



IIT ROORKEE



NPTEL ONLINE  
CERTIFICATION COURSE

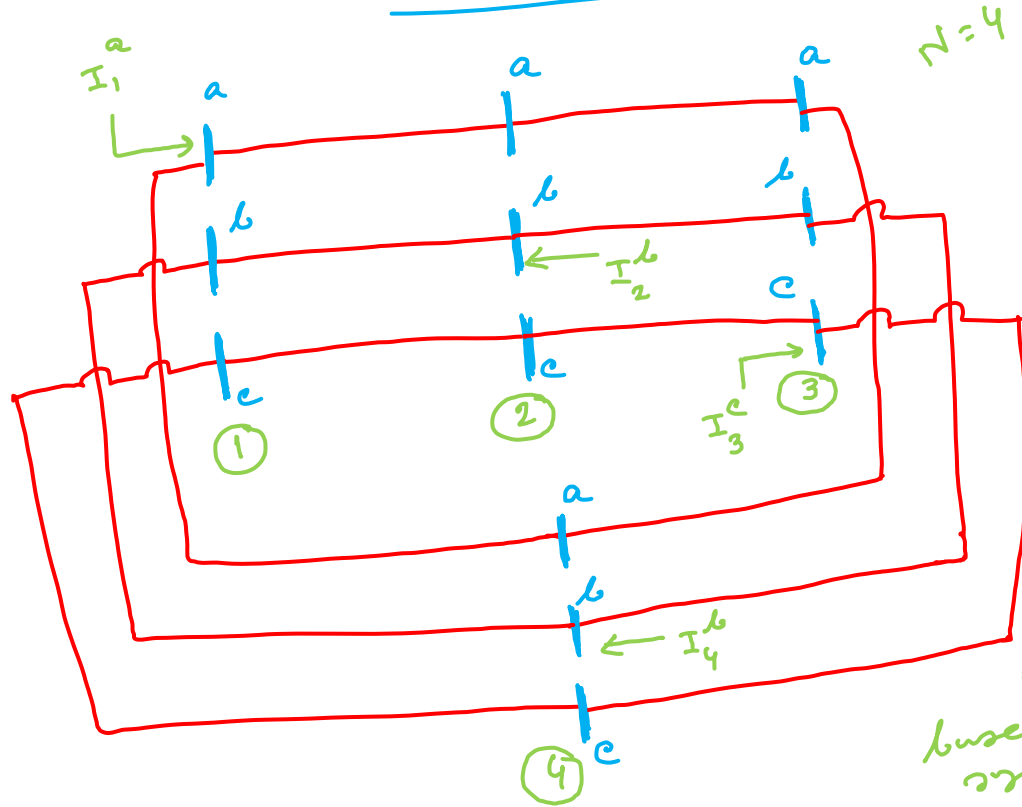
# Computer aided power system analysis

## Fault Analysis (Contd.)

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# Formation of $Y_{BUS}$ matrix of an unbalanced network.



$N=4$

$\vec{I}_i^p$  → injected current at phase 'p' of bus 'i'

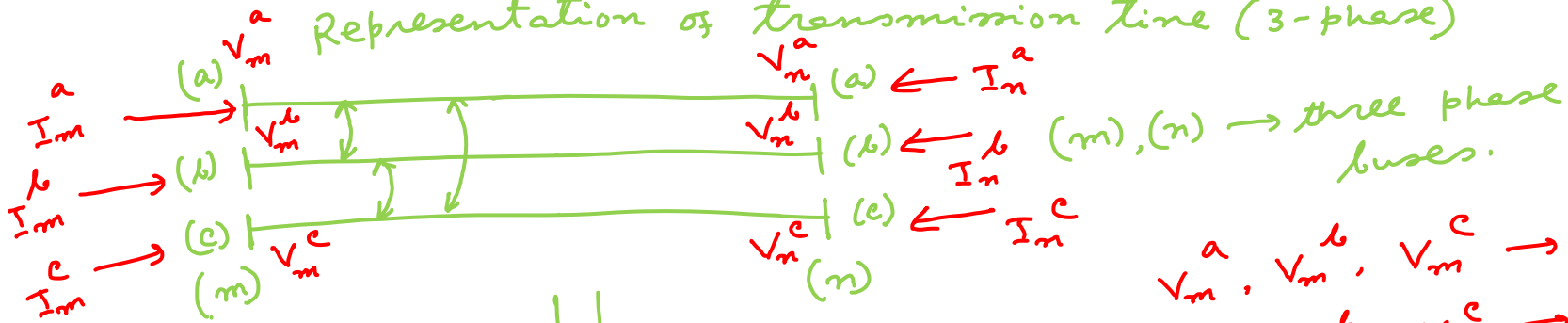
$i=1, 2, 3, 4$   
 $p=a, b, c$

$\vec{V}_i^p$  → voltage at phase 'p' of bus 'i'

$3N$   
 $3N$

$N \rightarrow$  no. of buses in the system

# Representation of transmission line (3-phase)



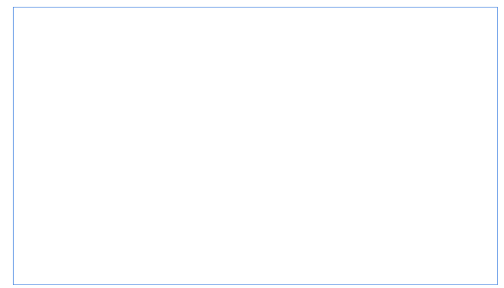
$V_m^a, V_m^b, V_m^c \rightarrow \text{bus 'm'}$   
 $V_n^a, V_n^b, V_n^c \rightarrow \text{bus 'n'}$   
 $I_m^{abc} = [I_m^a \quad I_m^b \quad I_m^c]^T \rightarrow (3 \times 1)$   
 $I_n^{abc} = [I_n^a \quad I_n^b \quad I_n^c]^T \rightarrow (3 \times 1)$

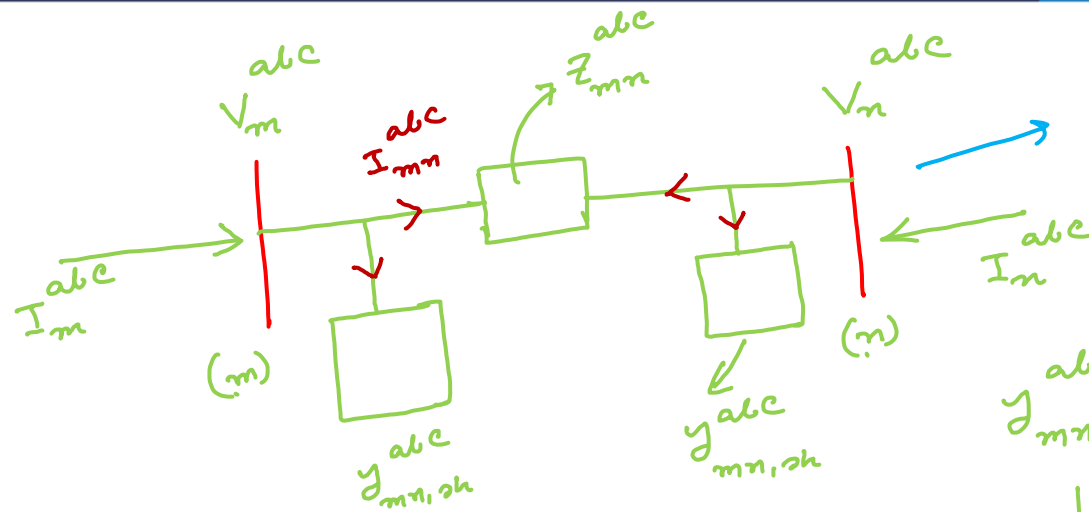
$$V_m^{abc} = [V_m^a \quad V_m^b \quad V_m^c]^T \rightarrow (3 \times 1)$$

$$I_m^{abc} \rightarrow (3 \times 1)$$

$$V_n^{abc} = [V_n^a \quad V_n^b \quad V_n^c]^T \rightarrow (3 \times 1)$$

$$I_n^{abc} \rightarrow (3 \times 1)$$





Equivalent  $\pi$  model  
of the line

$y_{mn,sh}^{abc}$

$\downarrow$   
(3x3)

$$= \begin{bmatrix} y_{mn,sh}^{aa} & y_{mn,sh}^{ab} & y_{mn,sh}^{ac} \\ y_{mn,sh}^{ba} & y_{mn,sh}^{bb} & y_{mn,sh}^{bc} \\ y_{mn,sh}^{ca} & y_{mn,sh}^{cb} & y_{mn,sh}^{cc} \end{bmatrix}$$

$\downarrow$   
(3x3)

$$Z_{mn}^{abc} = \begin{bmatrix} Z_{mn}^{aa} & Z_{mn}^{ab} & Z_{mn}^{ac} \\ Z_{mn}^{ba} & Z_{mn}^{bb} & Z_{mn}^{bc} \\ Z_{mn}^{ca} & Z_{mn}^{cb} & Z_{mn}^{cc} \end{bmatrix} \rightarrow (3 \times 3)$$

$I_{mn}^{abc}$



