EEE- 601
POWER SYSTEM ANALYSIS
Unit-2

Unbalanced Fault Summary

- SLG: Sequence networks are connected in series, parallel to three times the fault impedance
- LL: Positive and negative sequence networks are connected in parallel; zero sequence network is not included since there is no path to ground
- DLG: Positive, negative and zero sequence networks are connected in parallel, with the zero sequence network including three times the fault impedance

Generalized System Solution

- Assume we know the pre-fault voltages
- The general procedure is then

1. Calculate Z_{bus} for each sequence
2. For a fault at bus i, the Z_{ii} values are the thevenin equivalent impedances; the pre-fault voltage is the positive sequence thevenin voltage
3. Connect and solve the thevenin equivalent sequence networks to determine the fault current

Generalized System Solution, cont'd

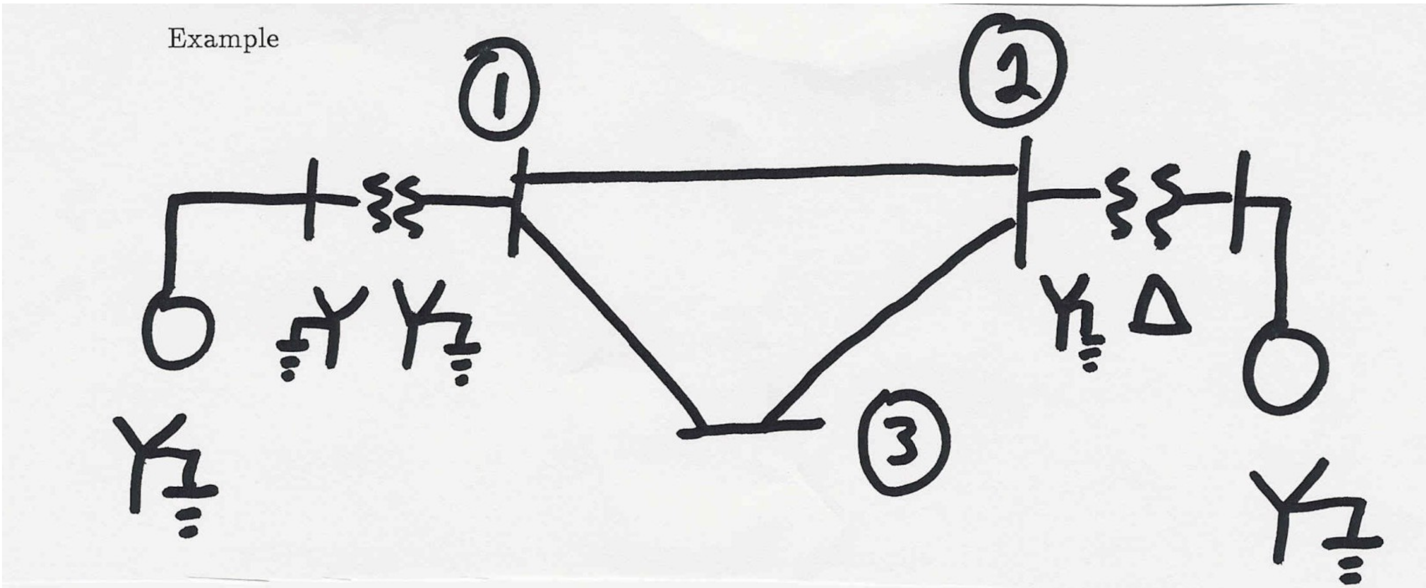
4. Sequence voltages throughout the system are given by

$$\mathbf{V} = \mathbf{V}^{prefault} + Z \begin{bmatrix} 0 \\ \vdots \\ 0 \\ -I_f \\ 0 \\ \vdots \\ 0 \end{bmatrix}$$

This is solved for each sequence network!

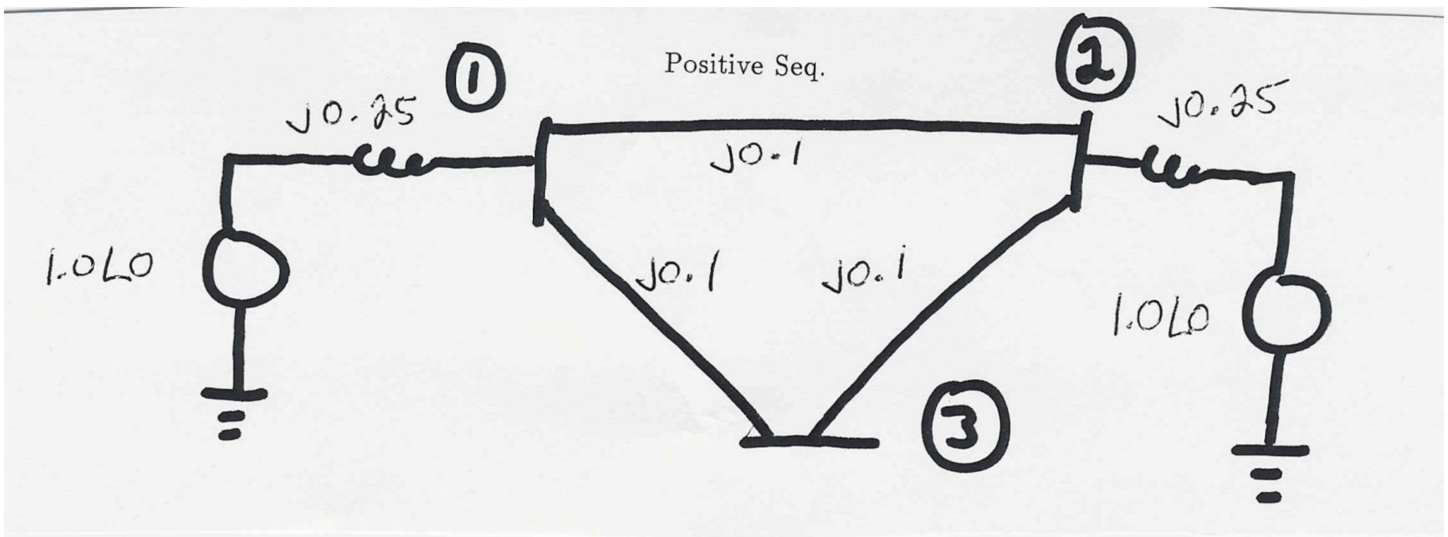
5. Phase values are determined from the sequence values

Unbalanced System Example



For the generators assume $Z^+ = Z^- = j0.2$; $Z^0 = j0.05$
For the transformers assume $Z^+ = Z^- = Z^0 = j0.05$
For the lines assume $Z^+ = Z^- = j0.1$; $Z^0 = j0.3$
Assume unloaded pre-fault, with voltages =1.0 p.u.

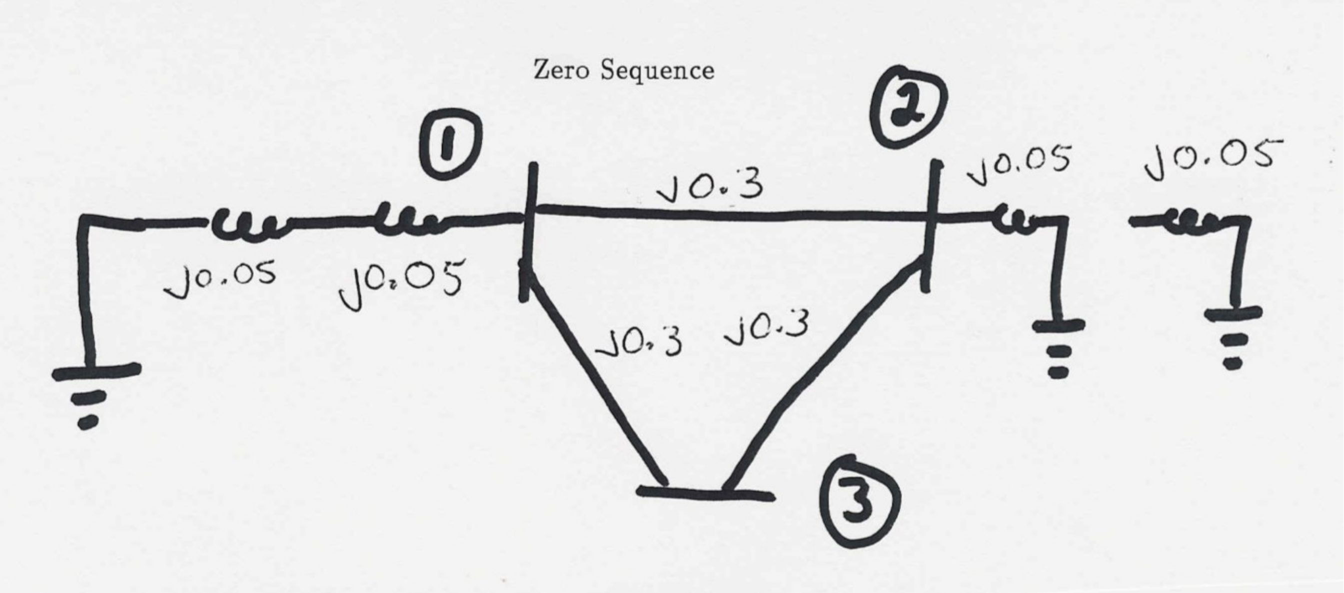
Positive/Negative Sequence Network



$$\mathbf{Y}_{bus}^{+} = j\begin{bmatrix} -24 & 10 & 10 \\ 10 & -24 & 10 \\ 10 & 10 & -20 \end{bmatrix} \qquad \mathbf{Z}_{bus}^{+} = j\begin{bmatrix} 0.1397 & 0.1103 & 0.125 \\ 0.1103 & 0.1397 & 0.125 \\ 0.1250 & 0.1250 & 0.175 \end{bmatrix}$$

Negative sequence is identical to positive sequence

Zero Sequence Network



$$\mathbf{Y}_{bus}^{0} = j\begin{bmatrix} -16.66 & 3.33 & 3.33 \\ 3.33 & -26.66 & 3.33 \\ 3.33 & 3.33 & -6.66 \end{bmatrix} \mathbf{Z}_{bus}^{0} = j\begin{bmatrix} 0.0732 & 0.0148 & 0.0440 \\ 0.0148 & 0.0435 & 0.0.292 \\ 0.0440 & 0.0292 & 0.1866 \end{bmatrix}$$

Thank you