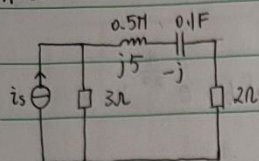


11-2



$$i_s = 2\sqrt{2} \cos 10t \text{ A} \quad \dot{I}_s = 2 \angle 0^\circ$$

$$\dot{U}_s = [3 \parallel (j5 - j) + 2] \dot{I}_s = \left( \frac{18}{41} + j \frac{36}{41} \right) \cdot 2 \angle 0^\circ$$

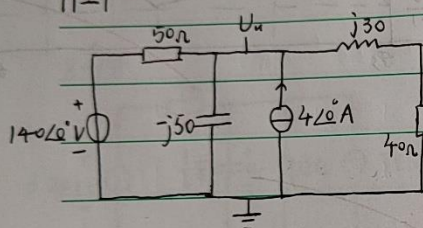
$$= 4.19 \angle 24.8^\circ$$

$$\varphi = \phi_1 - \phi_2 = 24.8^\circ$$

$$P = 4.19 \times 2 \times \cos 24.8^\circ = 7.61 \text{ W}$$

$$Q = 4.19 \times 2 \times \sin 24.8^\circ = 3.51 \text{ Var}$$

11-7



以下方节点为参考节点, 列出节点方程

$$\left( \frac{1}{50} + \frac{1}{-j50} + \frac{1}{j30 + 40} \right) \dot{U}_n = \frac{140 \angle 0^\circ}{50} + 4 \angle 0^\circ$$

$$\Rightarrow \dot{U}_n = 180 - j40$$

流

$$\text{电源} \quad \bar{S}_1 = \dot{U}_n (4 \angle 0^\circ)^* = (720 - j160) \text{ V} \cdot \text{A}$$

$$\text{电压源} \quad \bar{S}_2 = 140 \angle 0^\circ \times \left( \frac{140 \angle 0^\circ - \dot{U}_n}{50} \right)^* = (-112 - j112) \text{ V} \cdot \text{A}$$

$$\text{电容} \quad \bar{S}_3 = \dot{U}_n \cdot \left( \frac{\dot{U}_n}{-j50} \right)^* = -j680 \text{ V} \cdot \text{A}$$

$$40 \Omega \text{ 电阻} + \text{电感} \quad \bar{S}_4 = \frac{\dot{U}_n^2}{(j30 + 40)^*} = (544 + j408) \text{ V} \cdot \text{A}$$

$$50 \Omega \text{ 电阻} \quad \bar{S}_5 = \frac{140 \angle 0^\circ \cdot \dot{U}_n}{50} = 64 \text{ V} \cdot \text{A}$$

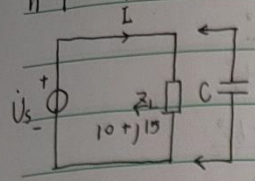
$$\bar{S}_1 + \bar{S}_2 = (608 - j272) \text{ V} \cdot \text{A}$$

$$\bar{S}_3 + \bar{S}_4 + \bar{S}_5 = (608 - j272) \text{ V} \cdot \text{A}$$

$$\therefore \bar{S}_1 + \bar{S}_2 = \bar{S}_3 + \bar{S}_4 + \bar{S}_5$$

复功率守恒成立

11-9



(1) 令  $\dot{U}_s = 220 \angle 0^\circ \text{ V}$   $\varphi = \varphi_1 - \varphi_2 = 56.3^\circ$   
 $\therefore \dot{I}_s = \frac{\dot{U}_s}{Z_L} = \frac{220 \angle 0^\circ}{10 + j15} = 12.2 \angle -56.3^\circ$   
 $P = 220 \times 12.2 \cos 56.3^\circ = 1489.2 \text{ W}$   
 $Q = 220 \times 12.2 \sin 56.3^\circ = 2233.0 \text{ var}$

$\therefore S = 220 \times 12.2 = 2684.0 \text{ V} \cdot \text{A}$   
 $\lambda = \frac{P}{S} = \cos 56.3^\circ = 0.555$

(2) 并联电容, 负载不受影响,  $P = 1489.2 \text{ W}$ ,  $Q = 2233.0 \text{ var}$   
 总负载的功率因数为 0.95

则  $\varphi' = \arccos 0.95 = 18.2^\circ$

$Q' = P \cdot \tan \varphi' = 489.6 \text{ var}$

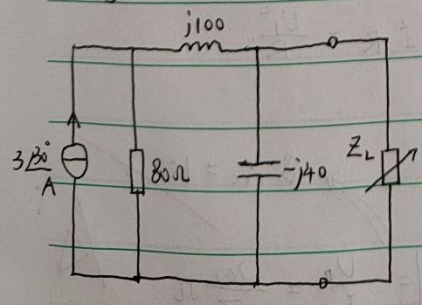
有  $Q' + Q_c = Q$  且  $Q_c = \omega C U_s^2$

$\therefore C = \frac{Q - Q'}{\omega U_s^2} = \frac{2233.0 - 489.6}{50 \times 2\pi \times 220^2} = 114.7 \mu\text{F}$

电源

$P' = 1489.2 \text{ W}$   $Q' = 489.6 \text{ var}$   $S' = \sqrt{P'^2 + Q'^2} = 1567.6 \text{ VA}$   
 $I' = \frac{S'}{U_s} = \frac{1567.6}{220} = 7.1 \text{ A}$

11-13



开路电压 (戴维南等效电路)

$\dot{U}_C = \frac{80}{80 + j100 - j40} \times 3 \angle 30^\circ \times (-j40)$   
 $= 96 \angle -96.9^\circ$

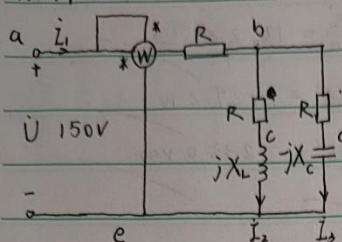
等效阻抗  $Z_{eq} = (-j40) \parallel (80 + j100) = \frac{64}{5} - j\frac{248}{5}$

则当  $Z_L = Z_{eq}$  时  $Z_L$  吸收的有功功率最大

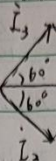
$P_{max} = \frac{\dot{U}_C^2}{4 R_{eq}} = \frac{96^2}{4 \times \frac{64}{5}} = 180 \text{ W}$



11-19



$$\text{由 } I_1 = I_2 = I_3, \quad I_1 = I_2 + I_3$$

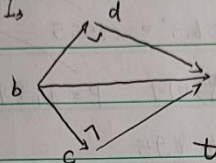


$$I_1 = I_0 \angle 0^\circ$$

$$I_2 = I_0 \angle -60^\circ$$

$$I_3 = I_0 \angle 60^\circ$$

再画出电压矢量图



$$U_{bc} = U_{bd} = IR$$

$$\text{故 } R_{\triangle bde} \cong R_{\triangle bce}$$

$$U_{be} = \frac{U_{bc}}{\cos 60^\circ} = 2IR$$

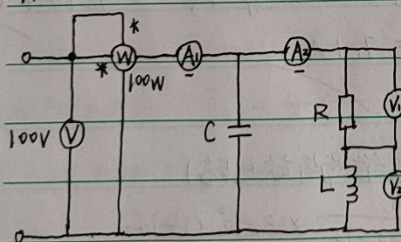
$$\therefore U = U_{ae} = 3IR = 150V$$

$$P_{\text{读}} = 3I^2R = 1500W$$

$$\text{解得 } R = 5\Omega, \quad I = 10A$$

$$X_L = X_C = \sqrt{3}R = 5\sqrt{3}\Omega$$

11-25



$$U_1 = 2U_2, \quad \dot{U} = \dot{U}_1 + \dot{U}_2$$

$$\text{且 } \dot{U}_1 \text{ 与 } \dot{U}_2 \text{ 正交, } U^2 = U_1^2 + U_2^2$$

$$\text{联立解得 } U_1 = 40\sqrt{5}V$$

$$U_2 = 20\sqrt{5}V$$

$$100 = I_2^2 R = \frac{U_1^2}{R}$$

$$\Rightarrow R = 80\Omega, \quad I_2 = \frac{\sqrt{5}}{2}A$$

$$\therefore I_1 = I_2 = \frac{\sqrt{5}}{2}A$$

$$X_L = \frac{U_2}{I_2} = 40\Omega$$

$$X_C = 100\Omega$$

$$|Z| = |-jX_C // (R + jX_L)| = \left| \frac{(140 - j80)X_C}{80 + j(40 - X_C)} \right| = \frac{U_0}{I_1} = \frac{200}{\sqrt{5}}\Omega$$