Useful Formulas

$$V = IR$$

$$p = vi = i^2R = \frac{v^2}{R}$$

$$\sum_{n=1}^{N} i_n = 0$$

$$\sum_{m=1}^{M} v_m = 0$$

$$\mathbf{V}_1 + \mathbf{V}_2 + \ldots + \mathbf{V}_n = \mathbf{0}$$

$$\mathbf{I}_1 + \mathbf{I}_2 + \ldots + \mathbf{I}_n = \mathbf{0}$$

$$\boldsymbol{v_1} = \frac{R_1}{R_1 + R_2} v$$

$$\boldsymbol{i_1} = \frac{R_2}{R_1 + R_2} i$$

$$\begin{bmatrix} G_{11} & G_{12} & \cdots & G_{1N} \\ G_{21} & G_{22} & \cdots & G_{2N} \\ \vdots & \vdots & \vdots & \vdots \\ G_{N1} & G_{N2} & \cdots & G_{NN} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_N \end{bmatrix} = \begin{bmatrix} i_1 \\ i_2 \\ \vdots \\ i_N \end{bmatrix} \qquad \begin{bmatrix} R_{11} & R_{12} & \cdots & R_{1N} \\ R_{21} & R_{22} & \cdots & R_{2N} \\ \vdots & \vdots & \vdots & \vdots \\ R_{N1} & R_{N2} & \cdots & R_{NN} \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ \vdots \\ i_N \end{bmatrix} = \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_N \end{bmatrix}$$

$$V_{\mathrm{Th}} = v_{oc}$$

$$I_N = i_{sc}$$

$$R_{\mathrm{Th}} = \frac{v_{oc}}{i_{sc}} = R_N$$

$$I_L = \frac{V_{\mathrm{Th}}}{R_{\mathrm{Th}} + R_L}$$

$$V_L = R_L I_L = \frac{R_L}{R_{\mathrm{Th}} + R_L} V_{\mathrm{Th}}$$

$$R_{Th} = \frac{v_o}{i_o}$$

$$p = \left(\frac{V_{Th}}{R_{Th} + R_L}\right)^2 R_L$$

$$R_L = \sqrt{R_{Th}^{\ 2} + (X_{Th} + X_L)^2} = \sqrt{R_{Th}^{\ 2} + X_{Th}^{\ 2}} = |Z_{Th}|$$

$$P = \frac{1}{2}|I|^2 R_L = \frac{|V_{Th}|^2 R_L/2}{(R_{Th} + R_L)^2 + (X_{Th} + X_L)^2}$$

$$z = x + jy$$

$$z = r\angle\varphi$$

$$z = re^{j\varphi}$$

$$\boldsymbol{V} = R\boldsymbol{I}$$

$$\boldsymbol{V} = j\omega L\boldsymbol{I}$$

$$\boldsymbol{I} = j\omega C\boldsymbol{V}$$

$$Z = \frac{\boldsymbol{V}}{\boldsymbol{I}}$$

$$\omega = 2\pi f$$

$$f = \frac{1}{T}$$

$$V_{rms} = \frac{V_m}{\sqrt{2}}$$

$$Z = \frac{\mathbf{V}}{\mathbf{I}} = \frac{\mathbf{V}_{rms}}{\mathbf{I}_{rms}} = \frac{V_{rms}}{I_{rms}}\angle(\theta_v - \theta_i)$$

$$\boldsymbol{S} = P + jQ = \boldsymbol{V}_{rms}(\boldsymbol{I}_{rms})^* = V_{rms}I_{rms}\angle(\theta_v - \theta_i)$$

$$\mathrm{pf} = \frac{P}{S} = \cos(\theta_v - \theta_i) \qquad S = |\boldsymbol{S}| = V_{rms}I_{rms} = \sqrt{P^2 + Q^2}$$

$$P = \mathrm{Re}(\boldsymbol{S}) = S\cos(\theta_v - \theta_i) \qquad Q = \mathrm{Im}(\boldsymbol{S}) = S\sin(\theta_v - \theta_i)$$

$$P = \frac{1}{2}V_m I_m = \frac{1}{2}I_m^2 R = \frac{1}{2}V_m^2/R = I_{rms}^2 R = \frac{V_{rms}^2}{R}$$

$$|Q_c| = Q_1 - Q_2$$

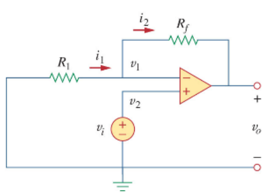
$$C = \frac{|Q_c|}{\omega V_{rms}^2} = \frac{P(\tan\theta_1 - \tan\theta_2)}{\omega V_{rms}^2}$$

$$|Z(j\omega)| = \sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2}$$

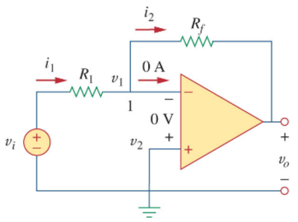
$$Q = \frac{\omega_0 L}{R} = \frac{1}{\omega_0 RC} = \frac{1}{R}\sqrt{\frac{L}{C}}$$

$$|\mathbf{V}_L| = \frac{V_m}{R}\omega_o L = QV_m$$

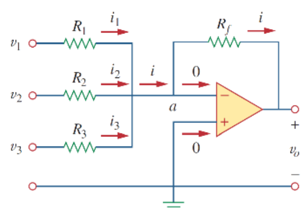
$$|\mathbf{V}_C| = \frac{V_m}{R}\frac{1}{\omega_o C} = QV_m$$



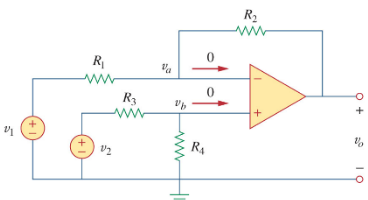
$$v_o = \left(1 + \frac{R_f}{R_1}\right)v_i$$



$$v_o = -\frac{R_f}{R_1}v_i$$



$$v_o = -\left(\frac{R_f}{R_1}v_1 + \frac{R_f}{R_2}v_2 + \frac{R_f}{R_3}v_3\right)$$



$$v_o = \frac{R_2(1 + R_1/R_2)}{R_1(1 + R_3/R_4)}v_2 - \frac{R_2}{R_1}v_1$$