Topics for Today:

- Announcements
  - Matlab - last reminder.
  - Office hrs: 2:00-3:00pm M,W,F
  - Office: EERC 614. Phone: 906.487.2857
  - Recommended problems from Ch.3, solutions posted

- Transformers and circuits w/transformers
  - An example of phase shift, using VTs system protection
  - Paralleling of transformers
    - Proportioning of MVA flow for unequal MVA size, unlike impedances
    - Circuit calculations for above cases
    - Design and operations issues
  - Phase shifting transformers
  - Remaining topics will be covered in context of system operation & analysis, i.e. Chapters 7 and 8.
    - Per phase Pi-equivalent for off-nominal turns ratio, phase shifts, etc.
    - Incorporation in system admittance matrix for short-circuit and load flow
Next: Synchronous Machines - Chapter 3
- Recommended problems & solns for Ch.3 are posted.
- Phasor diagrams - unity, lag, lead
- Salient rotor machines - calculation with Xd and Xq.
- Calculation Example(s)
- P & Q flows thru transmission lines
- More on admittance matrix [Y] construction
"open-delta"
or
"broken delta"

\[ V_{ag} + V_{bg} + V_{cg} = 0 \]

\[ V_{ag} + V_{bg} + V_{cg} = 3V_{ao} \]
\[ z_{\text{new}} = z_{\text{old}} \left( \frac{KV_{\text{old}}}{KV_{\text{new}}} \right)^2 \left( \frac{MVA_{\text{new}}}{MVA_{\text{old}}} \right) \]

2-step process -

1. Recover \( z_r \)

\[ z_r = z_{\text{old}} z_{\text{B,old}} \]

\[ z_r = z_{\text{old}} \left( \frac{KV_{\text{old}}}{MVA_{\text{old}}} \right) = z_{\text{r}} \]

2. Determine \( z_{\text{new}} \) in p.u.

\[ z_{\text{new}} = \frac{z_r}{z_{\text{B, new}}} = z_r \left( \frac{MVA_{\text{new}}}{KV_{\text{new}}^2} \right) \]
\[ Z_{\text{new}} = Z_{\text{old}} \left( \frac{KV_{\text{old}}}{KV_{\text{new}}} \right)^{2} \left( \frac{MVA_{\text{new}}}{MVA_{\text{old}}} \right) \]

Typically:

- \( MVA_{\text{new}} = 100 \text{ MVA} \)
- \( MVA_{\text{old}} = \frac{\text{Equip Rating (nameplate)}}{} \)

- \( KV_{\text{new}} = \text{System base of voltage} \)

- \( \text{nameplate} = 13.2 \text{ KV} \)
- \( 13.8 \text{ KV} \)
Paralleling XFMRS:

- Unlike impedances, same voltage ratio

Base: on 100 MVA

\[ \frac{T_1}{T_2} = \frac{90 \text{ MVA}}{100 \text{ MVA}} = 0.9 \text{ p.u.} \]

Constraints:

\[ \frac{I_{T_1}}{I_{T_2}} = \frac{4}{5} \]

Constraints:

Load

IF \( T_1 \) @ 90 MVA, \( T_2 \) @ 90 MVA
BAD

IF \( T_2 \) @ 100 MVA, \( T_1 \) @ 80 MVA
Good/OK

However, can't use 10 MVA of \( T_1 \) capacity.

Key: Spec same 7% on base of indiv. XFMRS!

i.e., \( T_2 \): j0.09 @ 100 MVA BASE
\( T_1 \): j0.04 @ 90 MVA BASE

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