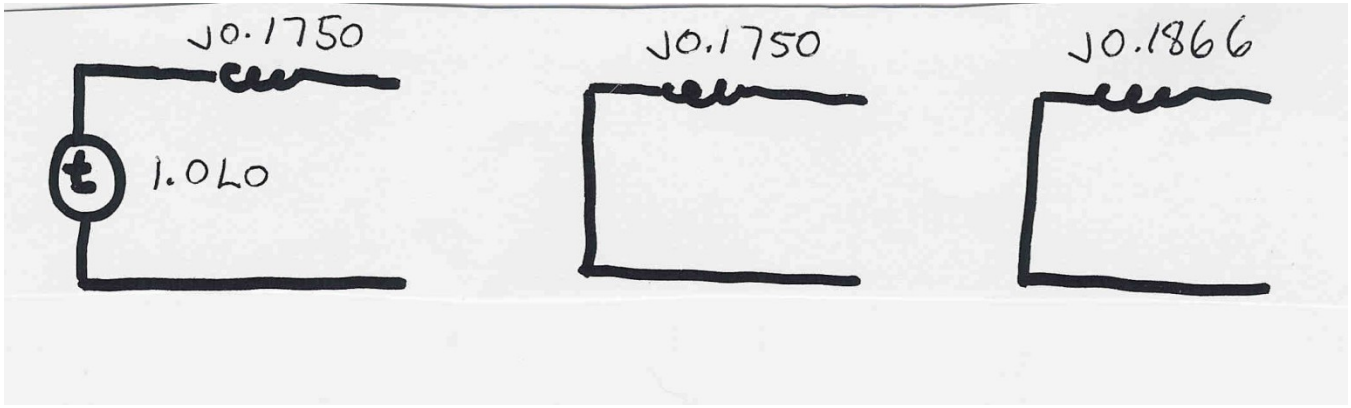
# EEE- 601
# POWER SYSTEM ANALYSIS
# Unit-2

# For a SLG Fault at Bus 3

The sequence networks are created using the pre-fault voltage for the positive sequence thevenin voltage, and the $Z_{bus}$ diagonals for the thevenin impedances

Positive Seq. Negative Seq. Zero Seq.




The fault type then determines how the networks are interconnected

# Bus 3 SLG Fault, cont'd

$$I_f^+ = \frac{1.0\angle 0°}{j(0.1750+0.1750+0.1866)} = -j1.863$$

$$I_f^+ = I_f^- = I_f^0 = -j1.863$$

$$\mathbf{V}^+ = \begin{bmatrix} 1.0\angle 0° \\ 1.0\angle 0° \\ 1.0\angle 0° \end{bmatrix} + \mathbf{Z}_{bus}^+ \begin{bmatrix} 0 \\ 0 \\ j1.863 \end{bmatrix} = \begin{bmatrix} 0.7671 \\ 0.7671 \\ 0.6740 \end{bmatrix}$$

$$\mathbf{V}^- = \mathbf{Z}_{bus}^- \begin{bmatrix} 0 \\ 0 \\ j1.863 \end{bmatrix} = \begin{bmatrix} -0.2329 \\ -0.2329 \\ -0.3260 \end{bmatrix}$$

# Bus 3 SLG Fault, cont'd

$$\mathbf{V}^0 = \mathbf{Z}^0_{bus}\begin{bmatrix} 0 \\ 0 \\ j1.863 \end{bmatrix} = \begin{bmatrix} -0.0820 \\ -0.0544 \\ -0.3479 \end{bmatrix}$$

We can then calculate the phase voltages at any bus

$$\mathbf{V}_3 = \mathbf{A} \times \begin{bmatrix} -0.3479 \\ 0.6740 \\ -0.3260 \end{bmatrix} = \begin{bmatrix} 0 \\ -0.522 - j0.866 \\ -0.522 + j0.866 \end{bmatrix}$$

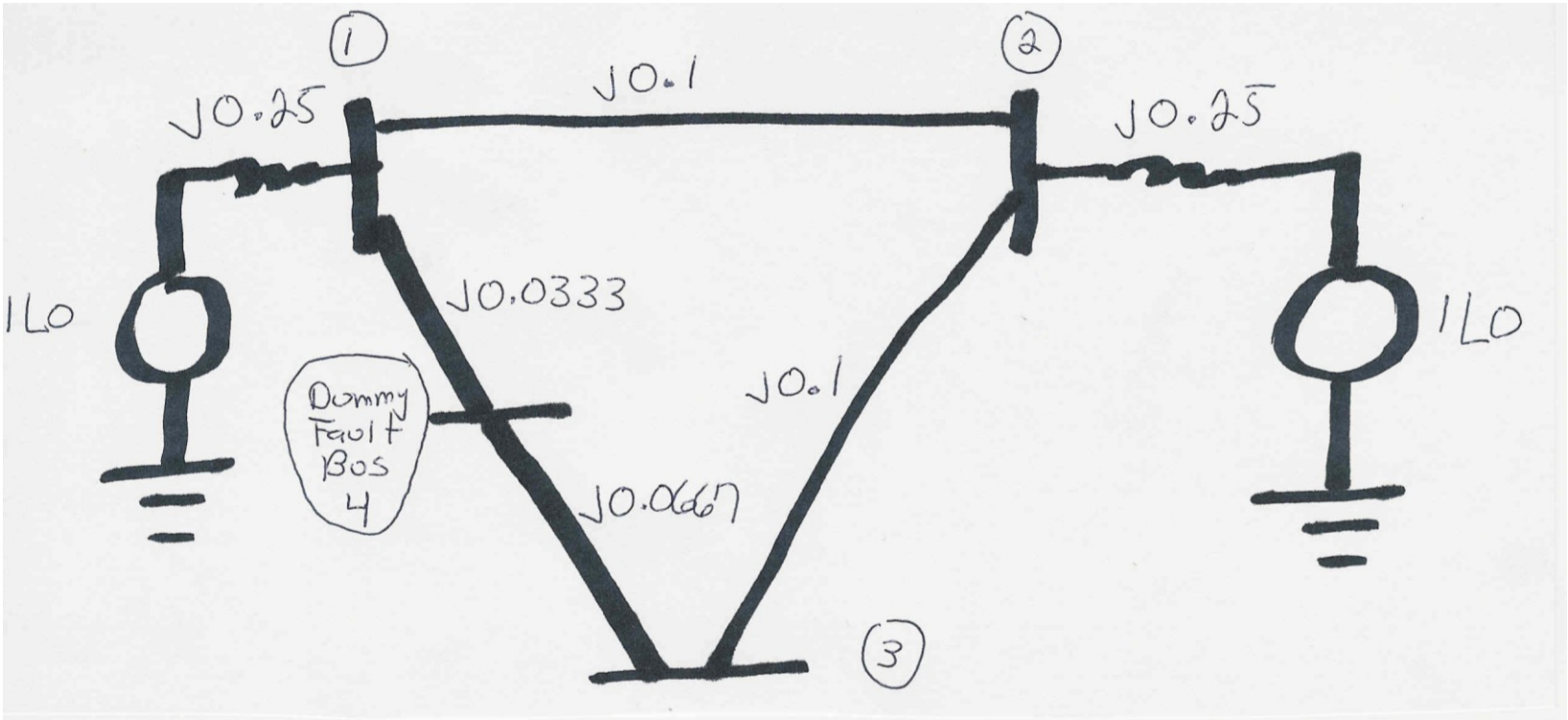
$$\mathbf{V}_1 = \mathbf{A} \times \begin{bmatrix} -0.0820 \\ 0.7671 \\ -0.2329 \end{bmatrix} = \begin{bmatrix} 0.4522 \\ -0.3491 - j0.866 \\ -0.3491 + j0.866 \end{bmatrix}$$

# Faults on Lines

- The previous analysis has assumed that the fault is at a bus. Most faults occur on transmission lines, not at the buses
- For analysis these faults are treated by including a dummy bus at the fault location. How the impedance of the transmission line is then split depends upon the fault location

# Line Fault Example

Assume a SLG fault occurs on the previous system on the line from bus 1 to bus 3, one third of the way from bus 1 to bus 3. To solve the system we add a dummy bus, bus 4, at the fault location



# Line Fault Example, cont'd

The $Y_{bus}$ now has 4 buses

$$\mathbf{Y}_{bus}^{+} = j\begin{bmatrix} -44 & 10 & 0 & 30 \\ 10 & -24 & 10 & 0 \\ 0 & 10 & -25 & 15 \\ 30 & 0 & 15 & -45 \end{bmatrix}$$

Adding the dummy bus only changes the new row/column entries associated with the dummy bus

$$\mathbf{Z}_{bus}^{+} = j\begin{bmatrix} 0.1397 & 0.1103 & 0.1250 & 0.1348 \\ 0.1103 & 0.1397 & 0.1250 & 0.1152 \\ 0.1250 & 0.1250 & 0.1750 & 0.1417 \\ 0.1348 & 0.1152 & 0.1417 & 0.1593 \end{bmatrix}$$

Thank you