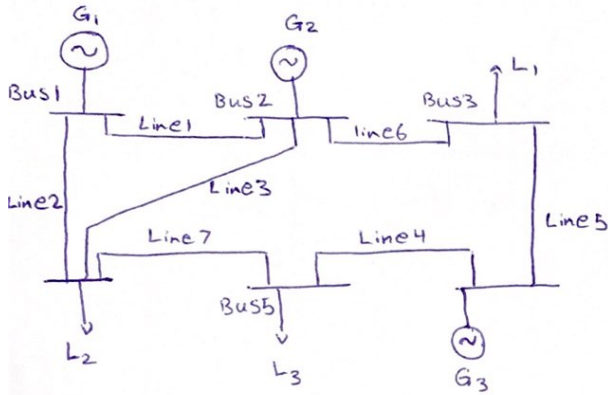


امنا ادرین یو

۹۸۱۴۳۵۳

تیمین سر ۶ تپیل سیم



Generator	Bus	P^G (P.u.)	Q^G (P.u.)	Q^{Gmin} (P.u.)	Q^{Gmax} (P.u.)
1	1	Parallel	Parallel	-2	2
2	2	1.4	Parallel	-1	1.4
3	6	0.2	0.1	-0.1	0.2

Line	From	to	Z (P.u.)	Capacity (P.u.)	Y_2 (P.u.)
1	1	2	$0.1 + j0.17$	2	$j0$
2	1	4	$0.15 + j0.258$	1	$j0$
3	2	4	$0.12 + j0.147$	2	$j0$
4	5	6	$0.08 + j0.14$	1	$j0$
5	3	6	$0.01 + j0.18$	1	$j0$
6	2	3	$0.02 + j0.037$	2	$j0$
7	4	5	$0.02 + j0.037$	2	$j0$

Bus	P^D (P.u.)	Q^D (P.u.)
1	0.6	0.25
2	0.5	0.2
3	0.4	0.15
4	0.4	0.15
5	0.5	0.2
6	0.5	0.2

معلومات: انماز و لسا و توان
التيوترتي

باس 2 ← PV

معلومات: و لسا (انماز و زاوية)
توان اليتو و راليتو تترتي

باس 1 ← صبت

معلومات: توان اليتو و راليتو تترتي
معلومات: و لسا (انماز و زاوية)

باس 6, 5, 4, 3 و 6 ← PQ

Y_{bus} Matrix: $[]_{8 \times 6}$

$$\Rightarrow \begin{cases} Y_{13} = Y_{14} = Y_{15} = Y_{16} = 0, & Y_{25} = Y_{26} = 0 \\ Y_{31} = Y_{34} = Y_{35} = 0, & Y_{51} = Y_{52} = Y_{53} = 0 \\ Y_{61} = Y_{62} = Y_{64} = 0, & Y_{41} = Y_{43} = Y_{46} = 0 \end{cases}$$

$$Y_{21} = Y_{12} = \frac{1}{Z_{12}} = \frac{1}{Z_{21}} = \frac{1}{0.1 + j0.17} = -2.57 + j4.37 \rightarrow \begin{cases} |Y_{12}| = 5.07 \\ \angle Y_{12} = +\tan^{-1}\left(\frac{4.37}{2.57}\right) = 2.10 \end{cases}$$

$$Y_{14} = Y_{41} = \frac{1}{Z_{14}} = \frac{1}{Z_{41}} = \frac{1}{0.15 + j0.258} = -1.684 + j2.89 \rightarrow \begin{cases} |Y_{14}| = |Y_{41}| = 3.35 \\ \angle Y_{14} = \angle Y_{41} = 2.097 \end{cases}$$

$$Y_{24} = Y_{42} = \frac{1}{Z_{24}} = \frac{1}{Z_{42}} = \frac{1}{0.12 + j0.197} = -2.25 + j3.70 \rightarrow \begin{cases} |Y_{24}| = |Y_{42}| = 4.35 \\ \angle Y_{24} = \angle Y_{42} = 2.11 \end{cases}$$

$$Y_{56} = Y_{65} = \frac{1}{Z_{56}} = \frac{1}{Z_{65}} = \frac{1}{0.08 + j0.14} = -3.07 + j5.38 \rightarrow \begin{cases} |Y_{56}| = |Y_{65}| = 6.20 \\ \angle Y_{56} = \angle Y_{65} = 2.08 \end{cases}$$

$$Y_{36} = Y_{63} = \frac{1}{Z_{36}} = \frac{1}{Z_{63}} = \frac{1}{0.01 + j0.18} = -23.58 + j42.45 \rightarrow \begin{cases} |Y_{36}| = |Y_{63}| = 48.56 \\ \angle Y_{36} = \angle Y_{63} = 2.07 \end{cases}$$

$$Y_{23} = Y_{32} = \frac{1}{Z_{23}} = \frac{1}{Z_{32}} = \frac{1}{0.02 + j0.037} = -11.30 + j20.91 \rightarrow \begin{cases} |Y_{23}| = |Y_{32}| = 23.77 \\ \angle Y_{23} = \angle Y_{32} = 2.06 \end{cases}$$

$$Y_{45} = Y_{54} = \frac{1}{Z_{45}} = \frac{1}{Z_{54}} = \frac{1}{0.02 + j0.037} = -11.30 + j20.91 \Rightarrow \begin{cases} |Y_{54}| = |Y_{45}| = 23.77 \\ \angle Y_{45} = \angle Y_{54} = 2.06 \end{cases}$$

$$Y_{11} = Y_{12} + Y_{14} = 4.25 - j7.26 \rightarrow \begin{cases} |Y_{11}| = 8.42 \\ \angle Y_{11} = -1.04 \end{cases}$$

$$Y_{22} = Y_{21} + Y_{23} + Y_{24} = 16.13 - j28.98 \rightarrow \begin{cases} |Y_{22}| = 33.17 \\ \angle Y_{22} = -1.06 \end{cases}$$

$$Y_{33} = Y_{32} + Y_{36} = 34.89 - j63.36 \rightarrow \begin{cases} |Y_{33}| = 72.33 \\ \angle Y_{33} = -1.06 \end{cases}$$

$$Y_{44} = Y_{41} + Y_{42} + Y_{45} = 15.24 - j 27.51 \rightarrow \begin{cases} |Y_{44}| = 31.45 \\ \angle Y_{44} = -1.06 \end{cases}$$

$$Y_{55} = Y_{54} + Y_{56} = 14.38 - j 26.30 \rightarrow \begin{cases} |Y_{55}| = 29.97 \\ \angle Y_{55} = -1.07 \end{cases}$$

$$Y_{66} = Y_{63} + Y_{65} = 26.06 - j 47.83 \rightarrow \begin{cases} |Y_{66}| = 54.76 \\ \angle Y_{66} = -1.06 \end{cases}$$

توان هارٹیک
و راکتیک
حساب کیلیم

$$\begin{cases} P_i = \sum_{j=1}^6 |V_i| |Y_{ij}| |V_j| \cos(\theta_{ij} + \delta_j - \delta_i) \\ Q_i = - \sum_{j=1}^6 |V_i| |Y_{ij}| |V_j| \sin(\theta_{ij} + \delta_j - \delta_i) \end{cases}$$

$$P_2 = |V_2| |Y_{21}| |V_1| \cos(\theta_{21} + \delta_1 - \delta_2) + |V_2| |Y_{22}| |V_2| \cos(\theta_{22} + \delta_2 - \delta_2) + |V_2| |Y_{23}| |V_3| \cos(\theta_{23} + \delta_3 - \delta_2) + |V_2| |Y_{24}| |V_4| \cos(\theta_{24} + \delta_4 - \delta_2)$$

$$P_3 = |V_3| |Y_{32}| |V_2| \cos(\theta_{32} + \delta_2 - \delta_3) + |V_3| |Y_{33}| |V_3| \cos(\theta_{33} + \delta_3 - \delta_3) + |V_3| |Y_{36}| |V_6| \cos(\theta_{36} + \delta_6 - \delta_3)$$

برای P_6 و P_5 و P_4 هم به همین صورت ادامه می دهیم

$$Q_3 = -|V_3| |Y_{32}| |V_2| \sin(\theta_{32} + \delta_2 - \delta_3) - |V_3| |Y_{33}| |V_3| \sin(\theta_{33} + \delta_3 - \delta_3) - |V_3| |Y_{36}| |V_6| \sin(\theta_{36} + \delta_6 - \delta_3)$$

$$Q_4 = -|V_4| |Y_{41}| |V_1| \sin(\theta_{41} + \delta_1 - \delta_4) - |V_4| |Y_{42}| |V_2| \sin(\theta_{42} + \delta_2 - \delta_4) - |V_4| |Y_{44}| |V_4| \sin(\theta_{44} + \delta_4 - \delta_4) - |V_4| |Y_{45}| |V_5| \sin(\theta_{45} + \delta_5 - \delta_4)$$

برای Q_6 و Q_5 هم به همین صورت ادامه می دهیم

حساب توان
راکتیک
در این شکل
نشان

$$Q_2 = -|V_2| |Y_{21}| |V_1| \sin(\theta_{21} + \delta_1 - \delta_2) - |V_2| |Y_{22}| |V_2| \sin(\theta_{22} + \delta_2 - \delta_2) - |V_2| |Y_{23}| |V_3| \sin(\theta_{23} + \delta_3 - \delta_2) - |V_2| |Y_{24}| |V_4| \sin(\theta_{24} + \delta_4 - \delta_2)$$

$$X = \begin{bmatrix} \delta_2 \\ \delta_3 \\ \delta_4 \\ \delta_5 \\ \delta_6 \\ \hline |V_3| \\ |V_4| \\ |V_5| \\ |V_6| \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ \hline 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

$$\begin{aligned} Q_2(1) &= -1.05 \times 5.07 \times 1 \times \sin(2.10) \\ &\quad - 1.05 \times 33.17 \times 1.05 \times \sin(-1.06) - 1.05 \times 23.77 \\ &\quad \times 1 \times \sin(2.066) - 1.05 \times 4.33 \times 1 \times \sin(2.11) \\ &= 1.52 \end{aligned}$$

$$Q_2^G = Q_2 + Q_2^L = 1.52 + 0.2 = 1.72 \quad \xrightarrow{Q_2^{g, \min} \leq Q_2^G \leq Q_2^{g, \max}} -1 \leq 1.72 \leq 1.4 \quad \times$$

$$Q_2^G > Q_2^{g, \max} \rightarrow Q_2^G = Q_2^{g, \max} = 1.4 \Rightarrow Q_2 = Q_2^G - Q_2^L = 1.4 - 0.2 = 1.2$$

→ $\sum_{i=1}^6 P_i \approx 2.06$
 ≈ 2

$$X = \begin{bmatrix} s_2 \\ s_3 \\ s_4 \\ s_5 \\ s_6 \\ \hline |V_2| \\ |V_3| \\ |V_4| \\ |V_5| \\ |V_6| \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ \hline 1.05 \\ 1 \\ \vdots \end{bmatrix}$$

$$P_2(1) = 1.05 \times 5.07 \times 1 \times \cos(2.10) + 1.05 \times 33.17 \times 1.05 \times \cos(-1.06) + 1.05 \times 23.77 \times 1 \times \cos(2.066) + 1.05 \times 4.33 \times 1 \times \cos(2.117) = 0.85$$

$$P_3(1) = 1 \times 23.77 \times 1.05 \times \cos(2.066) + 1.72 \times 33 \times 1 \times \cos(-1.06) + 1 \times 48.56 \times 1 \times \cos(2.07) = -0.56$$

$$P_4(1) = 1 \times 3.350 \times 1 \times \cos(2.097) + 1 \times 4.33 \times 1.05 \times \cos(2.11) + 1 \times 31.45 \times 1 \times \cos(-1.06) + 1 \times 23.77 \times 1 \times \cos(2.066) = -0.11$$

$$P_5(1) = 1 \times 23.77 \times 1 \times \cos(2.066) + 1 \times 29.97 \times 1 \times \cos(-1.07) + 1 \times 6.20 \times 1 \times \cos(2.08) = 0.003$$

$$P_6(1) = 1 \times 48.56 \times 1 \times \cos(2.077) + 1 \times 6.20 \times 1 \times \cos(2.08) + 1 \times 54.76 \times 1 \times \cos(-1.06) = 0.0016$$

$$Q_3 = -1 \times 23.77 \times 1.05 \times \sin(2.06) - 1 \times 72.33 \times 1 \times \sin(-1.06) - 1 \times 48.56 \times 1 \times \sin(2.07) = -1.04$$

$$Q_4 = -1 \times 3.35 \times 1 \times \sin(2.09) - 1 \times 4.33 \times 1.05 \times \sin(2.11) - 1 \times 31.45 \times \sin(-1.068) - 1 \times 23.77 \times 1 \times \sin(2.06) = -0.18$$

$$Q_5 = -1 \times 23.77 \times 1 \times \sin(2.06) - 1 \times 29.97 \times 1 \times \sin(-1.07) - 1 \times 6.20 \times 1 \times \sin(2.08) = -0.0001$$

$$Q_6 = -1 \times 48.56 \times 1 \times \sin(2.07) - 1 \times 6.20 \times 1 \times \sin(2.08) - 1 \times 54.76 \times 1 \times \sin(-1.06) = -0.0009$$

$$\text{error}^{\circ} \quad P_2^{\text{sch}} = P_2^G - P_2^D = 1.4 - 0.5 = 0.9$$

$$Q_2^{\text{sch}} = 0 - 0.2 = -0.2$$

$$P_4^{\text{sch}} = 0 - 0.4 = -0.4$$

$$Q_4^{\text{sch}} = 0 - 0.15 = -0.15$$

$$P_3^{\text{sch}} = 0 - 0.4 = -0.4$$

$$Q_3^{\text{sch}} = 0 - 0.15 = -0.15$$

$$P_4^{\text{sch}} = 0 - 0.5 = -0.5$$

$$Q_5^{\text{sch}} = 0 - 0.2 = -0.2$$

$$P_6^{sch} = 0.2 - 0.5 = -0.3$$

$$Q_6^{sch} = 0.1 - 0.2 = -0.1$$

$$\Rightarrow \Delta P_2 = P_2^{sch} - P_2^{(1)} = 0.9 - 0.85 = 0.05$$

$$\Delta Q_2 = Q_2^{sch} - Q_2^{(1)} = -0.2 - 1.2 = -1.4$$

$$\begin{cases} \Delta P_3 = P_3^{sch} - P_3^{(1)} = -0.4 - (-0.56) = 0.16 \\ \Delta Q_3 = Q_3^{sch} - Q_3^{(1)} = -0.15 - (-1.04) = 0.89 \end{cases}$$

$$\begin{cases} \Delta P_4 = P_4^{sch} - P_4^{(1)} = -0.4 - (-0.11) = -0.29 \\ \Delta Q_4 = Q_4^{sch} - Q_4^{(1)} = -0.15 - (-0.18) = 0.03 \end{cases}$$

$$\begin{cases} \Delta P_5 = P_5^{sch} - P_5^{(1)} = -0.5 - 0.0003 = -0.5003 \\ \Delta Q_5 = Q_5^{sch} - Q_5^{(1)} = -0.2 - (-0.0001) = -0.1999 \end{cases}$$

$$\begin{cases} \Delta P_6 = P_6^{sch} - P_6^{(1)} = -0.3 - (0.0016) = -0.3016 \\ \Delta Q_6 = Q_6^{sch} - Q_6^{(1)} = -0.1 - (-0.009) = -0.0991 \end{cases}$$

$$\underbrace{\begin{bmatrix} \Delta P_2 \\ \Delta P_3 \\ \vdots \\ \Delta P_6 \\ \hline \Delta Q_2 \\ \Delta Q_3 \\ \vdots \\ \Delta Q_6 \end{bmatrix}}_{\text{res}} = \underbrace{\begin{bmatrix} \frac{\partial P_2}{\partial IV_1} & \frac{\partial P_2}{\partial IV_6} & \frac{\partial P_2}{\partial S_2} & \frac{\partial P_2}{\partial S_6} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{\partial P_6}{\partial IV_1} & \frac{\partial P_6}{\partial IV_6} & \frac{\partial P_6}{\partial S_2} & \frac{\partial P_6}{\partial S_6} \\ \hline \frac{\partial Q_2}{\partial IV_1} & \frac{\partial Q_2}{\partial IV_6} & \frac{\partial Q_2}{\partial S_2} & \frac{\partial Q_2}{\partial S_6} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{\partial Q_6}{\partial IV_1} & \frac{\partial Q_6}{\partial IV_6} & \frac{\partial Q_6}{\partial S_2} & \frac{\partial Q_6}{\partial S_6} \end{bmatrix}}_{\text{Jacobian}} \underbrace{\begin{bmatrix} \Delta IV_1 \\ \vdots \\ \Delta IV_6 \\ \hline \Delta S_2 \\ \vdots \\ \Delta S_6 \end{bmatrix}}_{\text{Jacobian}}$$