یا لطیف

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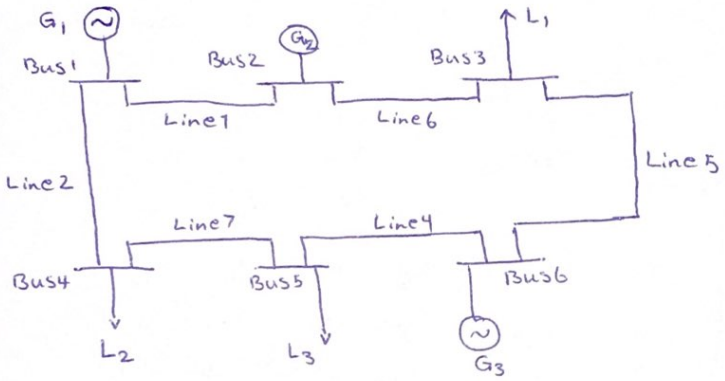
۹۸۱۴۳۵۳

تمرین سری 5 تحلیل سیستم



Generator	Bus	P^G (P.u)	Q^G (P.u)	$Q^{G,min}$ (P.u)	$Q^{G,max}$ (P.u)
1	1	تعادلی	تعادلی	-2	2
2	2	1.4	تعادلی	-1	1.4
3	3	0.2	0.1	-0.1	0.2

Line	From	to	Z (P.u)	capacity	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 + j0.197	2	j0
4	5	6	0.08 + j0.14	1	j0
5	3	6	0.01 + j0.018	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

الف) نوع باس ها و متغیر های حالت مجهول را تعیین کنید ؟

Bus 1 → باس مبنا → معلومات: $|\bar{V}|$, $\angle\bar{V}$; مجهول: Q, P

Bus 2 → PV باس → معلومات: $|\bar{V}|$, P ; مجهول: $\angle\bar{V}$, Q

Bus 3:6 → معرف → معلومات: P, Q ; مجهول: $\angle\bar{V}$, $|\bar{V}|$

$$\bar{V}(0): \begin{bmatrix} 1\angle 0^\circ \\ 1.05\angle 0^\circ \\ 1\angle 0^\circ \\ 1\angle 0^\circ \\ 1\angle 0^\circ \\ 1\angle 0^\circ \end{bmatrix} \qquad Y_{Bus}: \begin{bmatrix} Y_{11} & Y_{12} & Y_{13} & Y_{14} & Y_{15} & Y_{16} \\ Y_{21} & Y_{22} & Y_{23} & Y_{24} & Y_{25} & Y_{26} \\ Y_{31} & Y_{32} & Y_{33} & Y_{34} & Y_{35} & Y_{36} \\ Y_{41} & Y_{42} & Y_{43} & Y_{44} & Y_{45} & Y_{46} \\ Y_{51} & Y_{52} & Y_{53} & Y_{54} & Y_{55} & Y_{56} \\ Y_{61} & Y_{62} & Y_{63} & Y_{64} & Y_{65} & Y_{66} \end{bmatrix}$$

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

$$Y_{12} = \frac{1}{Z_{12}} = \frac{1}{0.14 + j0.17} = 2.57 - j4.37$$

$$Y_{14} = \frac{1}{Z_{14}} = \frac{1}{0.15 + j0.258} = 1.68 - j2.89$$

$$Y_{24} = \frac{1}{Z_{24}} = \frac{1}{0.12 + j0.197} = 2.253 - j3.7$$

$$Y_{36} = \frac{1}{Z_{36}} = \frac{1}{0.01 + j0.018} = 23.58 - j42.45$$

$$Y_{56} = \frac{1}{Z_{56}} = \frac{1}{0.08 + j0.14} = 3.076 - j5.38$$

$$Y_{23} = \frac{1}{Z_{23}} = \frac{1}{0.02 + j0.037} = 11.30 - j20.91$$

$$Y_{45} = \frac{1}{Z_{45}} = \frac{1}{0.02 + j0.037} = 11.30 - j20.91$$

$$\Rightarrow \begin{cases} Y_{11} = Y_{12} + Y_{14} = 4.2549 - j7.2670 \\ Y_{22} = Y_{12} + Y_{23} + Y_{24} = 16.13 - j28.99 \\ Y_{33} = Y_{23} + Y_{36} = 34.90 - j63.36 \end{cases} , \quad \begin{cases} Y_{44} = Y_{14} + Y_{24} + Y_{45} = 15.24 - j27.51 \\ Y_{55} = Y_{45} + Y_{56} = 14.38 - j26.30 \\ Y_{66} = Y_{36} + Y_{56} = 26.66 - j47.83 \end{cases}$$

ب) تعیین توان راکتیو باس ② در تکرار اول:

$$Q_i(t) = -Im\left\{ V_i^*(t) \cdot \sum_{j=1}^{6} Y_{ij} \cdot \bar{V}_j(t) \right\} \xrightarrow{i=2} Q_2(t) = -Im\left\{ 1.05 \left(Y_{21} V_1 + Y_{22} V_2 + Y_{23} V_3 + Y_{24} V_4 + Y_{25} V_5 + Y_{26} V_6 \right) \right\} = -Im\left\{ 0.847 - j1.521 \right\} = \underline{1.521}$$

نقال تزریقی
② زنراتور : $Q_2^G = Q_2 + Q_2^L = 1.521 + 0.2 = 1.721$

شرط محدودیت راکتیو ژنراتور : $Q_2^{G,min} ? \le Q_2^G ? \le Q_2^{G,max} \Rightarrow -1 \le Q_2^G \le 1.4$ X

$\Rightarrow Q_2^G > Q_2^{G,max} \xrightarrow{Q_2 \text{ ثابت}} Q_2(t) = Q_2^{G,max} - Q_2^L = 1.4 - 0.2 = 1.2$

$P_2 = P_2^G - P_2^L = 1.4 - 0.5 = 0.9 \Rightarrow V_2(1) = \frac{1}{Y_{22}} \times \left(\frac{P_2 - jQ_2}{V_2^*(0)} - \sum_{\substack{j=1 \\ j \neq i}}^{6} Y_{2j} \cdot \bar{V}_j(0) \right)$

$= \frac{1}{16.13 - j28.99} \times \left(\frac{0.9 - j1.2}{1.05 \angle 0^*} - \left(Y_{21} \cdot V_2(0) + Y_{23} \cdot V_3(0) + Y_{24} \cdot V_4(0) + Y_{25} \cdot V_5(0) + Y_{26} \cdot V_6(0) \right) \right)$

$= \frac{1}{16.13 - j28.99} \times \left(0.857 - j1.14 - \left((-2.57 + j4.37) \times (1) + (-11.30 + j20.91) + (-2.25 + j3.702) \right) \right) = 1.042 + j0.005$

باس 3 وضعیت : $P_3 + jQ_3 = \left[P_3^G - P_3^D \right] + j\left(Q_3^G - Q_3^D \right) = (0 - 0.4) + j(0 - 0.15) = -0.4 - j0.15$

$\Rightarrow V_3(1) = \frac{1}{Y_{33}} \cdot \left[\frac{P_3 - jQ_3}{V_3^*(0)} - \left(Y_{31} \cdot V_1(0) - Y_{32} \cdot V_2(1) - Y_{34} \cdot V_4(0) - Y_{35} V_5(0) - Y_{36} \cdot V_6(0) \right) \right]$

$= \frac{1}{34.89 - j63.36} \left(\frac{-0.4 + j0.15}{1 \angle 0^*} - \left((-11.30 + j20.91) \times (1.042 + j0.005) + (-23.58 + j42.45) \times (1 \angle 0^*) \right) \right) = 1.009 - j0.002$

باس 4 وضعیت : $P_4 + jQ_4 = (P_4^G - P_4^D) + j(Q_4^G - Q_4^D) = (0 - 0.4) + j(0 - 0.15) = -0.4 - j0.15$

$\Rightarrow V_4(1) = \frac{1}{Y_{44}} \left(\frac{P_4 - jQ_4}{V_4^*(0)} - Y_{41} V_1(0) - Y_{42} V_2(1) - Y_{43} \cdot V_3(1) - Y_{45} V_5(0) - Y_{46} \cdot V_6(0) \right)$

$= 0.99 - j0.007$

باس 5 وضعیت : $P_5 + jQ_5 = (P_5^G - P_5^D) + j(Q_5^G - Q_4^D) = (0 - 0.5) + j(0 - 0.2) = -0.5 - j0.2$

$$\Rightarrow \bar{V}_5(1) = \frac{1}{Y_{55}}\left(\frac{P_5 - jQ_5}{V_5^*(0)} - Y_{51}V_1(0) - Y_{52}V_2(1) - Y_{53}V_3(1) - Y_{54}V_4(1) - Y_{56}V_6(0)\right)$$

$$= 0.982 - j0.017$$

Bus 6 : $P_6 + jQ_6 = (P_6^G - P_6^D) + j(Q_6^G - Q_6^D) = (0.2 - 0.5) + j(0.1 - 0.2) = -0.3 - j0.1$

$$V_6(1) = \frac{1}{Y_{66}}\left(\frac{P_6 - jQ_6}{V_6^*(0)} - Y_{61}V_1(0) - Y_{62}V_2(1) - Y_{63}V_3(1) - Y_{64}V_4(1) - Y_{65}V_5(1)\right) = 1.002 - j0.007$$

$$\Rightarrow V_2(1) - V_2(0) = \underset{|Re|}{0.042} + \underset{|Im|}{j0.005}, \quad V_5(1) - V_5(0) = \underset{|Re|}{-0.017} - \underset{|Im|}{j0.017}$$

$$V_3(1) - V_3(0) = 0.009 - j0.002 \quad , \quad V_6(1) - V_6(0) = 0.002 - j0.007$$

$$V_4(1) - V_4(0) = -0.004 - j0.007$$

$$\left|Re\{V_2(1) - V_2(0)\}\right| = 0.0427 \quad , \quad \left|Im\{V_2(1) - V_2(0)\}\right| = 0.005$$

$$|V_2| = \sqrt{(1.042)^2 + (0.005)^2} = 1.042 \Rightarrow \delta V_2 = \tan^{-1}\left(\frac{0.005}{1.042}\right) = 0.32^\circ$$

$$|V_3| = \left[(0.009)^2 + (-0.002)^2\right]^{1/2} = 1.009 \Rightarrow \delta V_3 = \tan^{-1}\left(\frac{-0.002}{1.009}\right) = -0.11^\circ$$

$$|V_4| = \left[(-0.995)^2 + (-0.007)^2\right]^{1/2} = 0.995 \Rightarrow \delta V_4 = \tan^{-1}\left(\frac{0.007}{0.995}\right) = -044^\circ$$

$$|V_5| = \left[(0.982)^2 + (-0.0176)^2\right]^{1/2} = 0.982 \Rightarrow \delta V_5 = \tan^{-1}\left(\frac{-0.017}{0.982}\right) = -1.02^\circ$$

$$|V_6| = \left[(0.002)^2 + (0.007)^2\right]^{1/2} = 1.002 \Rightarrow \delta V_6 = \tan^{-1}\left(\frac{-0.007}{1.002}\right) = -44^\circ$$

$$P_1 = Re\left\{V_1^* \sum_{j=1}^{6} Y_{1j} \cdot V_j\right\} = Re\left\{Y_{11}V_1 + Y_{12}V_2(1) + Y_{14}V_4(1)\right\} = Re\left\{(4.25 - j7.26) + \left((-2.57 + j4.37)(1.042 + j0.005)\right) + \left((-1.68 + j2.89)(0.995 - j0.007)\right)\right\} = -0.104$$

$$\Rightarrow Q_1 = -Im\left\{V_1^* \sum_{j=1}^{6} Y_{1j} \cdot V_j\right\} = -0.171$$