Studi Aliran Daya

(Power Flow Analysis)

Mata Kuliah Analis Sistem Tenaga

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Agenda

- Matriks Admitansi
- Persamaan Aliran Daya
- Metode Gaus-Siedell
- Metode Newton-Raphson

Referensi utama : Power System Analys – Hadi Saadat Chapter 6

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Pendahuluan

- Studi aliran daya merupakan penentuan/perhitungan tegangan, arus, daya, dan PF yang terdapat pada berbagai simpul dalam suatu jarngan listrik keadaan operasi normal. Hal ini penting untuk perencanaan, pengoperasian, dan perawatan.
- Sistem dalam keadaan seimbang; dengan demikian kita dapat melakukan perhitungan dengan menggunakan model satu-fasa.
- Semua besaran dinyatakan dalam per-unit; dengan demikian berbagai tingkat tegangan dalam sistem sebagai akibat digunakannya transformator, tidaklah menjadi persoalan.

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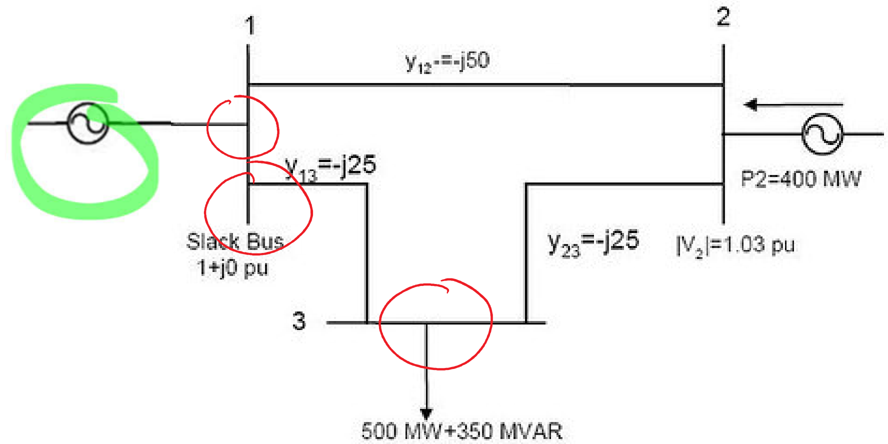
Pendahuluan

- Analisa system tenaga direpresentasikan permodelan terhadap komponen-komponen system tenaga seperti gen, trafo, GI, transmisi, shunt cap, inductor, dan load.
- Terdapat tiga jenis bus :
- Generator Bus
- Load Bus
- Slack/Swing/Ref Bus



Type of Buses	Know or Specified Quantities	Unknown Quantities or Quantities to be determined.
Generation or P-V Bus	P, | V |	Q, δ
Load or P-Q Bus	P, Q	| V |, δ
Slack or Reference Bus	| V |, δ	P, Q

Matriks Admitansi : KCL

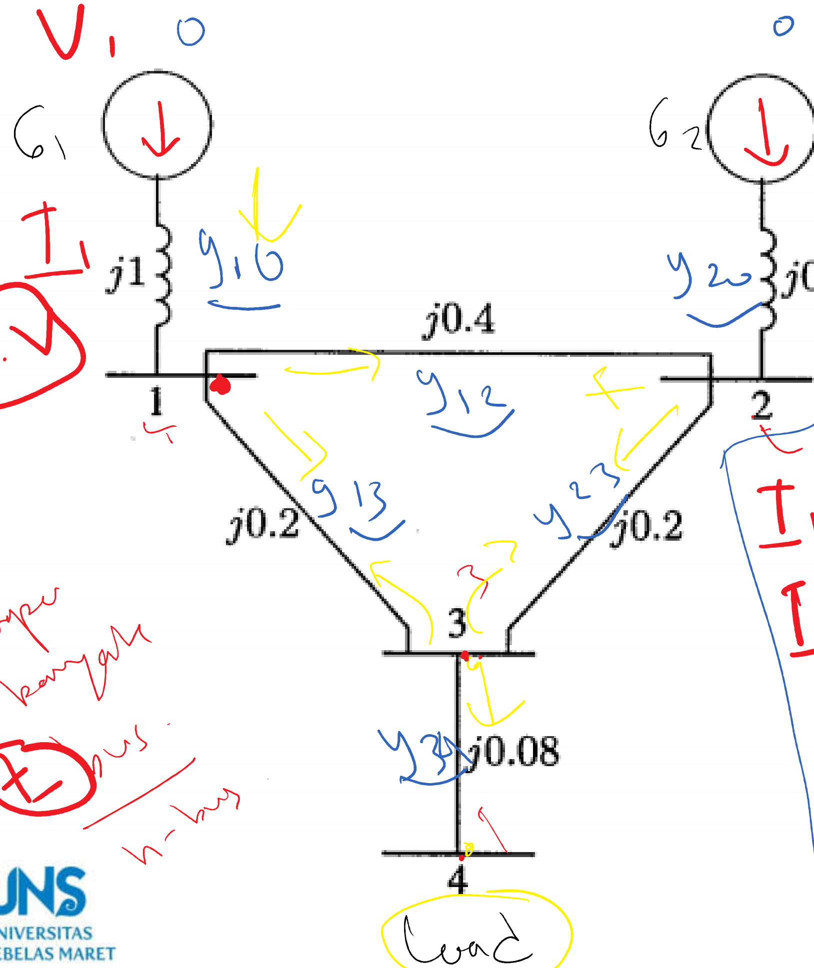
$$Y = \frac{1}{Z}$$

Impedansi → seberapa penghambat

Admitansi → seberapa mudah menghantarkan

$$y_{ij} = \frac{1}{Z_{ij}} = \frac{1}{r_{ij} + j X_{ij}}$$

Resistansi, Reaktansi



$I = Y \cdot V$

KCL

$$I_1 = y_{10} V_1 + y_{12}(V_1 - V_2) + y_{13}(V_1 - V_3)$$

$$I_2 = y_{20} V_2 + y_{12}(V_1 - V_2) + y_{23}(V_2 - V_3)$$

$$0 = y_{23}(V_3 - V_2) + y_{13}(V_3 - 1) + y_{34}(V_3 - V_4)$$

$$0 = y_{34}(V_4 - V_3)$$

$$I_1 = (y_{10} + y_{12} + y_{13})V_1 - y_{12}V_2 - y_{13}V_3$$

$$I_2 = -y_{12}V_1 + (y_{20} + y_{12} + y_{23})V_2 - y_{23}V_3$$

$$0 = -y_{13}V_1 - y_{23}V_2 + (y_{13} + y_{23} + y_{34})V_3 - y_{34}V_4$$

$$0 = -y_{34}V_3 + y_{34}V_4$$

$$Y_{11} = y_{10} + y_{12} + y_{13}$$

$$Y_{22} = y_{20} + y_{12} + y_{23}$$

$$Y_{33} = y_{13} + y_{23} + y_{34}$$

$$Y_{44} = y_{31}$$

$$Y_{12} = Y_{21} = -y_{12}$$

$$Y_{13} = Y_{31} = -y_{13}$$

$$Y_{3} = Y_{32} = -y_{23}$$

$$Y_{34} = Y_{43} = -y_{34}$$

$$I_1 = Y_{11}V_1 + Y_{12}V_2 + Y_{13}V_3 + Y_{14}V_4$$

$$I_2 = Y_{21}V_1 + Y_{22}V_2 + Y_{23}V_3 + Y_{24}V_4$$

$$I_3 = Y_{\ 1}V_1 + Y_{32}V_2 + Y_{33}V_3 + Y_{34}V_4$$

$$I_4 = Y_{41}V_1 + Y_{42}V_2 + Y_{43}V_3 + Y_{44}V_4$$

$= 0$

$$\underbrace{\begin{bmatrix} I \\ \vdots \\ i_n \end{bmatrix}}_{I} = \underbrace{\begin{bmatrix} \cdot & \cdot & \cdot & \cdot \\ \cdot & & \cdot & \cdot \\ \cdot & & \cdot & \cdot \\ \cdot & & & \end{bmatrix}}_{Y} \underbrace{\begin{bmatrix} \; \end{bmatrix}}_{V}$$

Persamaan matriksnya :

$$\begin{bmatrix} I_1 \\ I_2 \\ \vdots \\ I_n \end{bmatrix} = \begin{bmatrix} Y_{11} & Y_{12} & \cdots & Y_{1n} \\ Y_{21} & Y_{22} & \cdots & Y_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ Y_{n1} & Y_{n2} & \cdots & Y_{nn} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ \vdots \\ V_n \end{bmatrix}$$

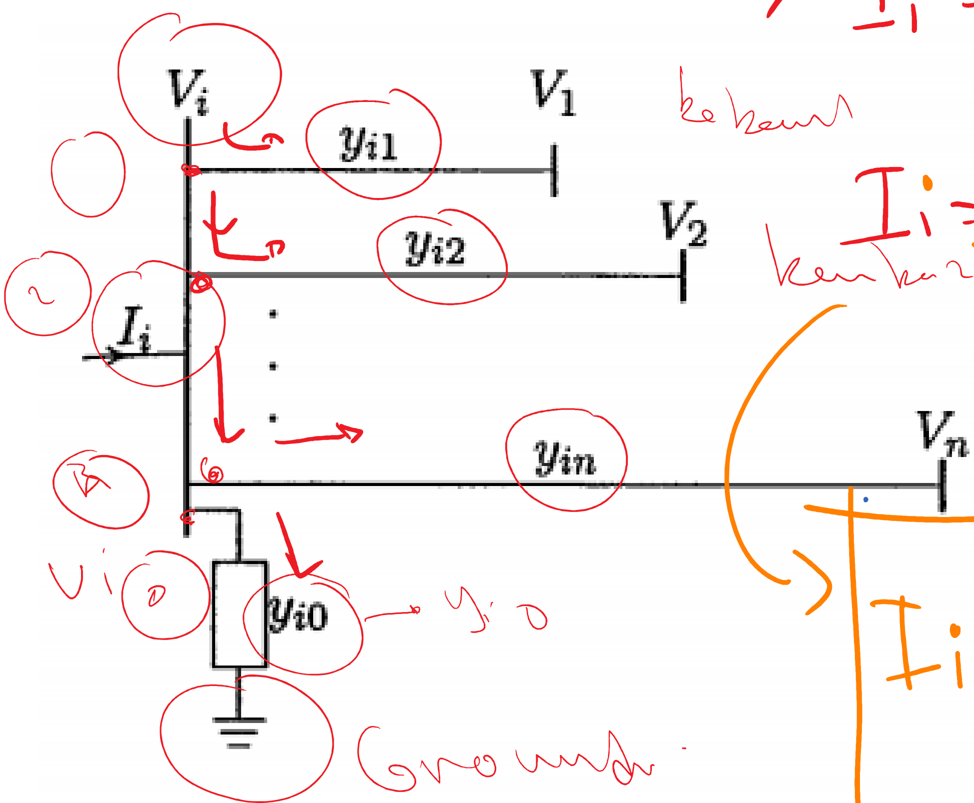
$$\bar{I}_{bus} = \bar{Y}_{bus} \cdot \bar{V}_{bus}$$

$$\bar{V}_{bus} = Y_{bus}^{-1} \cdot I_{bus}$$

$$\bar{Y}_{bus} = V_{bus}^{-1} \cdot I_{bus}$$

Commonly admitansi

Power Flow Equation



$$I_i = y_{i0} V_i + y_{i1}(V_i - V_1) + y_{i2}(V_i - V_2) + \dots + y_{in}(V_i - V_n)$$

$$I_i = (y_{i0} + y_{i1} + y_{i2} + \dots + y_{in}) V_i - y_{i1} V_1 - y_{i2} V_2 - \dots - y_{in} V_n$$

$$I_i = V_i \sum_{j=0}^{n} y_{ij} - \sum_{j=1}^{n} y_{ij} V_j, \quad j \neq i$$

$$S = V_i \cdot I_i^*$$

$$P_i + jQ_i = V_i I_i^*$$

$$I_i = \frac{P_i + jQ_i}{V_i^*}$$

$$\frac{P_i + jQ_i}{V_i^*} = V_i \sum_{j=0}^{n} y_{ij} - \sum_{j=1}^{n} y_{ij} V_j$$

persamaan daya → iterasi

→ Gauss - Siedell

→ Newton - Rapshon

aliran

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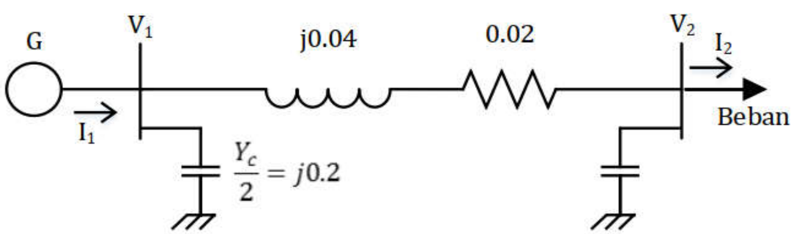
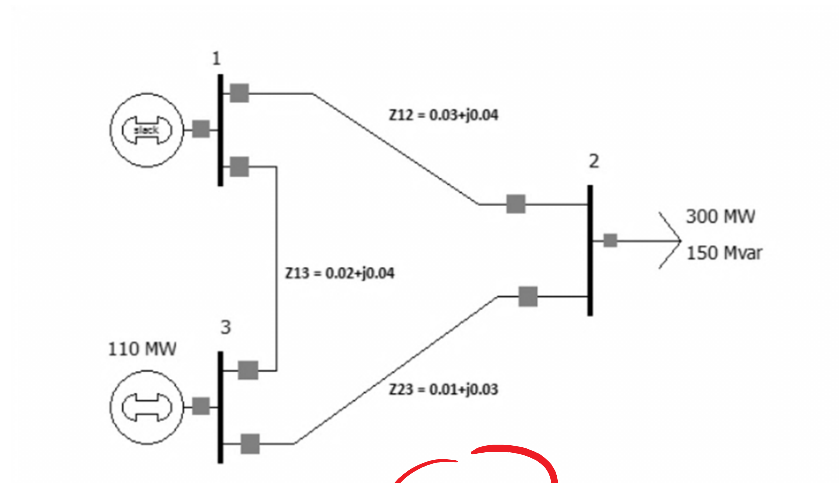
Exercise 1.

No. 1

Define the admittance matrixs and V1, V2, If $I_1 = 6A$ and, $I_2 = 5.6A$.



No. 2 Find Y bus admittance matrix from fig. below:



No. 3

3

PROBLEMS

6.1. A power system network is shown in Figure 6.17. The generators at buses 1 and 2 are represented by their equivalent current sources with their reactances in per unit on a 100-MVA base. The lines are represented by π model where series reactances and shunt reactances are also expressed in per unit on a 100 MVA base. The loads at buses 3 and 4 are expressed in MW and Mvar.

(a) Assuming a voltage magnitude of 1.0 per unit at buses 3 and 4, convert the loads to per unit impedances. Convert network impedances to admittances and obtain the bus admittance matrix by inspection.

(b) Use the function **Y = ybus(zdata)** to obtain the bus admittance matrix. The function argument **zdata** is a matrix containing the line bus numbers, resistance and reactance. (See Example 6.1.)

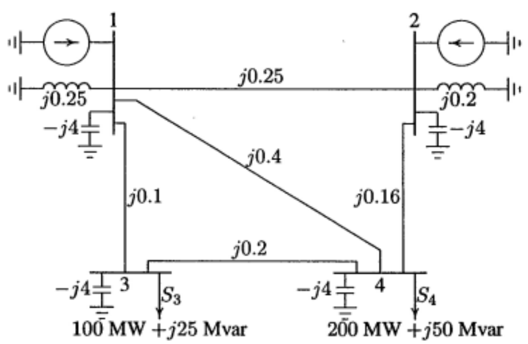


FIGURE 6.17
One-line diagram for Problem 6.1.

No. 4

4

6.2. A power system network is shown in Figure 6.18. The values marked are impedances in per unit on a base of 100 MVA. The currents entering buses 1 and 2 are

$$I_1 = 1.38 - j2.72 \text{ pu}$$
$$I_2 = 0.69 - j1.36 \text{ pu}$$

(a) Determine the bus admittance matrix by inspection.

(b) Use the function **Y = ybus(zdata)** to obtain the bus admittance matrix. The function argument **zdata** is a matrix containing the line bus numbers, resistance and reactance. (See Example 6.1.) Write the necessary *MATLAB* commands to obtain the bus voltages.