ECE 3600 Final Exam Information

You may write more on this sheet.
You may also use Exam 1, 2 & 3 Information sheets

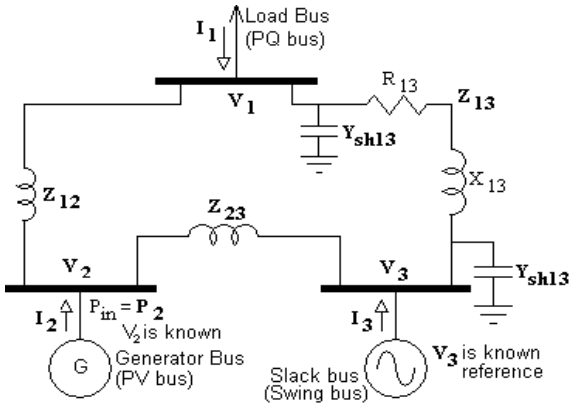
Power Flow

Admittance Matrix

$$\begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} Y_{11} & Y_{12} & Y_{13} \\ Y_{21} & Y_{22} & Y_{23} \\ Y_{31} & Y_{32} & Y_{33} \end{bmatrix} \cdot \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$

$Y_{nn} = \sum$ of all admittances connected to bus n

$Y_{\substack{mn \\ m \neq n}}$ = - admittance connected between busses n & m



Faults

Symmetrical faults Just analyze on a normal per-phase basis

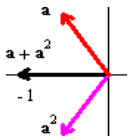
Unsymmetrical Faults

$$\begin{bmatrix} V_A \\ V_B \\ V_C \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} \cdot \begin{bmatrix} V_{A0} \\ V_{A1} \\ V_{A2} \end{bmatrix} \quad \begin{bmatrix} V_{A0} \\ V_{A1} \\ V_{A2} \end{bmatrix} = \frac{1}{3} \cdot \begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix} \cdot \begin{bmatrix} V_A \\ V_B \\ V_C \end{bmatrix}$$

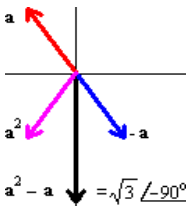
$$\begin{bmatrix} I_A \\ I_B \\ I_C \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} \cdot \begin{bmatrix} I_{A0} \\ I_{A1} \\ I_{A2} \end{bmatrix} \quad \begin{bmatrix} I_{A0} \\ I_{A1} \\ I_{A2} \end{bmatrix} = \frac{1}{3} \cdot \begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix} \cdot \begin{bmatrix} I_A \\ I_B \\ I_C \end{bmatrix}$$

$a = 1\angle 120^o$ so $a^2 = 1\angle 240^o$ and $a^3 = 1$

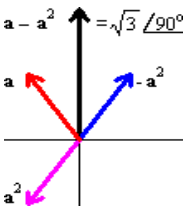
$a + a^2 = -1$



$a^2 - a = \sqrt{3}\angle -90^o$



$a - a^2 = \sqrt{3}\angle +90^o$



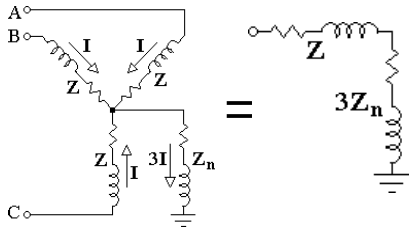
Pre-Fault Setup Find pre-fault V_T and I_{gen}. $E''_A = V_T + I_{gen} \cdot Z''_g$

It can be helpful to find E_{ThA} and all the Thevenin impedances

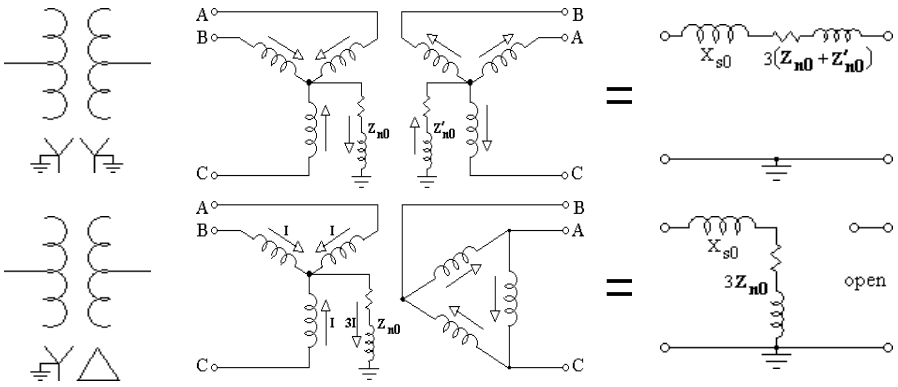
Circuits are on the back of this sheet

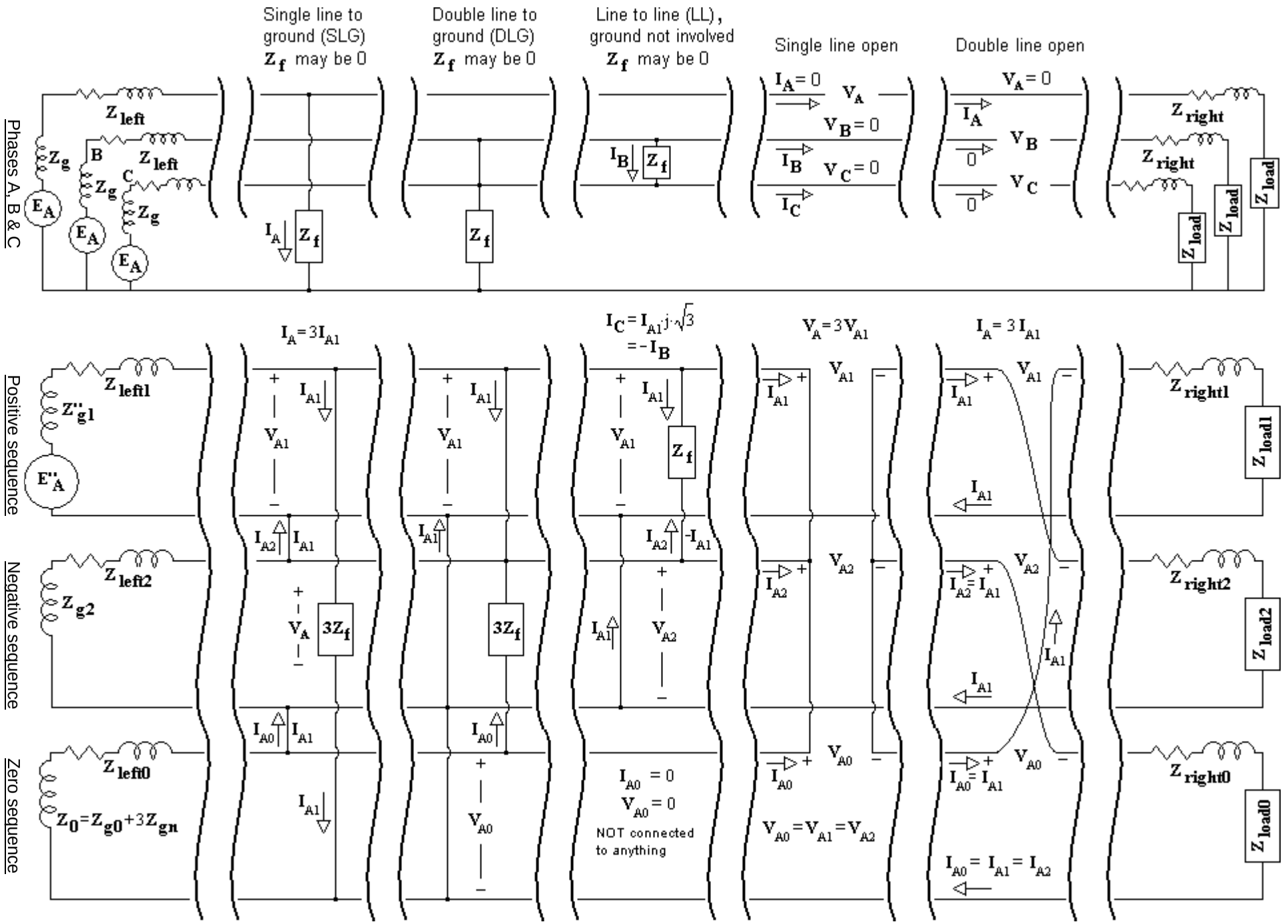
Zero-Sequence Impedances

Anything connected Δ looks like and open.
Anything connected Y without a center-to-neutral or ground connection also looks like and open, otherwise:



Transformers are all open from both sides except:




Phases A, B & C
Positive sequence
Negative sequence
Zero sequence
Single line to ground (SLG) Z_f may be 0
Double line to ground (DLG) Z_f may be 0
Line to line (LL), ground not involved Z_f may be 0
Single line open
Double line open
Z_{left}
Z_g
E_A
Z_{right}
Z_{load}
$I_A = 3I_{A1}$
$I_C = I_{A1} \cdot j\sqrt{3} = -I_B$
$V_A = 3V_{A1}$
$I_A = 3I_{A1}$
Z''_{g1}
E''_A
Z_{left1}
Z_{right1}
Z_{load1}
Z_{g2}
Z_{left2}
Z_{right2}
Z_{load2}
$3Z_f$
Z_{left0}
Z_{right0}
Z_{load0}
$Z_0 = Z_{g0} + 3Z_{gn}$
$I_{A0} = 0$
$V_{A0} = 0$
NOT connected to anything
$V_{A0} = V_{A1} = V_{A2}$
$I_{A0} = I_{A1} = I_{A2}$