Topics for Today:

- Announcements
  - Nov 7th - Chance to perfect Detailed Term Project outline (3-level) in format of report Table of Contents + complete 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, 8 solns now posted.

- Chapter 7, 10 - Network Equations, Basic Fault applications
  - Fault current - dc offset. Section 10.1
  - Importance of X/R ratio
  - Circuit breaker ratings
  - Three-Phase fault calcs using [Zbus]. Section 10.3
  - Fault current contributions using [Zbus]. Eqn. (10.21)
  - Admittance approach using [Ybus]
I. Intro

II. Background
   A. Topic Area 1
   B. Topic Area 2
   C. Topic Area 3

III. Proposed Approach

New Work/Contribution
Must have branches to Gnd in order to invert.

$\begin{bmatrix} Y \end{bmatrix} = [Z]$

Look at $[Z]$ in regards to S.C. calc's.

If $[Z]$ is symmetric about the main diagonal (bilateral) then use either row or col.
\[ Z_{nn} = Z_{TH} \text{ at bus } n. \]

Off-diagonal \( Z \)'s represent the mutual impedances between bus \( n \) & all other buses.

\[ [V] = [I_{inj}] \]

\[ Z_{mn} \rightarrow n \]

\[ I_{inj} = -I_{sc} \]

\[ V_F = \text{Voltage at bus } (\text{Voc}) \text{ pre-fault} \]

\[ I_{sc} = \frac{V_F}{Z_{nn}} \]

Reference
"Proport" Situation

\[ [Y][v] = [I_{inj}] \]

\[ [Z] = [Y]^{-1} \]

Reference

Lines, XFRS, LOADS, SHUNT CAP/REACTORS
(for this case, also the Gran Impedances)

**EX: Fig 7.5**

IF there is a fault at bus n in system,

\[ V_{F,n} \]

\[ I_F = \frac{V_F}{Z_{nn}} \]

Often assume that

\[ V_F = 1.05 \angle 0^\circ \text{ p.u.} \]
What happens at other buses during the fault? All bus voltages will dip. How much?

During Fault

\[ E_f = V_F - \frac{I_F \cdot Z_{Im}}{Z_{En}} \]

\[ = V_F - \frac{V_F}{Z_{Em}} \cdot Z_{Im} = V_F - \frac{Z_{Im}}{Z_{Em}} V_F \]
\[ V_i = V_F - I_F Z_{ln} \]

\[ I_n = -I_F, \text{ injected into bus n} \]

V drops due to \(-I_F\)
Fault Contributions (i.e. current)

Must Know

IFault contr: Are CBS going to be able to interrupt?
- Relay engineers must know all current flows.
During Fault:
\[
\begin{align*}
\Delta V_g &= V_F - I_F Z_{n-g} \\
\Delta V_j &= V_F - I_F Z_{n-j} \\
\Delta V_K &= V_F - I_F Z_{n-k}
\end{align*}
\]
\[
\Delta I_{gn} = \frac{\Delta V_g - \Delta V_n}{Z_{n-g}}
\]
Refering to Yours, Current contribs are

\[ I_1 = \frac{V}{Z_1} \]

\[ I_2 = \frac{V}{Z_2} \]

\[ V = \frac{I_1 Z_1}{Z_1 + Z_2} \]

\[ I = \frac{V}{Z} \]

\[ Z = Z_1 + Z_2 \]

\[ I = \frac{V}{Z} = \frac{V}{Z_1 + Z_2} \]

\[ Z = Z_1 + Z_2 \]

\[ I = \frac{V}{Z} \]
P.6 method ok for Short-Line Connections.

- What about Pi-equiv Line
- Shunt Load
- Shunt Cap/React?

*must include effect of Shunt Cap, unless V_n = 0.

More on this later, and in EE5240, $ EE5223,$

Not a contributor to 60-Hz Short-circuit current
Begin with practical use of [22] 7c

Thevenin Impedance: Main diagonal element of [22]

Useful to know 27th at bus

Fault

Voltage

Fault

\( V_{th} = \frac{V}{2} \)}
Matlab
- Program a function of time.
- Plot.

Eqn: \( I_{sc}\) of Synch Gen.

- True RMS (text)
- Peak envelope
- \( i(t) \)