Topics for Today:

• Questions from last lectures?
• Comments on Homework #2
  • Augmentation for L-G Fault - signs!
Today - system data for computer studies
  • Transformer Data
  • More on tap-changing transformers
Coming up - keep studying Chapters 3 & 4.
  • Nonlinear systems of equations
  • Newton Iterative Method
  • Newton-Raphson Load Flow Formulation
  • Everybody have access to Aspen?
XFMRs - Use L-N (ΦA-N) Per Phase Eqiv.

5 \to \frac{6}{\text{p.u.}}

In [Ybus]

\[ y_{56} = -\frac{1}{\pm 66} \]

(And \ y_{65})

\[ y_{55} = y_{55} + \pm 65 \]

\[ y_{66} = y_{66} + \]  

Basis 2-winding XFMR is simple.

Modify - \ y_{55} \ y_{56} \ y_{65} \ y_{66} -

How about?
- LTC (or TCUL)
- Phase Shifter (PS)
Basis Approach: Develop Pi-Equiv and handle just like T-Line.

One-Line:

\[ 1 \xrightarrow{a:1} 2 \]

per-unit per-phase

\[ 1 \xrightarrow{\text{REF}} 2 \]

Tap-Changers

- LTC's
- Phase-Shift

\[ a:1 \xrightarrow{\text{NOMINAL}} c:1 \]

± Adjustment in phase angle (PS) or volt mag (LTC)
Tap Changing XFMRS - Variations (p.u. representations)

\[ y_{sc} = \frac{1}{R + jX} \]

"C" is off-nominal turns ratio. In general, C is complex.

- C is real for LTC.
- C is complex for PS.

If |C| \neq 1 then magnitude change.
If C is complex, Phase Shift.
Standard Approach:

\[
\begin{bmatrix}
\gamma_{11} & \gamma_{12} \\
\gamma_{21} & \gamma_{22}
\end{bmatrix}
\begin{bmatrix}
V_1 \\
V_2
\end{bmatrix}
= 
\begin{bmatrix}
I_1 \\
I_2
\end{bmatrix}
\]

Goal:

\[
y_{11} = y_{\text{SER}} + y_{\text{SH1}} \\
y_{12} = -y_{\text{SER}} \\
y_{21} = -y_{\text{SER}} \\
y_{22} = y_{\text{SER}} + y_{\text{SH2}}
\]