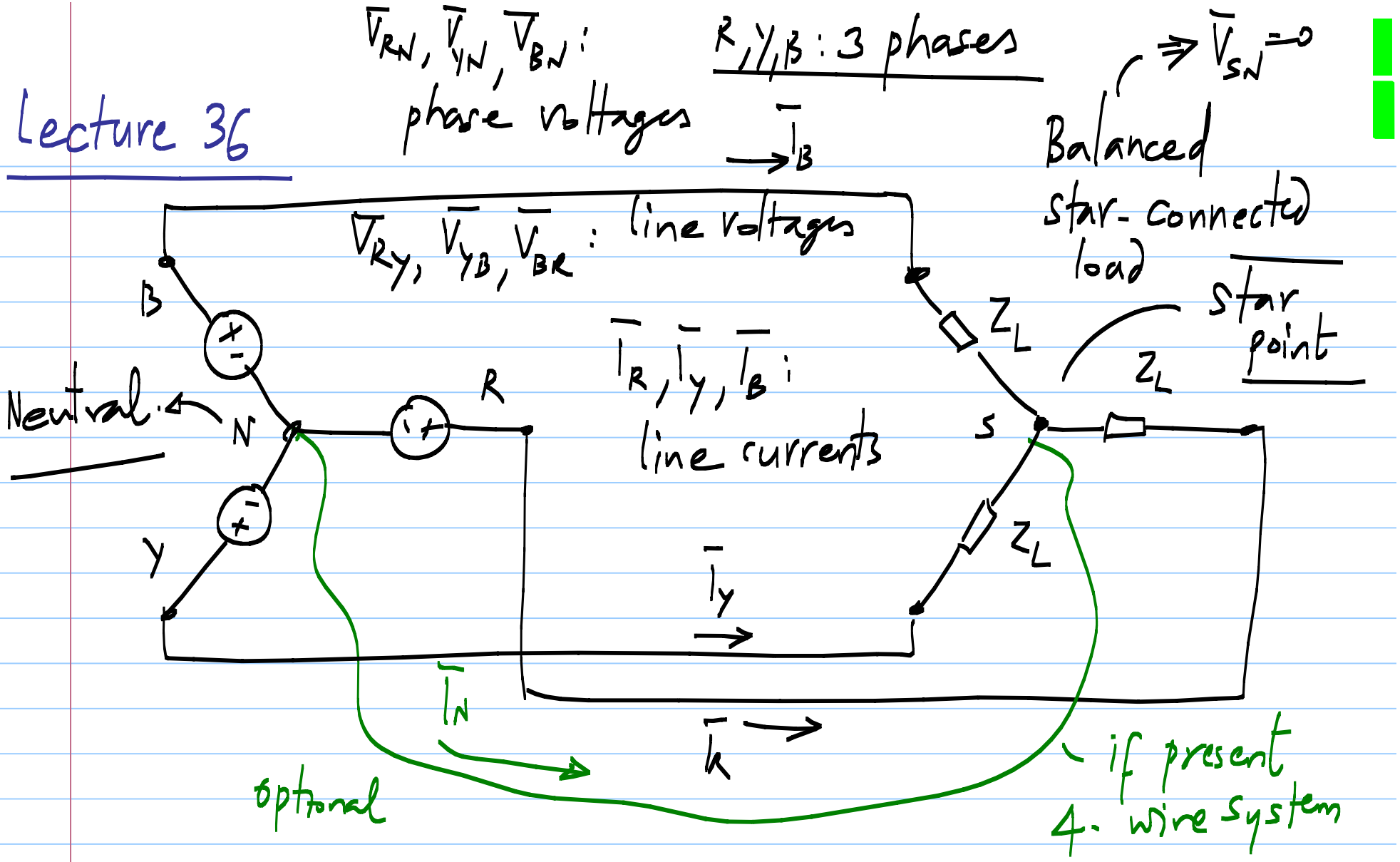
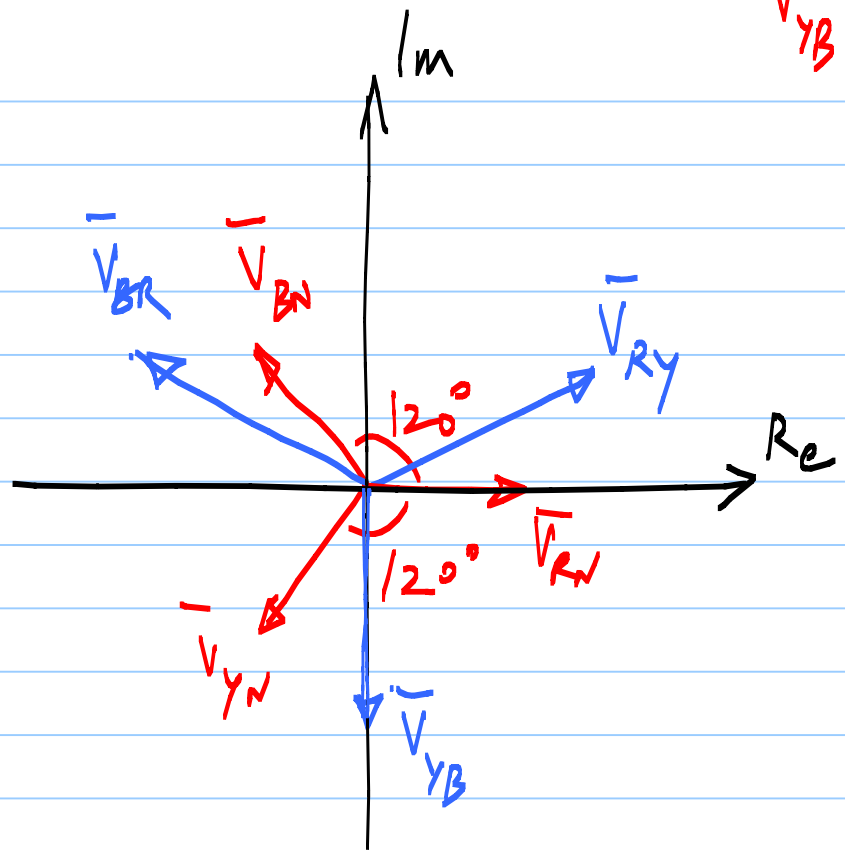
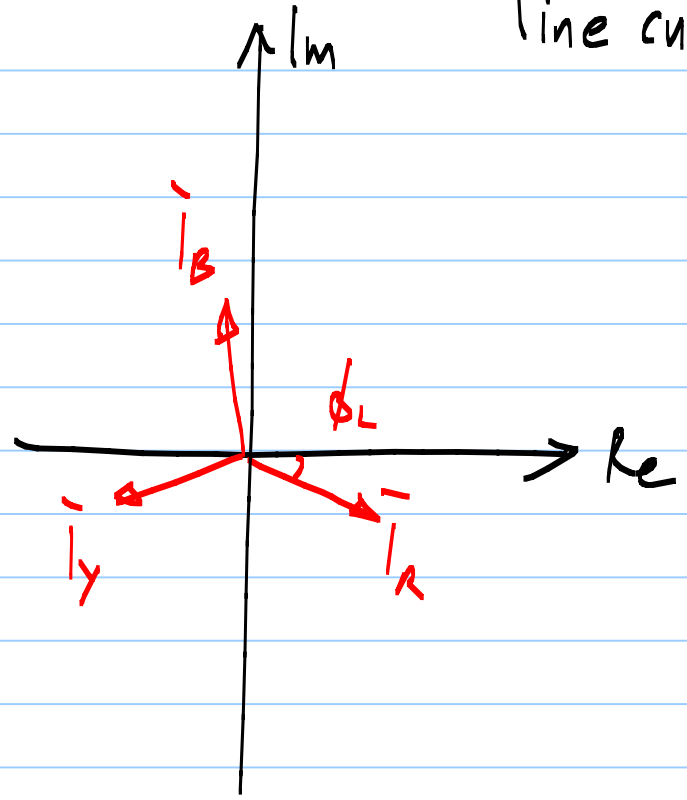
Lecture 36


$\bar{V}_{RN}, \bar{V}_{YN}, \bar{V}_{BN}$: phase voltages
R, Y, B : 3 phases
$\Rightarrow \bar{V}_{SN} = 0$
Balanced star-connected load
$\bar{I}_B$
$\bar{V}_{RY}, \bar{V}_{YB}, \bar{V}_{BR}$: line voltages
B
R
Y
N
Neutral
Z_L
Z_L
Z_L
S
Star point
$\bar{I}_R, \bar{I}_Y, \bar{I}_B$: line currents
$\bar{I}_Y$
$\bar{I}_N$
$\bar{I}_R$
optional
if present
4. wire system

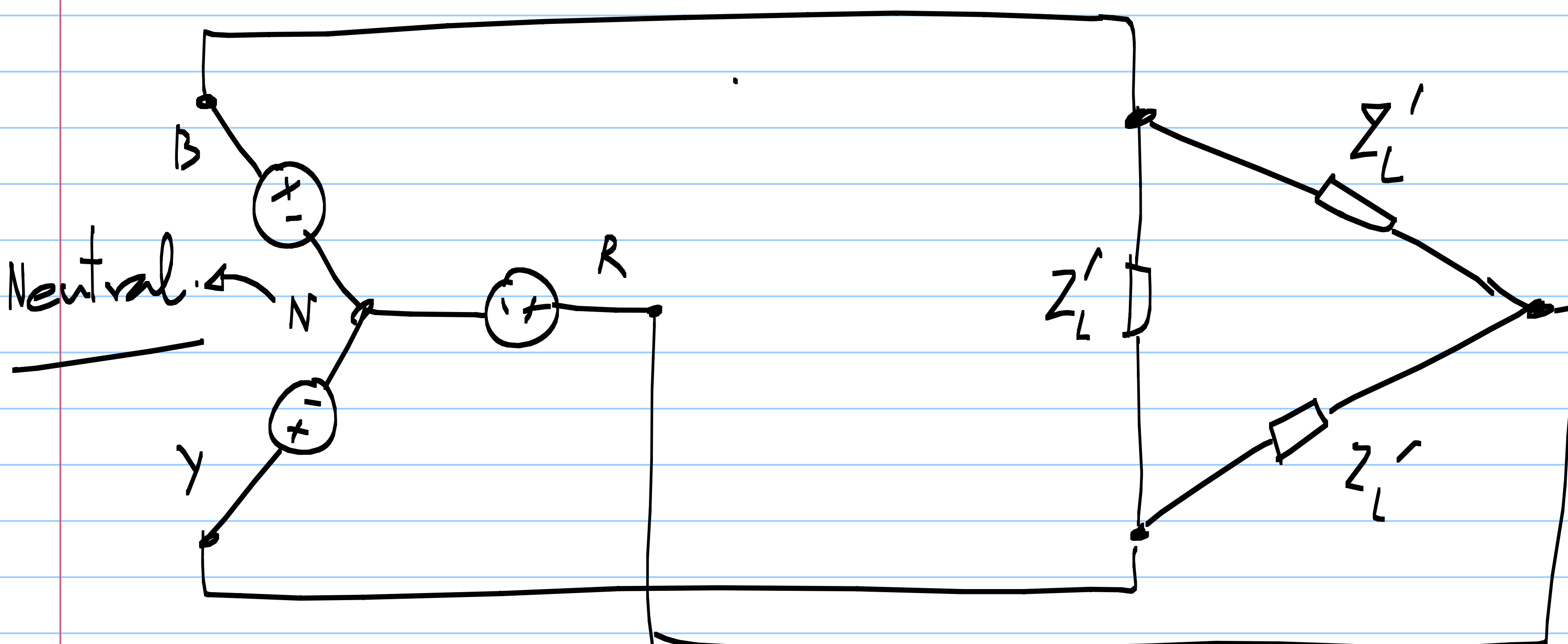
V_{YB} ?

$\bar{I}_R$ line currents?

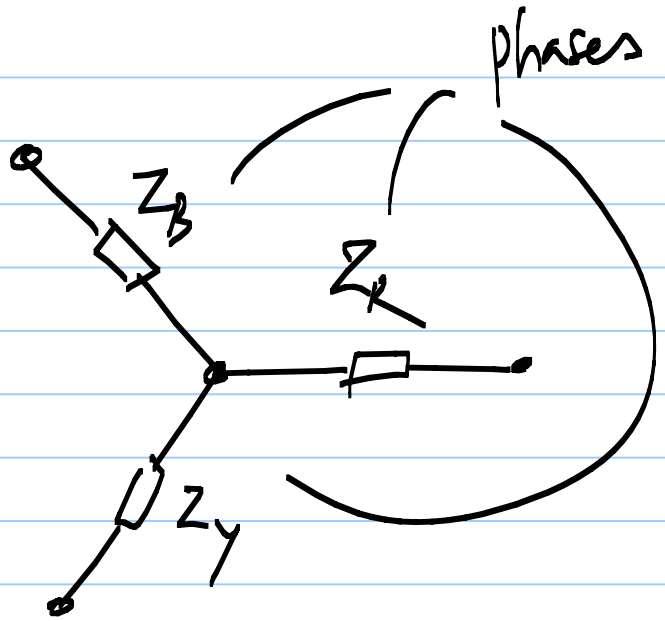


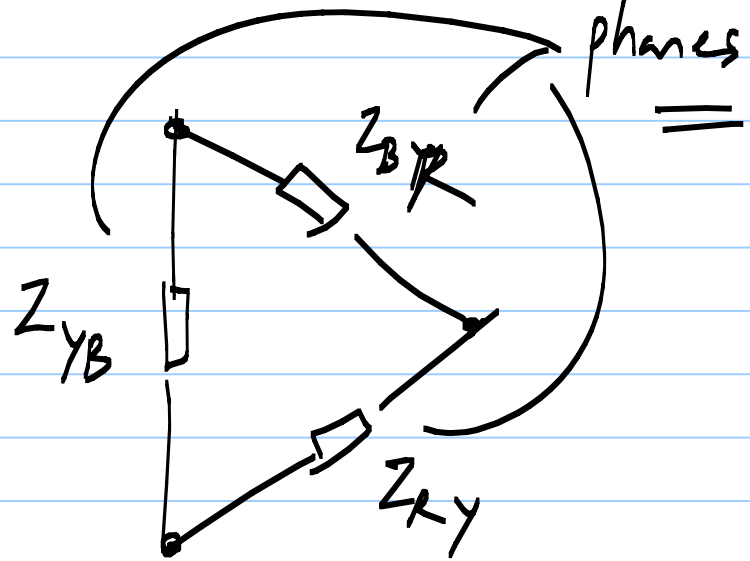


$$Z_L = |Z_L| \exp(j\phi_L)$$


Neutral
N
B
Y
R
Z_L'
Z_L'
Z_L'

$\{Z_R, Z_Y, Z_B\}$ in terms of $\{Z_{RY}\ Z_{YB}\ Z_{BR}\}$





$$Z_R = \frac{Z_{RY} \cdot Z_{BR}}{Z_{RY} + Z_{YB} + Z_{BR}}$$

$$Z_{RY} = \frac{Z_B Z_R + Z_R Z_Y + Z_Y Z_B}{Z_B}$$

Star connected load: line currents = load phase currents

Delta connected load: line voltages = phase voltages

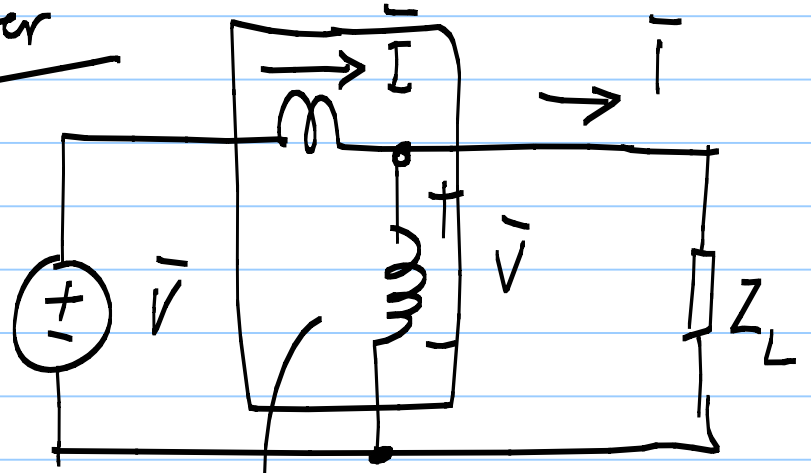
Delta load: 3 wire system $\bar{I}_R + \bar{I}_Y + \bar{I}_B = 0$

Star load: 3/4 wire system

4 wire system: $\bar{I}_N = -(\bar{I}_R + \bar{I}_Y + \bar{I}_B) = 0$ (balanced)

Power factor: specified per phase

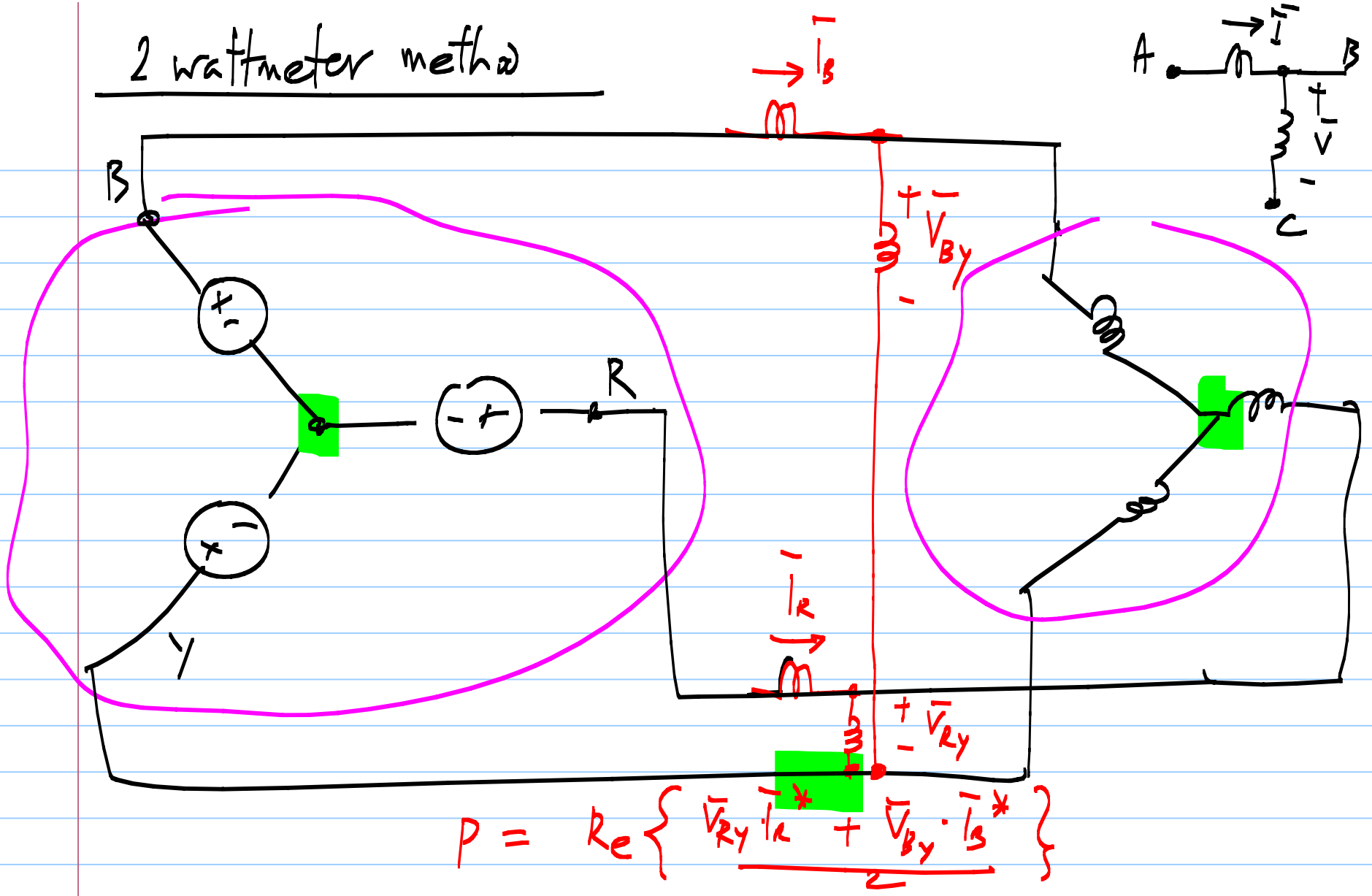
Wattmeter



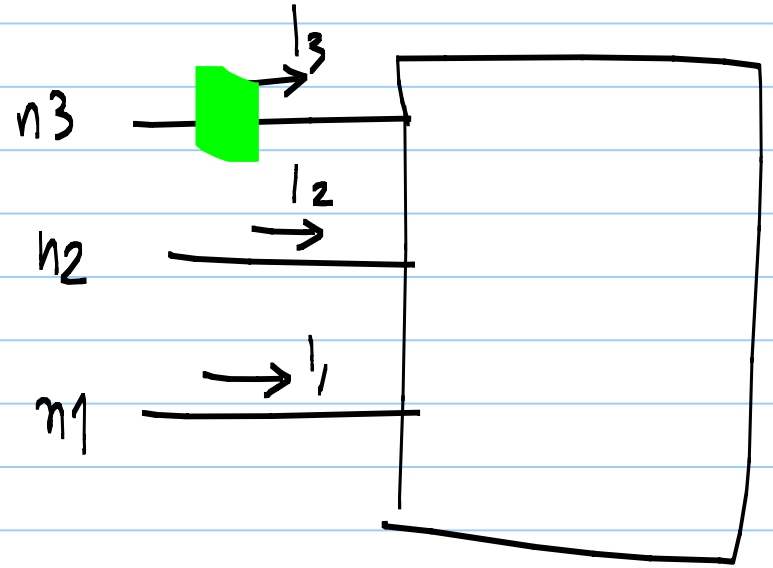
$$Re\left(\frac{\bar{V}\bar{I}^*}{2}\right)$$

reading: $Re\left[\frac{\bar{V}\bar{I}^*}{2}\right]$

2 wattmeter metho



$$P = Re\{ \bar{V}_{RY} \cdot \bar{I}_R + \bar{V}_{BY} \cdot \bar{I}_B^* \}$$



$$V_1 I_1 + V_2 I_2 + V_3 I_3$$

$$V_1 I_1 + V_2 I_2 + V_3 (-I_1 - I_2)$$

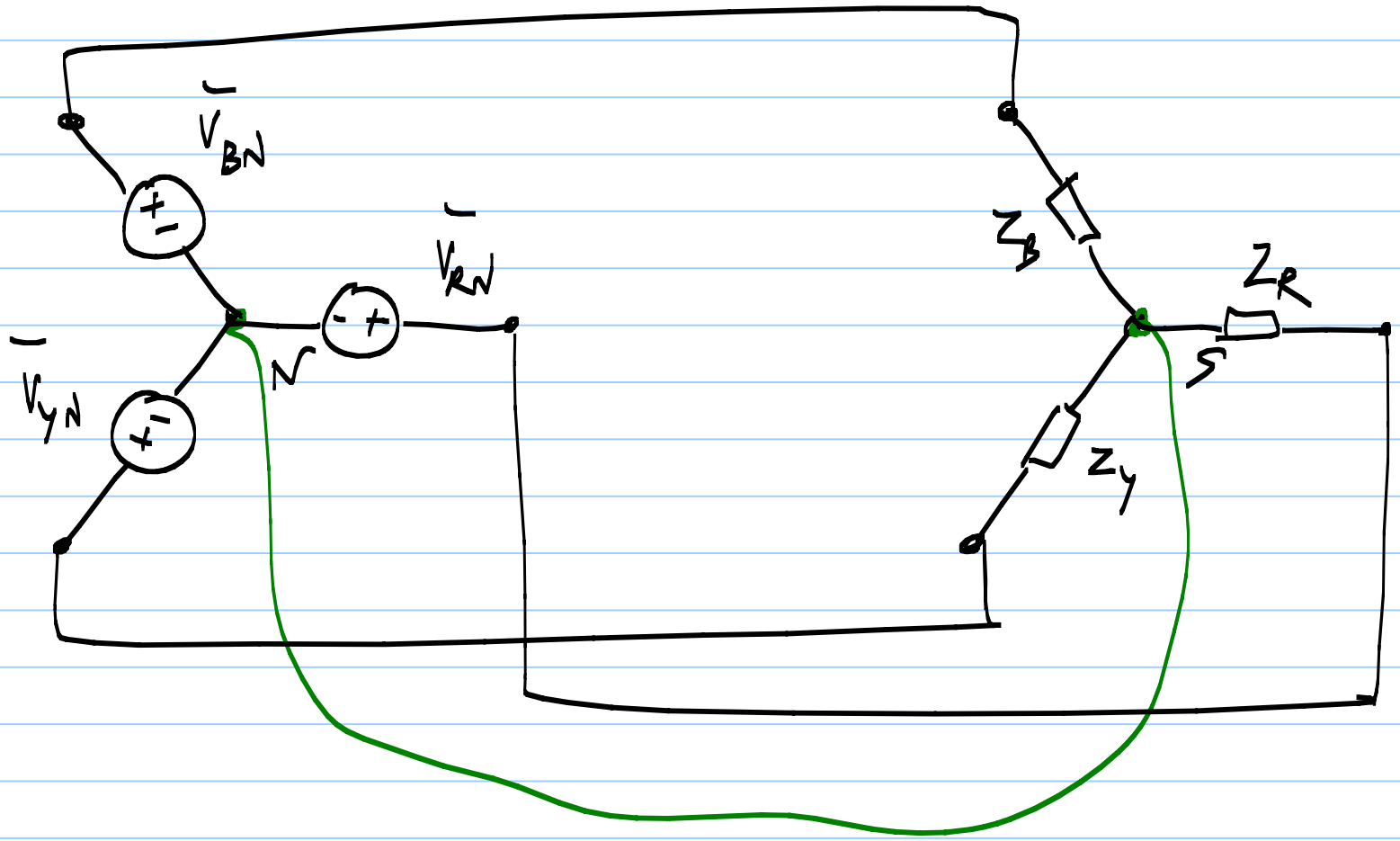
$$= (V_1 - V_3) I_1 + (V_2 - V_3) I_2$$

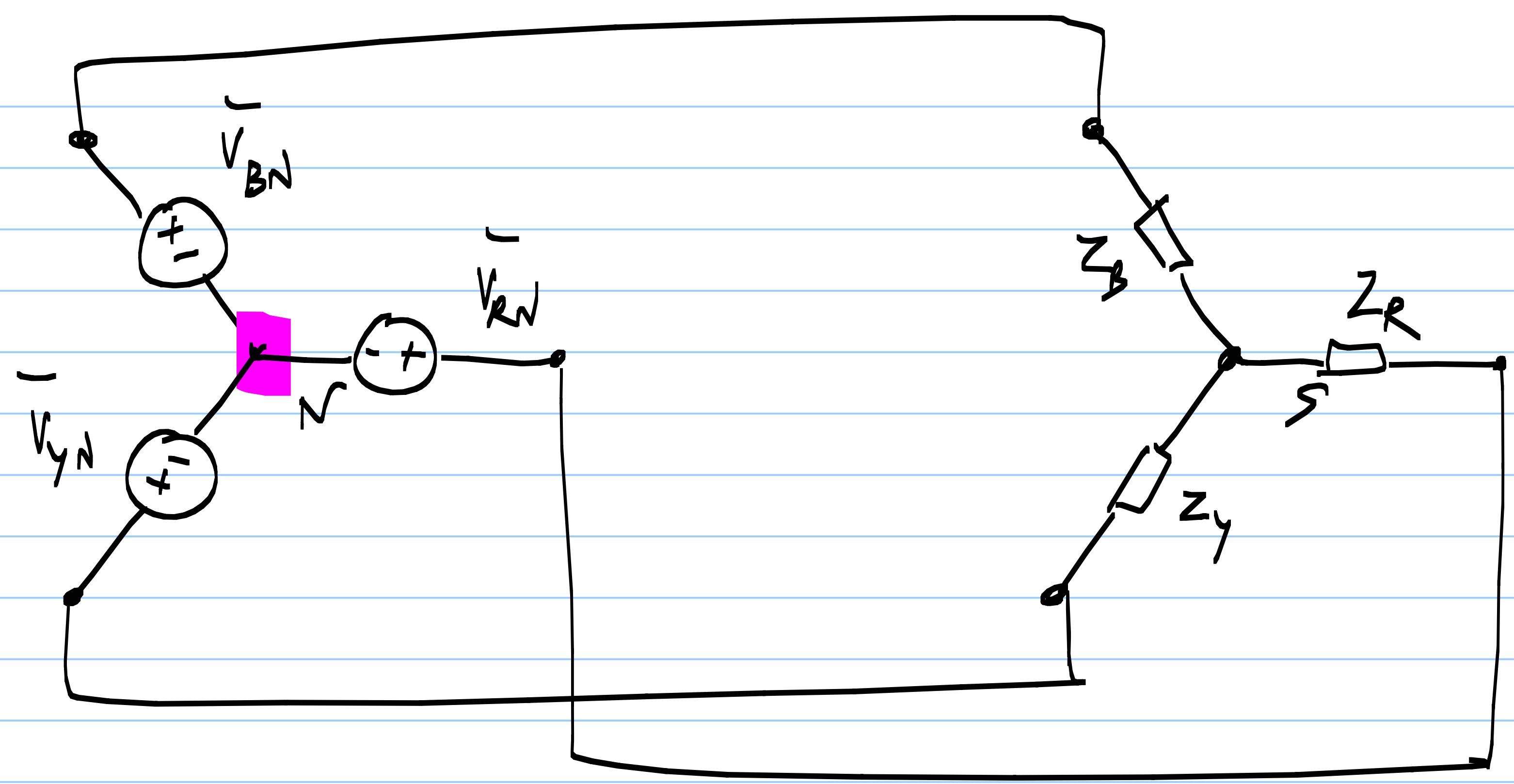
$$= V_{13} \cdot I_1 + V_{23} \cdot I_2$$

- ref.

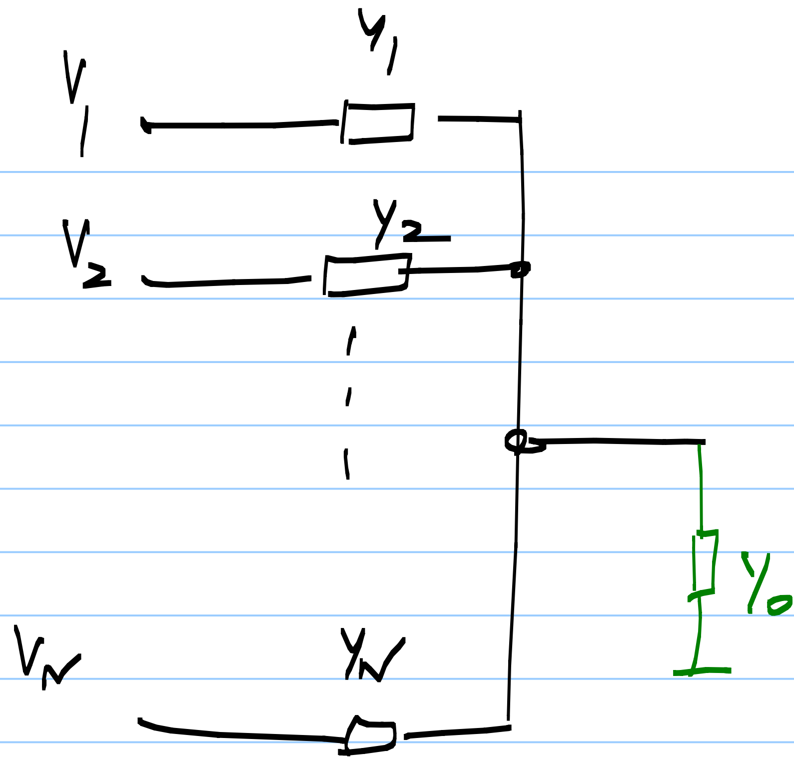
Un balanced loads:

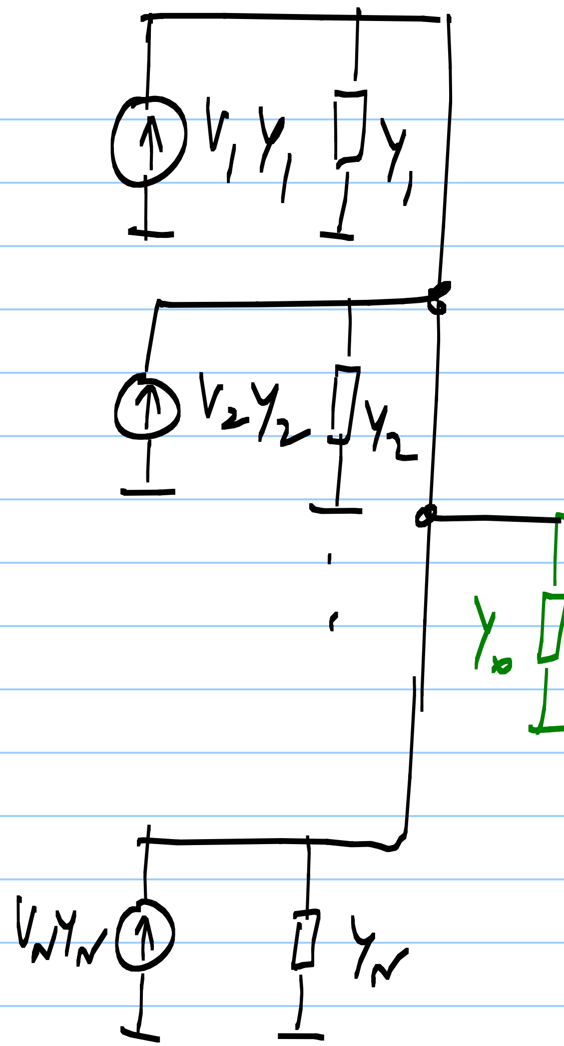
3 separate circuits; Com. node (N, S)





$$\bar{V}_{SN} = \left(\frac{\bar{V}_{RN}/Z_R + \bar{V}_{YN}/Z_Y + \bar{V}_{BN}/Z_B}{1/Z_R + 1/Z_Y + 1/Z_B} \right)$$





$$\frac{\sum V_k Y_k}{\sum Y_k + Y_0}$$