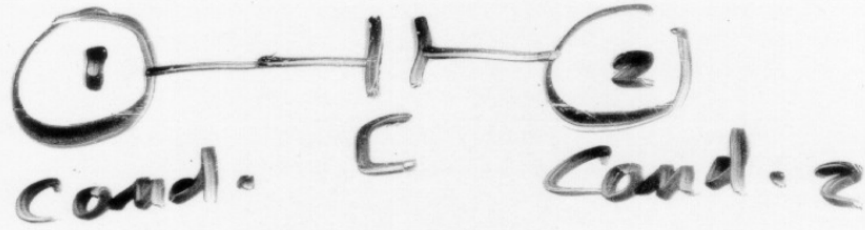
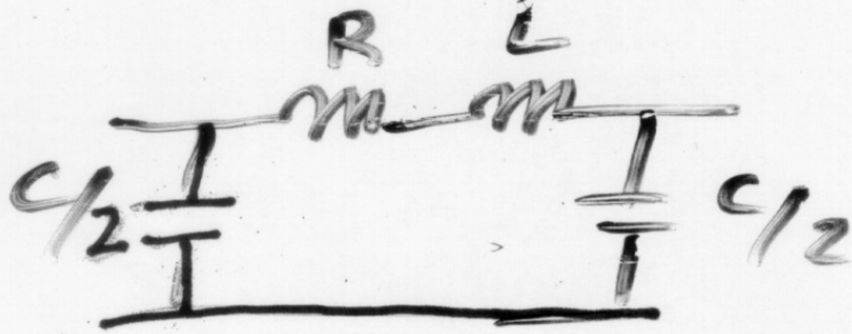
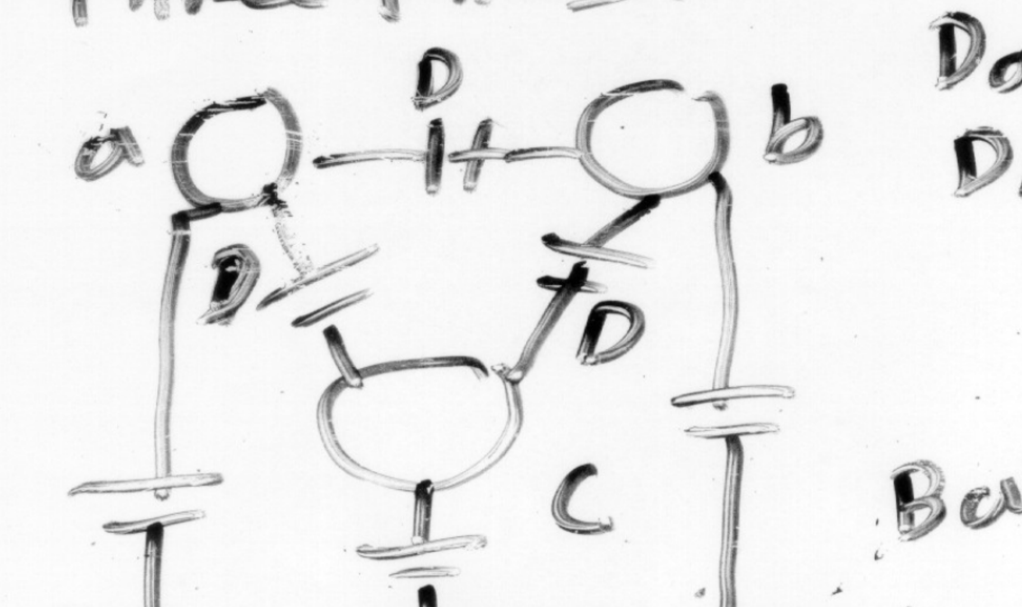
Transmission line Model ①



$$L_{total} = L_{int} + L_{ext}$$



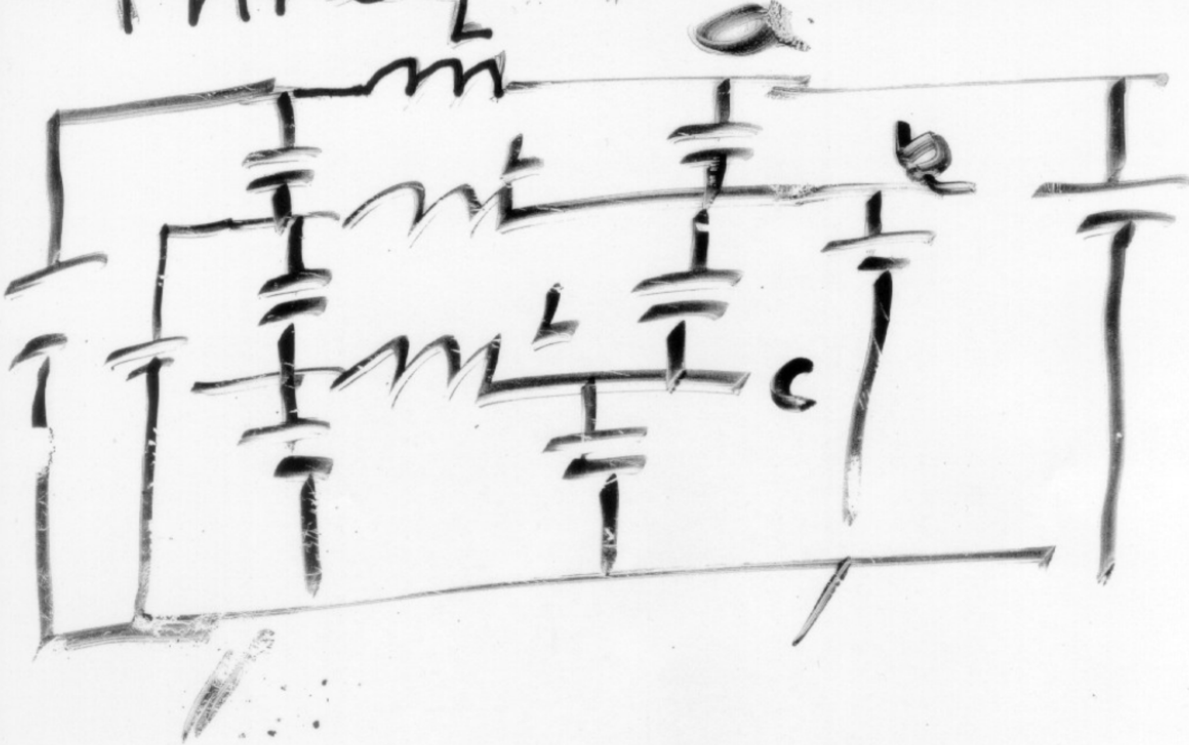
Three Phase



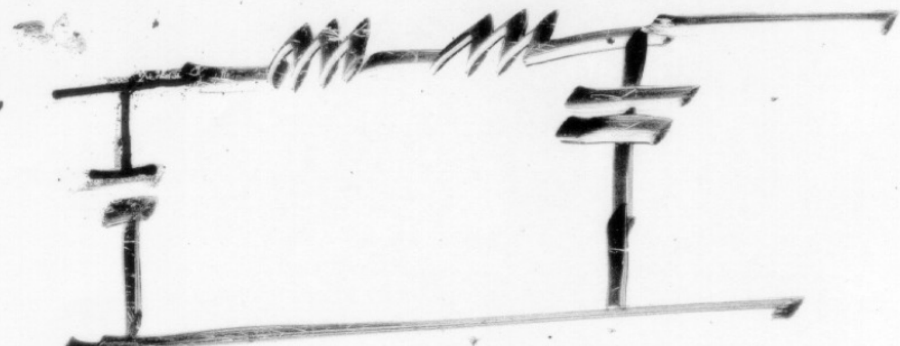
$D_{ab} = D_{ac} = D_{cb} = D$

Balanced.

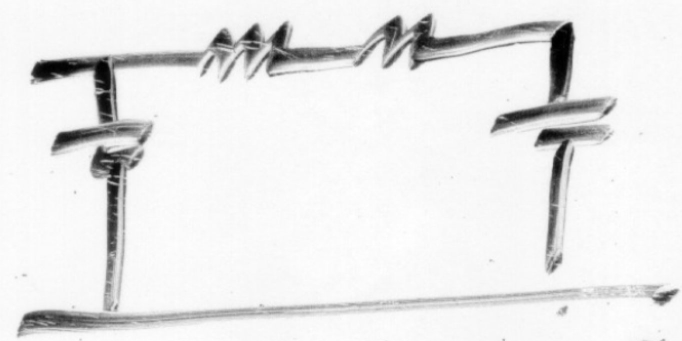
Three-phase cond. 2



a



b



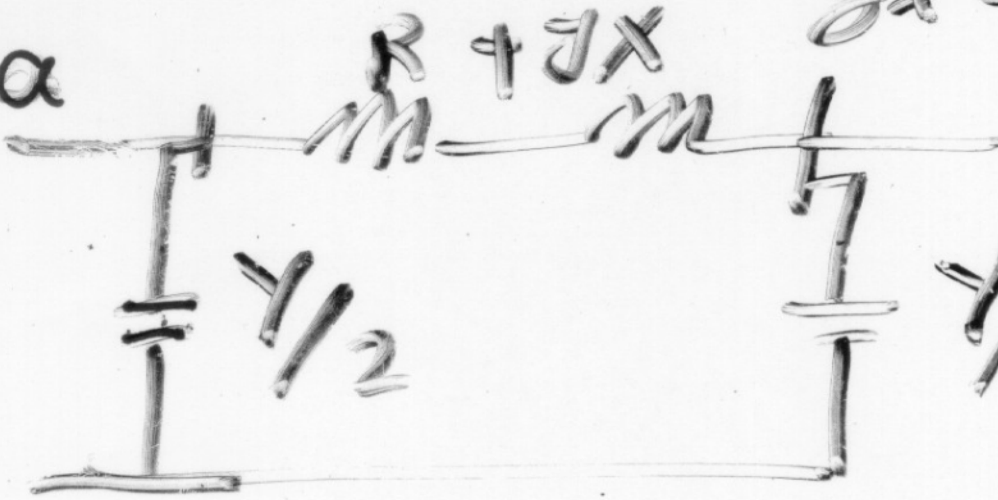
same for c

Short line (3)

Long line

$z\ell = r + jx$ Ω/mile

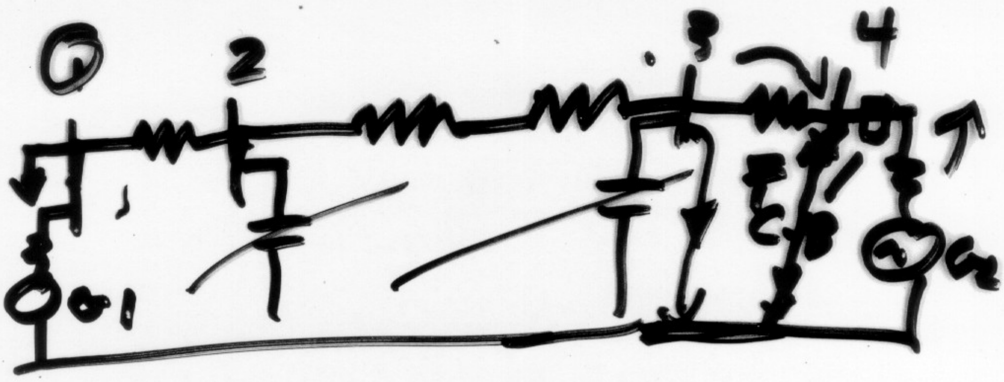
a



℧/mile

b and c same.

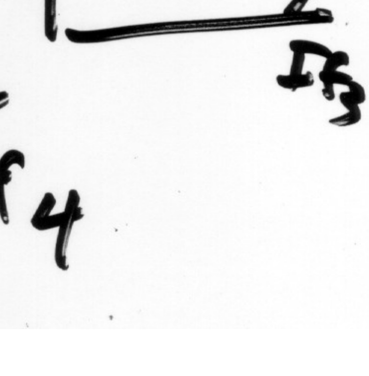
$$Y/2 = G/2 + j\frac{B}{2}$$

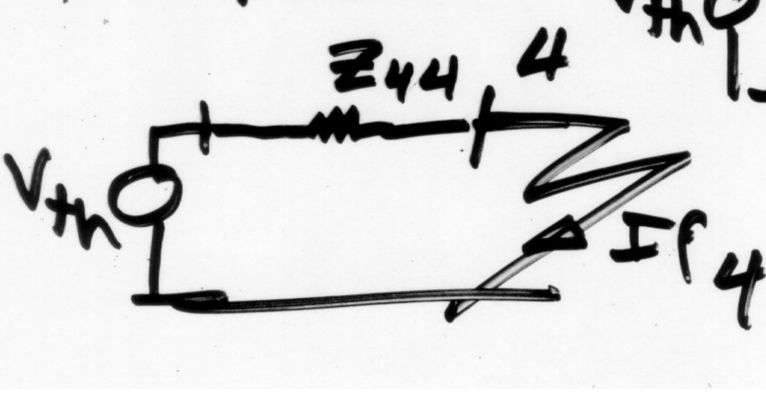


G_1 = same as G_2

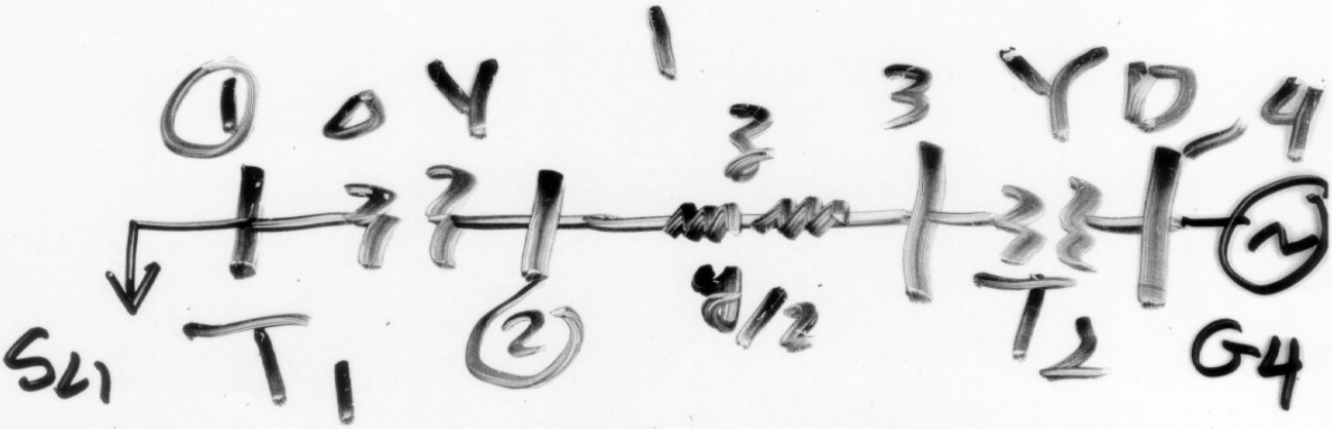
fault at bus 4

3 — phase fault.





Problem 5



z per section $= 0.128 + j.64\ \Omega/\text{Mile}$

$Z = 12.8\ \Omega + j64\ \Omega$

$\ell = 100$ miles

$Z = (100)\, z = Z$

$y/2 = j.0028\ \mho/\text{mile}$

$Y/2 = y/2 \times 100 = j.28\ \mho$

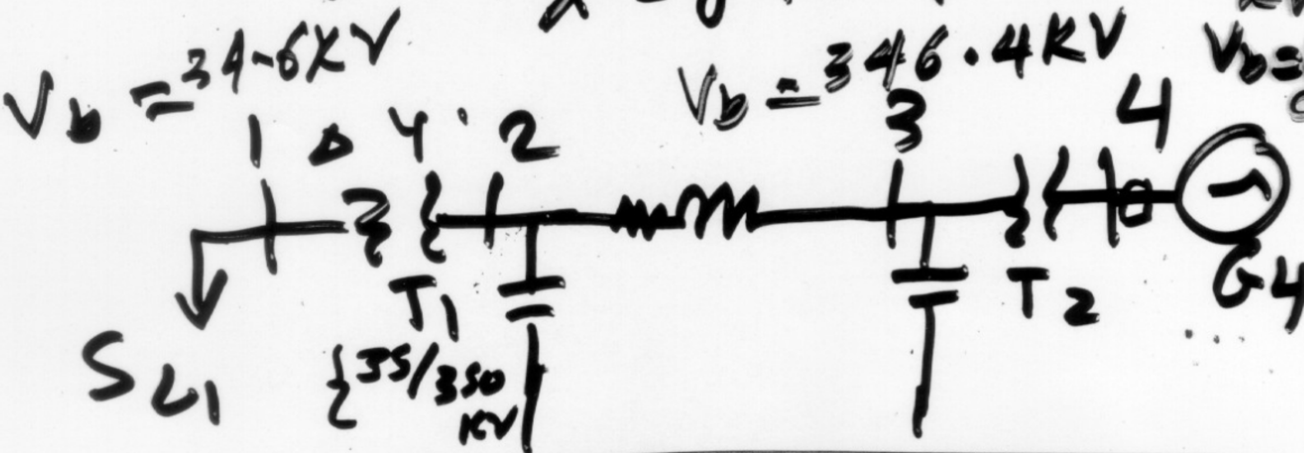
T_1 { $3\text{-}\phi$
120 MVA
15 kV/350 kV $Z = (j.18)$ [illegible]

6A

$S_{L1} = 100\,MW + j80\,Mvar$

$V_b = 35\,kV$

$G_1 \left\{ = \begin{array}{l} 20\,kV \\ 200\,MVA \\ X = j.10\ p.u \end{array} \right.$

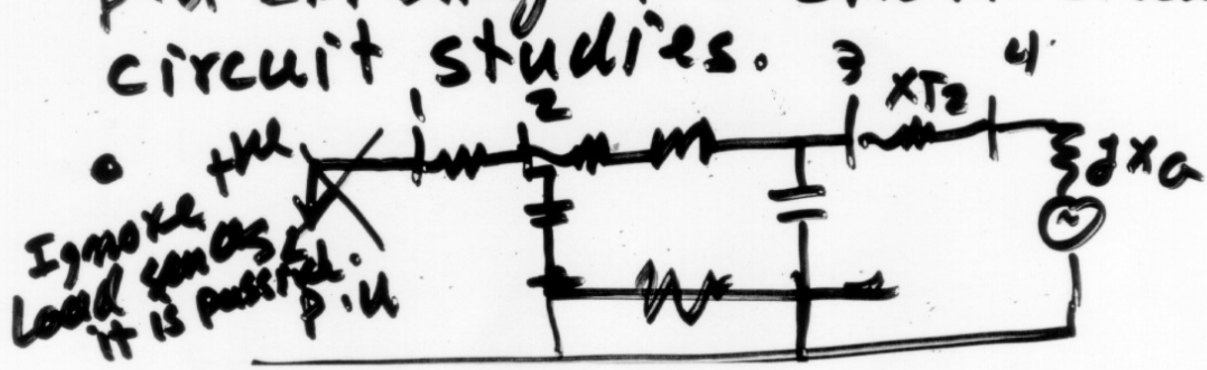


one-line diag.

$S_b = 100\ MVA$

$$Z_{p.u_n} = Z_{p.u\,old}\left(\frac{V_{b\,old}}{V_{b\,n}}\right)^2\left(\frac{S_{b\,new}}{S_{b\,old}}\right)$$

p.u ckt diag. for short circu[it] circuit studies.



6B

$$T_2 = \begin{cases} Y - \Delta \\ 90\ \text{MVA} \\ 200\sqrt{3} / 20\ \text{KV} \\ (1+j\,7)\ \% \text{ on } 90 \\ \text{MVA rating.} \end{cases}$$

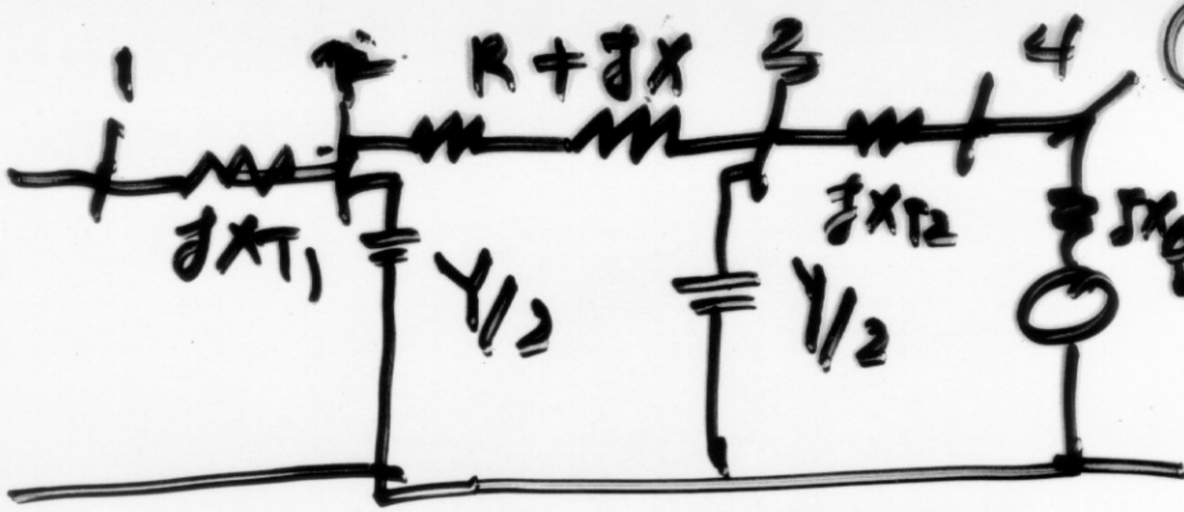
compute

1- p-u model.

2- YBUS for short ckt studies

3- ZBUS. "

4- ~~Y~~BUS and ZBUS for power Flow studies



short ckt model

$$Y_{Bus} = \begin{array}{c|cccc} 1 & & & & \\ 2 & & & & \\ 3 & & & & \\ 4 & & & & \\ \hline & 1 & 2 & 3 & 4 \end{array}$$

$$\begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \end{bmatrix} = \begin{bmatrix} Y_{11} & Y_{12} & Y_{13} & \\ & & & \\ & & & \\ & & & \end{bmatrix}$$

next page.

$$Y_{BUS} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \end{array} \begin{array}{c} \begin{array}{cccc} 1 & 2 & 3 & 4 \end{array} \\ \begin{bmatrix} Y_{11} & Y_{12} & 0 & 0 \\ Y_{21} & Y_{22} & Y_{23} & 0 \\ 0 & Y_{23} & Y_{33} & Y_{34} \\ 0 & 0 & Y_{43} & Y_{44} \end{bmatrix} \end{array}$$

$Y_{ij} = 0$ if $i \neq j$ not connected

$Y_{ij} = \sum y_{ij}$ if $i = j$

$Y_{ij} = -\frac{1}{z}$ if i connected to j

$= -y_{ij}$

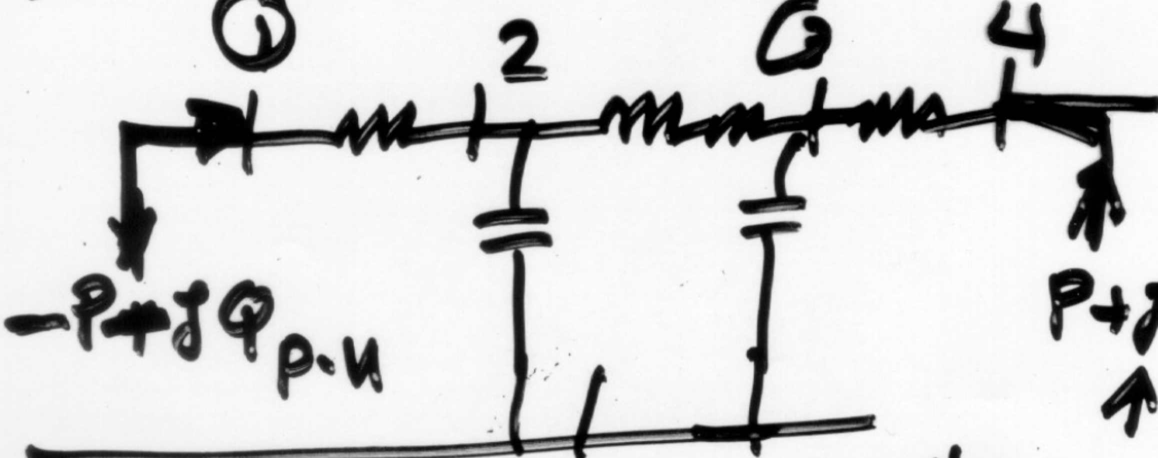
$I_{BUS} = [Y_{BUS}][Y_{BUS}]$

$V_{BUS} = [Z_{BUS}][I_{BUS}]$

9

$$Z_{BUS} = [Y_{BUS}]^{-1}$$

Load FLOW



Load negative injection

Gen positive injection

$$\begin{bmatrix} V_1 \\ V_2 \\ V_3 \\ V_4 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} & Z_{13} & Z_{14} \\ Z_{21} & Z_{22} & Z_{23} & Z_{24} \\ \vdots & & & \vdots \\ \vdots & & & \vdots \end{bmatrix} \begin{bmatrix} I_1 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

I_2

$V_1 = Z_{11} I_1 \qquad Z_{11} = \frac{V_1}{I_1}$

Z_{thev}.

$Z_{22} = \frac{V_2}{I_2} = Z_{thev}$