132 & 0,0551 \end{vmatrix}$$

$$\begin{vmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \end{vmatrix} = 2 \begin{vmatrix} P_1 \\ P_2 \\ P_3 \end{vmatrix}$$

$\delta_1 = j0,0551 \cdot (-0,15) + j0,04132 \cdot 0,15 + j\,0,02755 \cdot (-0,3)$

$\delta_1 = -j0,01033$

$\delta_2 = -j0,0093$

$\delta_3 = -j0,01446$

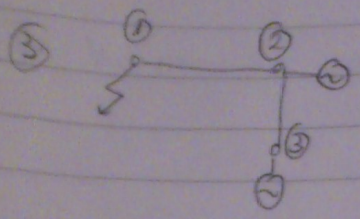
$P_{1-2} = \dfrac{\delta_1 - \delta_2}{X_{1-2}} = -0,02493$

$P_{1-4} = \dfrac{\delta_1 - \delta_4}{X_{1-4}} = -0,125$

$P_{2-3} = \dfrac{\delta_2 - \delta_3}{X_{2-3}} = 0,12488$

$P_{3-4} = \dfrac{\delta_3 - \delta_4}{X_{3-4}} = -0,17497$

$P = \frac{U^2}{R}$ $R =$



$U_n = 110\,kV$

$l_{2-3} = 2$

$x_{1-2} = j10\,\Omega$

$x_{2-3} = j5\,\Omega$

$x_{d_2}'' = x_{d_3}'' = 10\%$

$S_{n2} = 30\,MVA$

$S_{n3} = 100\,MVA$

$S_B = 100\,MVA$

$$x_{1-2} = j10 \cdot \frac{S_B}{U_n^2} = j0{,}08264$$

$$x_{2-3} = j5 \cdot \frac{S_B}{U_n^2} = j0{,}04132$$

$y_{1-2} = -j12{,}1$ p.u.

$y_{2-3} = -j24{,}2$ p.u.

$$x_{d_2} = j0{,}1 \cdot \frac{S_B}{S_{n_2}} = j0{,}2$$

$x_{d_3} = j0{,}1$

$y_{d_2} = -j5$

$y_{d_3} = -j10$

$$Y = \begin{vmatrix} -j12,1 & j12,1 & 0 \\ j12,1 & -j41,3 & j24,2 \\ 0 & j24,2 & -j34,2 \end{vmatrix}$$

$$Z = j \begin{vmatrix} 0,16545 & 0,08281 & 0,0586 \\ 0,08281 & 0,08281 & 0,0586 \\ 0,0586 & 0,0586 & 0,0707 \end{vmatrix}$$

$$\begin{vmatrix} d\,U_1^k \\ d\,U_2^k \\ d\,U_3^k \end{vmatrix} = - \begin{vmatrix} 1 \\ 1 \\ 1 \end{vmatrix} + \begin{vmatrix} Z \end{vmatrix} \cdot \begin{vmatrix} d\,I_1 \\ d\,I_2 \\ d\,I_3 \end{vmatrix}$$

$$d\,U_1^k = 0 = 1 + Z_{11} \cdot d\,I_1$$

$$d\,I_1 = \frac{-1}{Z_{11}} = j6,04412$$

$$d\,U_2^k = 1 + Z_{21} \cdot d\,I_{11} = 0,49949 \text{ p.u}$$

$$d\,U_3^k = 1 + Z_{31} \cdot d\,I_1 = 0,64581 \text{ p.u}$$

$$I_{2-3} = \frac{d\,U_2^k - d\,U_3^k}{x_{2-3}} = j\,3,54114 \text{ p.u}$$

$$I_{2-3} = j\,3,54114 \cdot \frac{S_B}{\sqrt{3} \cdot U_n} = \boxed{j858,617 \text{ A}}$$