Topics for Today:

- Announcements
  - Detailed term project outlines (i.e. Table of Contents + List of references)
  - Software: online students - apply for ATP/ATPDraw license, verify licensing when you receive it by e-mail, and we will mail you the install CD.
  - ASPEN software - arranging to run off of MTU server via internet.
  - Office: EERC 614. Phone: 906.487.2857
  - Recommended problems & all solutions: Ch.7 solns posted.

- Chapter 7 - Network Equations, Admittance Approaches
  - How’s your linear algebra? Time to make use of it...
  - Basic strategy for building up [Y] for whole network
  - Quick recap of xfmrs and lines.
  - Generators
  - Example of building [Y] for 4-bus system.
  - Network Reduction (Kron Reduction)
  - Solution of matrix equations (system of linear equations)
  - Upcoming homework - intro to Matlab, matrices, equations.
Basic Idea:

Per-Phase A-N

Gen Norton Admittance

\[
[Y]
\]

Lines, XFMRS, Shunt Reactors, Shunt Capacitors

\[
[Y][V] = [I_{\text{inj}}]
\]
\[ [Z_B] = [Y_B]^{-1} \]

\[\Rightarrow\]

...still only need modify

Y55  Y57

Y75  Y77

treat as off-nominal turns ratio.
$\rightarrow [Y_{Bus}]$

Building by inspection:

\[
\begin{bmatrix}
1 & -1 & 0 & -1 \\
-1 & 2 & -1 & 0 \\
0 & -1 & 3 & -1 \\
-1 & 0 & -1 & 4 \\
\end{bmatrix}
\]

From KCL:

\[
\sum I_s \text{ in } = 0
\]

\[
-y_3 \cdot 4
\]
\[
\begin{align*}
y_{33} &= y_{33} + y_{3-4} \\
y_{44} &= y_{44} + y_{4-3} \\
y_{34} &= y_{34} - y_{3+4} \\
y_{43} &= y_{43} - y_{4+3}
\end{align*}
\]

If bilateral,
\[
y_{3-4} = y_{4-3}
\]

FACTS -

- non-bilateral
- \( y_{nn} \) and \( y_{n-n} \)

EX:

- UPFC - P&Q
- SVC - Shut Q
- P.S. Transformer
\[
\bar{y}_{11} = \frac{\bar{I}_1}{\bar{V}_1} \bigg| \bar{V}_2 = 0
\]
\[
\bar{y}_{12} = \frac{\bar{I}_1}{\bar{V}_2} \bigg| \bar{V}_1 = 0
\]
\[
\bar{y}_{21} = \frac{\bar{I}_2}{\bar{V}_1} \bigg| \bar{V}_2 = 0
\]
\[
\bar{y}_{22} = \frac{\bar{I}_2}{\bar{V}_2} \bigg| \bar{V}_1 = 0
\]

Open- and Short-Circuit Tests
Four Cases

Next:

\[ \text{XFMRs} \begin{bmatrix} y_0 & y_{12} \\ y_2 & y_{22} \end{bmatrix} \]