Ongoing List of Topics:

- URL: [http://www.ece.mtu.edu/faculty/bamork/EE5223/index.htm](http://www.ece.mtu.edu/faculty/bamork/EE5223/index.htm)
- Term Project - last few proj/teams being firmed up and getting moving.
  - Follow timeline, see posting on web page (posted in week 5)
  - Weeks 7 thru 9 - develop formal outline w/complete reference list
- Homework set 9 to be completed by after break
- Protection fundamentals for 87T (finish up topic from Monday’s Lecture 22)
  - a) must connect CT secondaries to provide proper phase shift so that restraint currents flowing through restraint elements are in phase;
  - Following topics will be discussed in depth in a future lecture: b) relay settings are used to compensate for pri voltage ratio and CT ratios. c) Mismatch problems - due to being forced to use less than full CT ratio, and having Pri and Sec CTs with different accuracy levels. Differential slope of trip characteristic can be 10%, 15%, 25% to allow for mismatch.
EE5223/4223 - L24

- 3 Winding Xfmrs
- Distance Relaying
- Differential Schemes
  - Buses
  - Xfmrs - Phase Shift, CT ratios
  - Generators
  - Lines
3-WDG Xfmr

System

Thev

L-G Fault
or
L-L-G fault..... how can we take advantage of ground polarizing source?
"Star equiv" in seg. networks.

Actual Coil Config:

phase CT here

new CT here
\[
\sum S_{in} = 0 = 3\sqrt{3} I_{in}^* \\
|I_{a1}|: \text{Pos Seg.} = \frac{|I_C|}{\sqrt{3}} \\
\text{Neg Seg.} = \frac{|I_C|}{\sqrt{3}} \\
\text{Zero Seg.:}
\]
Using Actual Amps & Volts
(NOT PER UNIT!)

evaluate $\sum S_{in} = 0$

$\bar{V}_s \bar{I}_s^* + \bar{V}_c \bar{I}_c^* + \bar{V}_\Delta \bar{I}_\Delta^* = 0$

Can solve for $\bar{I}_\Delta$!

Problem: 4.4
Relay "sees" $V_{Ag}, J_{Be}, J_{tc}$, $I_a, I_b, I_c$.

Line $L$ with $a$.

What $Z_s$ can be calculated?
\[ Z = \frac{\tilde{V}}{\tilde{I}} \]

**Phase Impedances:**

\[ Z_A = \frac{\tilde{V}_{AG}}{\tilde{I}_A} \]
\[ Z_B = \frac{\tilde{V}_{BG}}{\tilde{I}_B} \]
\[ Z_C = \frac{\tilde{V}_{CG}}{\tilde{I}_C} \]

**Seq Impedances:**

\[ Z_0 = \frac{\tilde{V}_{AO}}{\tilde{I}_{AO}} \]
\[ Z_1 = \frac{\tilde{V}_{AI}}{\tilde{I}_{AI}} \]
\[ Z_2 = \frac{\tilde{V}_{A2}}{\tilde{I}_{A2}} \]
\[ z_{AB} = \frac{\bar{V}_{AB}}{(\bar{I}_A - \bar{I}_B)} \]
\[ z_{BC} = \frac{\bar{V}_{BC}}{(\bar{I}_A - \bar{I}_B)} \]
\[ z_{CA} = \frac{\bar{V}_{CA}}{(\bar{I}_B - \bar{I}_A)} \]