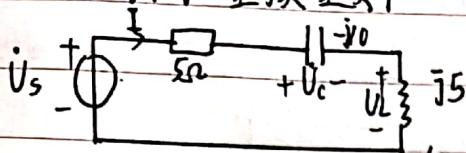


第十章作业

[10-33] 原电路相量模型如下:



1) KVL: $U_s = 5i + 10j \frac{di}{dt} + 0.5 \frac{di}{dt}$

2) $\dot{U}_s = (5 - j10 + j5)\dot{I} = 20 \angle 45^\circ \text{ V}$

$\therefore \dot{I} = \frac{20 \angle 45^\circ}{5\sqrt{2} \angle -45^\circ} \text{ A} = 2.83 \angle 90^\circ \text{ A}$

$\therefore i = 2.83 \cos(10t + 90^\circ) \text{ A}$

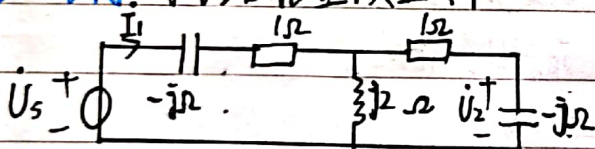
3) $\dot{U}_L = j5\dot{I} = 14.15 \angle 180^\circ \text{ V}$

$\dot{U}_C = -j10\dot{I} = 28.3 \angle 0^\circ \text{ V}$

$\therefore U_L = 14.15 \cos(10t + 180^\circ) \text{ V}$

$U_C = 28.3 \cos(10t) \text{ V}$

[10-34] 原电路相量模型如下:



$Z_{eq} = 1 - j + \frac{j2 \times (1 - j)}{j2 + 1 - j} = 3 - j$ 取 $\dot{U}_s = 10\sqrt{2} \angle 0^\circ$

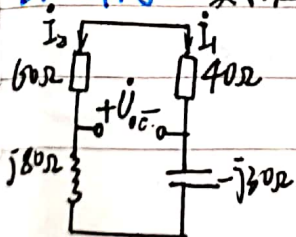
$\dot{I}_1 = \frac{\dot{U}_s}{Z_{eq}} = \frac{10\sqrt{2} \angle 0^\circ}{\sqrt{10} \angle -18.4^\circ} = 4.47 \angle 18.4^\circ \text{ A}$

$\dot{U}_2 = \frac{-j}{1 - j} \times \frac{j2 \times (1 - j)}{j2 + 1 - j} \times \dot{U}_s = 6.32 \angle -26.57^\circ \text{ V}$

$\therefore i_1 = 4.47 \cos(100t + 18.4^\circ) \text{ A} = 3.16\sqrt{2} \cos(100t + 18.4^\circ) \text{ A}$

$U_2 = 6.32 \cos(100t - 26.57^\circ) \text{ V} = 4.47\sqrt{2} \cos(100t - 26.57^\circ) \text{ V}$

[10-41] ①戴维南定理:



$Z_{eq} = (60 + j80) \parallel (40 - j30) = \frac{100 \times j50}{100 + j50} = 20(1 + j2) \Omega$

$\dot{I}_1 = \frac{60 + j80}{60 + j80 + 40 + (-j30)} \times 3 \angle 60^\circ$

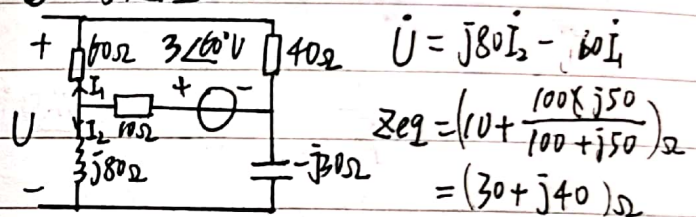
$\dot{I}_2 = \frac{40 - j30}{60 + j80 + 40 - j30} \times 3 \angle 60^\circ$

$\dot{U}_{oc} = 40\dot{I}_1 - 60\dot{I}_2 = 60\sqrt{5} \angle 123.43^\circ = 134.2 \angle 123.43^\circ \text{ V}$

$\dot{U}_{oc} = 134.2 \angle 123.43^\circ$
 $\dot{I} = \frac{\dot{U}_{oc}}{10 + Z_{eq}} = \frac{134.2 \angle 123.43^\circ}{30 + j40}$

$\frac{134.2 \angle 123.43^\circ}{50 \angle 53.13^\circ} = 2.68 \angle 70.3^\circ \text{ A}$

②互易定理:

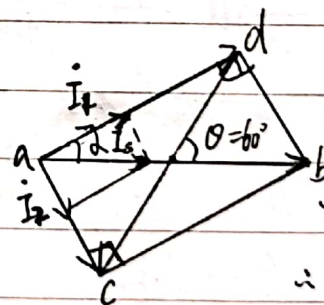


$\dot{U} = j80\dot{I}_2 - 60\dot{I}_1$
 $Z_{eq} = (10 + \frac{100 \times j50}{100 + j50}) \Omega = (30 + j40) \Omega$

$\dot{I}_1 = \frac{j50}{100 + j50} \times \frac{3 \angle 60^\circ}{Z_{eq}}, \dot{I}_2 = \frac{100}{100 + j50} \times \frac{3 \angle 60^\circ}{Z_{eq}}$

$\dot{U} = \frac{100j}{2 + j} \times \frac{3 \angle 60^\circ}{30 + j40} \text{ V} = 2.68 \angle 70.3^\circ \text{ V}$
由互易定理, $\frac{\dot{U}}{3 \angle 60^\circ \text{ V}} = \frac{\dot{I}}{3 \angle 60^\circ \text{ A}}$
 $\therefore \dot{I} = 2.68 \angle 70.3^\circ \text{ A}$

[10-51]



选 \dot{U}_{ab} 作为参考向量

$\because R_1 = R_2$
 $\therefore \frac{\dot{I}_2}{\dot{I}_1} = \frac{\dot{U}_{ac}}{\dot{U}_{ad}} = \frac{\dot{I}_2 R_1}{\dot{I}_1 R_2}$

由题意, $\angle \theta = 60^\circ, \angle acb = \angle adb = 90^\circ$

$\therefore \dot{U}_{ab} = \dot{U}_{ad} \therefore a, b, c, d$ 四点共圆

$\therefore \alpha = 30^\circ$

$\dot{I}_1 = \dot{I}_s \cos \alpha = 5\sqrt{3} \text{ A}, \dot{I}_2 = \dot{I}_s \sin \alpha = 5 \text{ A}$

$\dot{U}_{ab} = \frac{\dot{U}_{cb}}{\cos \alpha} = 10 \text{ V}, \dot{U}_{ad} = \dot{U}_{ab} \cos \alpha = 5\sqrt{3} \text{ V}$

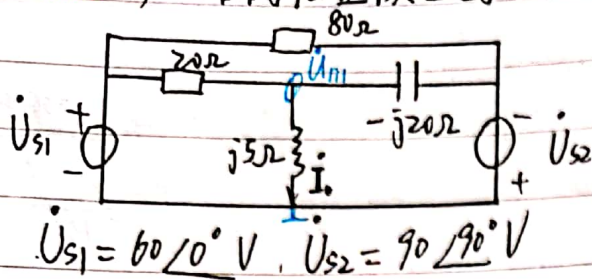
$\therefore R_1 = R_2 = \frac{\dot{U}_{ac}}{\dot{I}_2} = \frac{\dot{U}_{ad}}{\dot{I}_1} = 1 \Omega$

$X_L = \frac{\dot{U}_{cb}}{\dot{I}_2} = \sqrt{3} \Omega, X_C = \frac{\dot{U}_{db}}{\dot{I}_1} = \frac{\sqrt{3}}{3} \Omega$



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[10-53] 1) 电路的相量模型图如下:



(取有效值相量)

12) 用KCL方程, 对结点!

$$(\frac{1}{j5} + \frac{1}{20} + \frac{1}{-j20}) \dot{U}_{m1} - \frac{\dot{U}_{s1}}{20} + \frac{\dot{U}_{s2}}{-j20} = 0$$

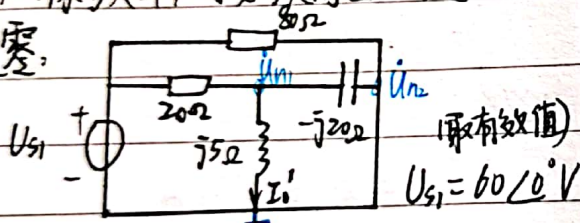
$$\therefore \dot{U}_{m1} = \frac{150\angle0^\circ}{1-j3} = \frac{150\angle0^\circ}{\sqrt{10}\angle-71.56^\circ} = 15\sqrt{10}\angle71.56^\circ \text{ V}$$

$$\dot{I}_o = \frac{\dot{U}_{m1}}{j5} = 9.5\angle-18.44^\circ \text{ A}$$

$$\therefore i_o = 9.5\sqrt{2} \cos(4 \times 10^4 t - 18.44^\circ) \text{ A}$$

13) 改变电压源频率, 则必须用叠加定理

① 将 U_{s2} 置零:



$$\text{KCL-1: } (\frac{1}{20} + \frac{1}{j5} + \frac{1}{-j20}) \dot{U}_{m1} - \frac{1}{20} \dot{U}_{s1} - \frac{1}{-j20} \dot{U}_{m2} = 0$$

$$\text{KCL-2: } (-\frac{1}{j20} + \frac{1}{80}) \dot{U}_{m2} - \frac{1}{-j20} \dot{U}_{m1} = 0 \quad \text{又 } \dot{U}_{m2} = 0$$

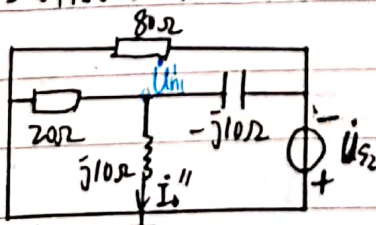
$$\therefore \dot{U}_{m1} = 6\sqrt{10}\angle71.56^\circ \text{ V}$$

$$\dot{I}_o' = \frac{\dot{U}_{m1}}{j5} = 3.8\angle-18.44^\circ \text{ A}$$

$$\dot{I}_o' = 3.8\sqrt{2} \cos(4 \times 10^4 t - 18.44^\circ) \text{ A}$$

② 将 U_{s1} 置零:

$$\dot{U}_{s2} = 90\angle90^\circ \text{ (取有效值)}$$



$$\text{KCL: } (\frac{1}{20} + \frac{1}{j10} + \frac{1}{-j10}) \dot{U}_{m1} - \frac{1}{-j10} (-\dot{U}_{s2}) = 0$$

$$\therefore \dot{U}_{m1} = 180^\circ \angle 0^\circ \text{ V}$$

$$\dot{I}_o'' = \frac{\dot{U}_{m1}}{j10} = 18\angle-90^\circ \text{ A}$$

$$\dot{I}_o'' = 18\sqrt{2} \cos(8 \times 10^4 t - 90^\circ) \text{ A}$$

$$\therefore \dot{I}_o = \dot{I}_o' + \dot{I}_o'' = [3.8\sqrt{2} \cos(4 \times 10^4 t - 18.44^\circ) + 18\sqrt{2} \cos(8 \times 10^4 t - 90^\circ)] \text{ A}$$

其他题

$$[10-14] \dot{I}_s = \frac{\dot{U}}{10} + \frac{\dot{U}}{j4} + \frac{\dot{U}}{-j2.5} = 2\angle-30^\circ \text{ A}$$

$$\therefore \dot{U} = \frac{40\angle-30^\circ}{24+j} = \frac{40\angle-30^\circ}{\sqrt{13}\angle91.3^\circ} = 11.09\angle-121.3^\circ \text{ V}$$

$$\therefore u = 11.09 \sin(4t - 86.3^\circ) \text{ V}$$

$$\dot{I}_L = \frac{\dot{U}}{j4} = 2.77\angle-171.3^\circ \text{ A}$$

$$\dot{I}_C = \frac{\dot{U}}{-j2.5} = 4.44\angle3.7^\circ \text{ A}$$

$$[10-16] \dot{I} \text{ 的初相: } \frac{\pi}{6} + \frac{\pi}{2} = \frac{2\pi}{3}$$

$$U_L \text{ 初相超前 } \dot{I} \text{ 的初相 } \frac{\pi}{2}, \varphi_{UL} = \frac{2\pi}{3} + \frac{\pi}{2} = \frac{7\pi}{6}$$

$$2\pi - \frac{7\pi}{6} = -\frac{5\pi}{6}$$

$$\dot{I} \text{ 的初相} = U_L \text{ 初相} - \frac{2\pi}{3}$$

$$\dot{I} \text{ 初相: } \pi - \frac{5\pi}{6} = \frac{\pi}{6}$$

$$[10-17] U \text{ 超前 } i_L 90^\circ \therefore U \text{ 初相 } 60^\circ$$

$$\text{求与 } U \text{ 初相同 } \varphi_{iL} = 60^\circ$$

$$\dot{I}_C \text{ 超前 } U 90^\circ \therefore \varphi_{iC} = 150^\circ$$

$$\varphi_{iC} = -30^\circ$$

$$[10-18] 1) X = -20\angle90^\circ = 20\angle90^\circ = 20j$$

$$\rightarrow 200L = 20 \quad L = 0.1 \text{ H}$$

$$2) X = -100\angle90^\circ = \frac{100}{j} = \frac{1}{j\omega C}$$

$$\therefore 500C = \frac{1}{100} \therefore C = 20 \mu\text{F}$$

$$3) X = 100\angle0^\circ = 100 \Omega$$

$$\text{统一 } \sin, \cos$$

$$i = 0.5 \sin(1000t - 30^\circ) \text{ A}$$

$$X = \frac{U}{I} = 100\angle0^\circ \therefore R = 100 \Omega$$



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