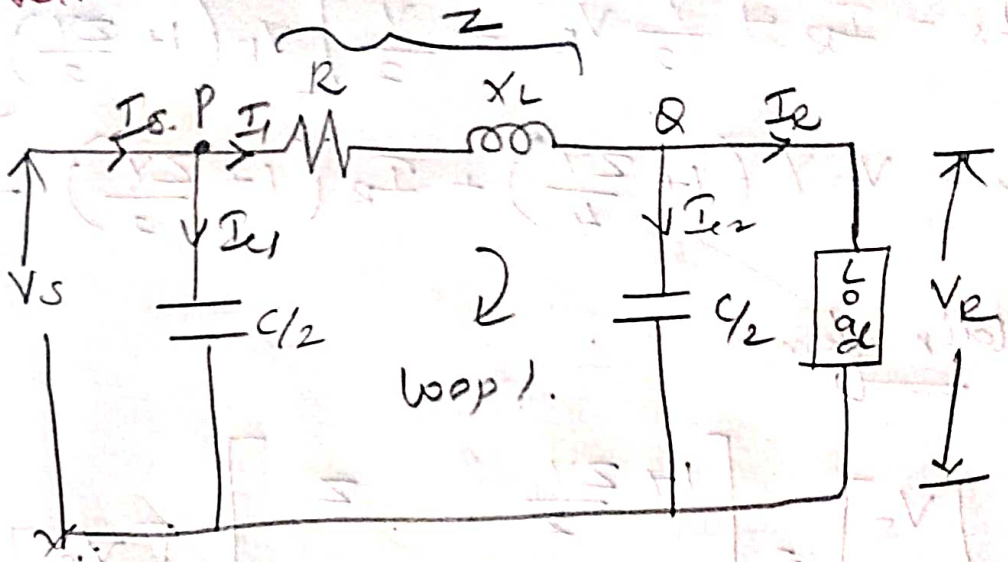


(Nominal π method)



Apply KCL at node Q.

$$I_1 = I_{C2} + I_R$$

$$I_{C2} = \frac{j\omega C}{2} V_R$$

$$I_1 = I_R + \frac{j\omega C}{2} V_R$$

$$I_1 = I_R + \frac{Y}{2} V_R$$

Apply KVL at loop 1.

$$V_S = V_R + I_1 Z$$

$$= V_R + \left(I_R + \frac{Y}{2} V_R \right) Z$$

$$V_S = V_R \left(1 + \frac{Y}{2} Z \right) + I_R Z \quad \text{--- (1)}$$

Apply KCL at node P

$$I_s = I_1 + I_{C1} = I_1 + \frac{j\omega C}{2} V_S$$

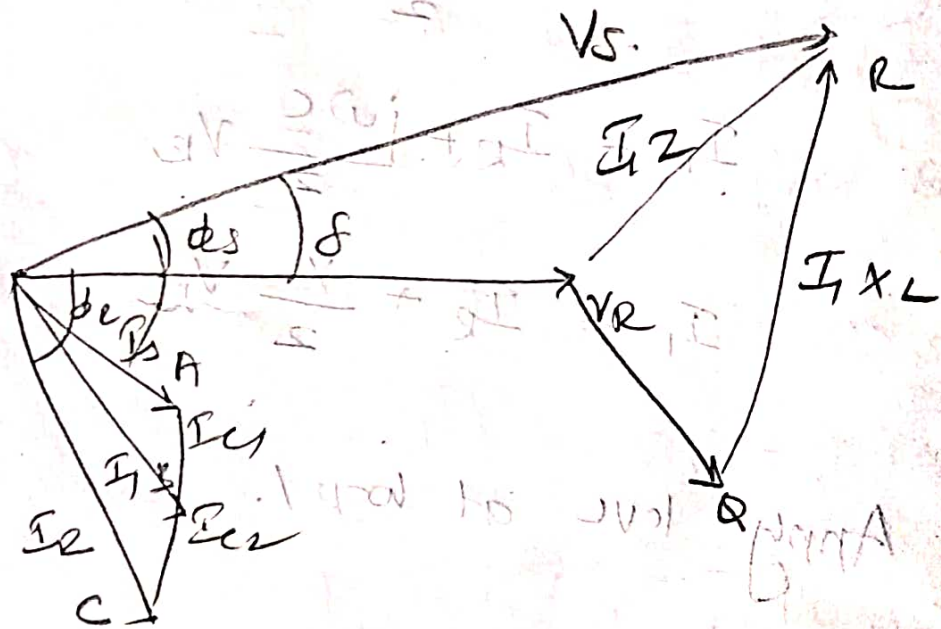
$$I_s = I_1 + \frac{Y}{2} V_S$$

$$I_s = I_R + \frac{Y}{2} V_R + \frac{Y}{2} \left[V_R \left(1 + \frac{ZY}{2} \right) \right] + I_R$$

$$I_s = V_R Y \left(1 + \frac{ZY}{4} \right) + I_R \left(1 + \frac{ZY}{2} \right) \quad \text{--- (2)}$$

matrix form

$$\begin{bmatrix} V_s \\ I_s \end{bmatrix} = \begin{bmatrix} 1 + \frac{ZY}{2} & Z \\ Y \left(1 + \frac{ZY}{4} \right) & 1 + \frac{ZY}{2} \end{bmatrix} \begin{bmatrix} V_R \\ I_R \end{bmatrix}$$



$$\% \text{ Pr efficiency} = \frac{P_{2(3\phi)}}{P_{1(3\phi)}} = \frac{3 I_R^2 R}{P_{1(3\phi)} + 3 I_R^2 R} \quad \text{--- (1)}$$

$$\text{--- (1) --- } P_{1(3\phi)} + 3 I_R^2 R \quad \text{--- (1)}$$