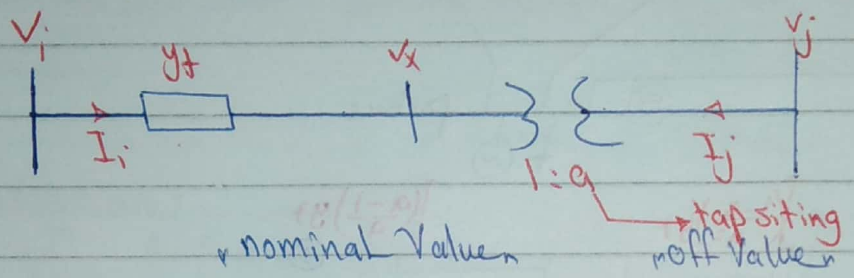
"Tap changing Transformer"

- بستخدم كوسيلة للتحكم في الفولت اللي طالع من "Transf" وبالتالي أقدر أتحكم في "Q"
- في حاجة اسمها "phase shifter" موجودة في المحول نستخدم كوسيلة للتحكم في "angle Pow"



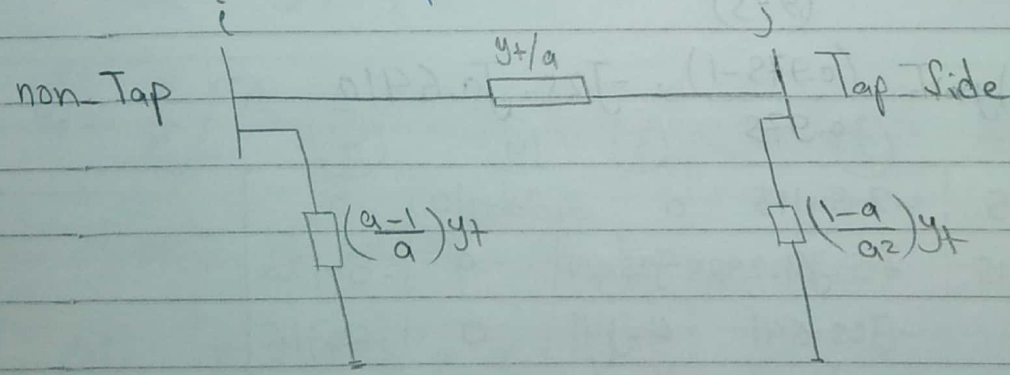
$$V_x = \frac{V_i}{a} \qquad I_i = -a^* I_j$$

$$I_i = y_t (V_i - V_x) \longrightarrow I_i = y_t V_i - y_t V_x$$

$$I_i = y_t V_i - \frac{y_t}{a} V_j \longrightarrow [1] \qquad I_j = \frac{-1}{a^*} I_i$$

$$I_j = -\frac{y_t}{a^*} V_i + \frac{y_t}{|a|^2} V_j \longrightarrow [2]$$

$$\begin{bmatrix} I_i \\ I_j \end{bmatrix} = \begin{bmatrix} y_t & -y_t/a \\ y_t/a^* & \frac{y_t}{|a|^2} \end{bmatrix} \begin{bmatrix} V_i \\ V_j \end{bmatrix}$$



↑ Section (1:a)

Tap side

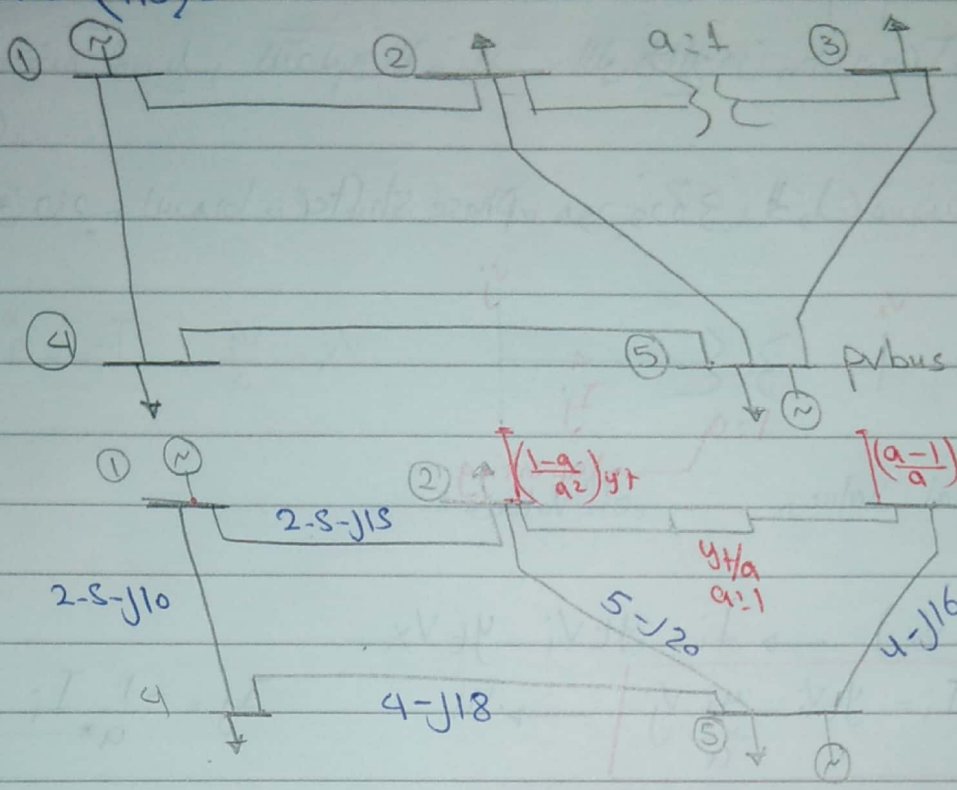
لو كان (a:1)

non Tap

$$\left(\frac{1-a}{a^2}\right) y_t \qquad \left(\frac{a-1}{a}\right) y_t$$

(a:1)

Ex 2.13 (110).



Tap siting = 0.975

reactance = 0.04

$y_t = \frac{1}{0.04j} = -j25$ Tap siting = 0.0975

$(2-3) \longrightarrow y_t/a = \frac{-j25}{0.975} = -j25.641$

$(2 \to o) \longrightarrow \left(\frac{1-a}{a^2}\right)y_t = \frac{1-0.975}{(.975)^2} * -j25 = -j0.6575$

$(3 \to o) \longrightarrow \left(\frac{a-1}{a}\right)y_t = \frac{(0.975-1)}{0.975} * -j25 = j0.6410$

$Y_{bus} =$

	①	②	③	④	⑤
①	5 - j25	-2-S+j15	0	-2-S+j10	0
②	-2-S+j15	7-S -j61.298S	-j25.641	0	-5+j20
③	0	-j25.641	4-j41	0	-4+j16
④	-2-S+j10	0	0	6.5 -j28	-4+j18
⑤	0	-5+j20	-4+j16	-4+j18	13-j54

bus ① slack $V_1 = 1\angle 0$

bus ② PQ bus $P_{2sch} = P_g - P_d = -\frac{60}{100} = -0.6 p_4$ $\quad Q_{2sch} = -\frac{35}{100} = -3.5 p_4$

bus ③ PQ bus $P_{3sch} = -\frac{70}{100} = -0.7 p_4$ $\quad Q_{3sch} = -\frac{42}{100} = -0.42 p_4$

bus ④ PQ bus $P_{4sch} = -\frac{80}{100} = -0.8 p_4$ $\quad Q_{4sch} = -\frac{50}{100} = -0.5 p_u$

bus ⑤ PV bus $P_{5sch} = P_g - P_d = \frac{190 - 65}{100} = 1.25 p_4$ $\quad V_5 = 1\angle 0$

Using Gauss Siedel

1st iteration

$$V_2^{(1)} = \frac{1}{Y_{22}}\left[\frac{P_{2sch} - jQ_{2sch}}{V_2^{*(0)}} - Y_{21}V_1^{(0)} - Y_{23}V_3^{(0)} - Y_{24}V_4^{(0)} - Y_{25}V_5^{(0)}\right]$$

$$= \frac{1}{7.5 - j61.298}\left[\frac{-0.6 + j3.5}{1} - (-2.5 + j15)(1) - (-j25.641)(1) - (-5 + j20)(1)\right]$$

$$= -0.6049 + j0.6441 \quad \boxed{0.1584 + j0.0931}$$

$$V_{2\,acc}^{(1)} = V_2^{(0)} + \alpha\left(V_2^{(1)} - V_2^{(0)}\right) = 1 + 1.6(0.6049 + j0.6441 - 1) = -0.3466 + j0.1491$$

$$V_3^{(1)} = \frac{1}{Y_{33}}\left[\frac{P_{3sch} - jQ_{3sch}}{V_3^{*(0)}} - Y_{31}V_1 - Y_{32}V_2 - Y_{34}V_4 - Y_{35}V_5\right] =$$

$$V_{3acc}^{(1)} = V_3^{(0)} + \alpha\left(V_3^{(1)} - V_3^{(0)}\right)$$

$$V_4^{(1)} = \frac{1}{Y_{44}}\left[\frac{P_{4sch} - jQ_{4sch}}{V_4^{*(0)}} - Y_{41}V_1 - Y_{42}V_2 - Y_{43}V_3 - Y_{45}V_5\right] =$$

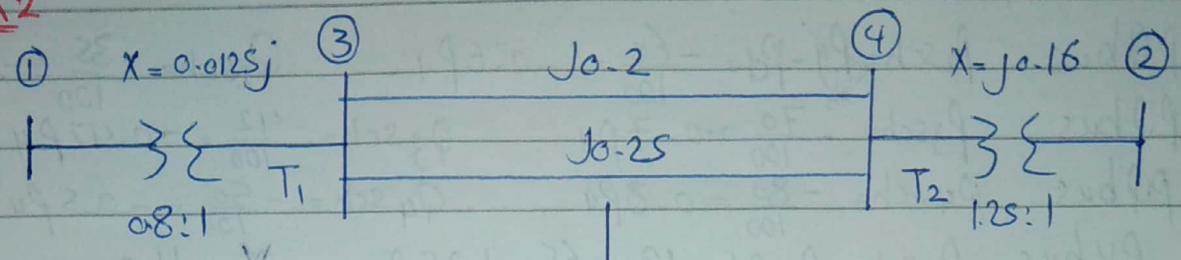
$$V_{4\,acc}^{(1)} = V_4^{(0)} + \alpha\left(V_4^{(1)} - V_4^{(0)}\right) =$$

$$Q_5^{(1)} = -Im\left[V_5^{*(0)}\left[Y_{51}V_1 + Y_{52}V_2 + Y_{53}V_3 + Y_{54}V_4 + Y_{55}V_5\right]\right]$$

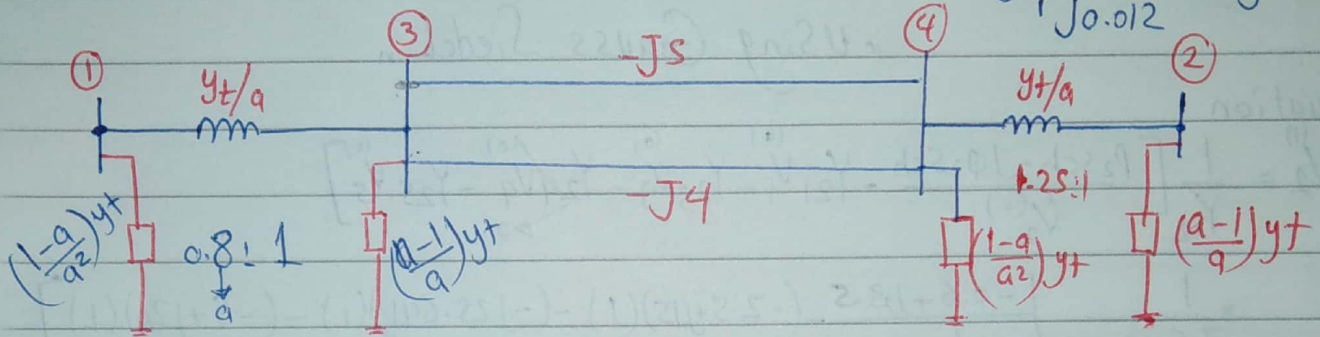
$$V_5^{(1)} = \frac{1}{Y_{55}}\left[\frac{P_{5sch} - jQ_{5sch}}{V_5^{*(0)}} - Y_{51}V_1 - Y_{52}V_2 - Y_{53}V_3 - Y_{54}V_4\right] = \square$$

$$V_{5\,Corr}^{(1)} = \frac{1\angle 0}{\sqrt{\square}}\left(\quad\right) = \square + j\square$$

Ex2



$$y_t = \frac{1}{j0.012} = -j80$$



at Trans 1 $(1-3) \rightarrow y_t/a = \frac{-j80}{0.8} = -j100$

$$y_{t_2} = \frac{1}{j0.16} = -j6.25$$

$(1-0) \rightarrow \left(\frac{1-a}{a^2}\right) y_t = \frac{(1-0.8)}{(0.8)^2} * -j80 = -j25$

$(3-0) \rightarrow \left(\frac{a-1}{a}\right) y_t = \frac{(0.8-1)}{0.8} * -j80 = j20$

at T_2 $(4-2) \rightarrow y_t/a = \frac{-j6.25}{1.25} = -j5$

$(4-0) = \left(\frac{1-a}{a^2}\right) y_t = \frac{1-1.25}{(1.25)^2} * -j6.25 = j$

$(2-0) = \left(\frac{a-1}{a}\right) y_t = \frac{1.25-1}{1.25} * -j6.25 = -j1.25$

Rm+
m−

$$Y_{bus} = \begin{bmatrix} -j125 & 0 & -j100 & 0 \\ 0 & -j6.25 & j & -j5 \\ -j100 & 0 & -j89 & -j9 \\ 0 & -j5 & -j9 & -j13 \end{bmatrix}$$