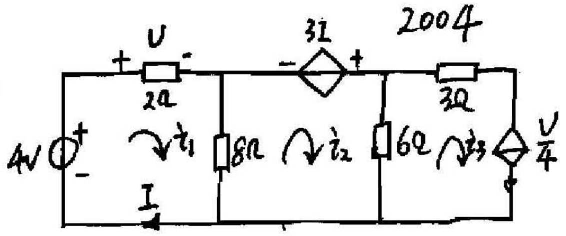
西南交通大学电路分析历年考研真题参考答案

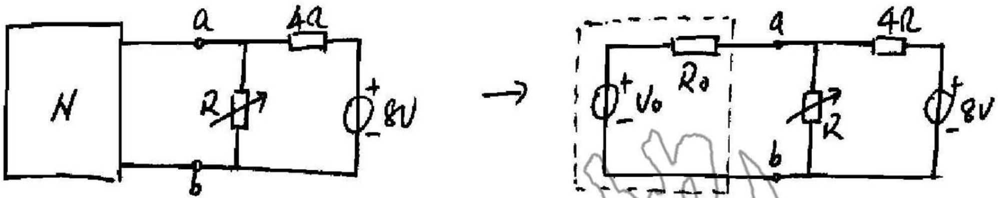
2004

一、



解：$\begin{cases} 2i_1+(i_1-i_2)\times 8=4 \\ -3I+6(i_2-i_3)+8(i_2-i_1)=0 \\ i_3=\frac{V}{4} \\ V=2i_1 \end{cases} \Rightarrow \begin{cases} i_1=2A \\ i_2=2A \\ i_3=1A \\ I=2A \end{cases}$

二、

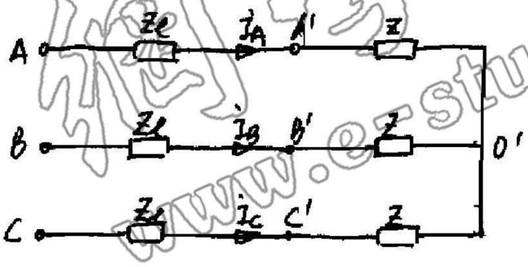


解：∵ N为直流线性有源网络，可等效戴维南电路.

当 $R=0$ 时 $i=8A \Rightarrow \frac{V_0}{R_0}=8\Omega$

当 $R=4\Omega$ 时 $\Rightarrow V_0-4R_0=8+4 \Rightarrow V_0=24V \quad R_0=3\Omega$

三、



解：$\dot{U}_{A'B'}=380\angle 0^\circ\ V$

$P=\sqrt{3}U_lI_l\cos\varphi \Rightarrow$

$I_l=\frac{P}{\sqrt{3}U_l\cos\varphi}=10A$

$\dot{U}_{A'}=220\angle -30^\circ\ V$

$\dot{U}_{B'}=220\angle -150^\circ\ V$

$\dot{I}_A=10\angle \varphi_u-\varphi_z=10\angle -30^\circ-60^\circ=10\angle -90^\circ\ A$

$\dot{I}_B=10\angle -210^\circ\ A \qquad \dot{I}_C=10\angle 30^\circ\ A$

$\dot{U}_A=\dot{I}_AZ_l+\dot{U}_{A'} \qquad \dot{U}_B=\dot{I}_BZ_l+\dot{U}_{B'}$

$\dot{U}_{AB}=\dot{U}_A-\dot{U}_B=(\dot{I}_A-\dot{I}_B)Z_l+(\dot{U}_{A'}-\dot{U}_{B'})$

$=378.38\angle 1.54^\circ\ V$

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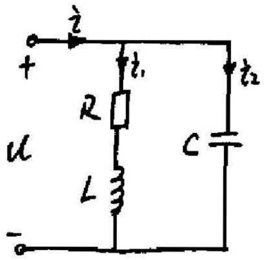
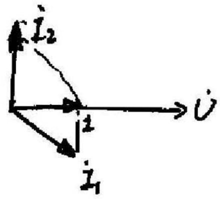
四





解：$\dot U = \frac{200}{\sqrt2}\angle -90^\circ$ V $\dot I = \frac{5}{\sqrt2}\angle -90^\circ$ A

$Z = \frac{U}{I} = \frac{200}{5} = 40\Omega$

∴R, L, C发生并联谐振.

$$Y = \frac{1}{R+j\omega L} + j\omega C = \frac{R}{R^2+(\omega L)^2} + j\left(\omega C - \frac{\omega L}{R^2+(\omega L)^2}\right)$$

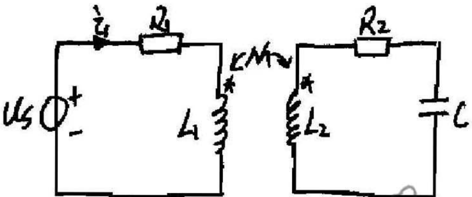
$$\frac{R}{R^2+(\omega L)^2} = \frac{1}{40} = \frac{20}{400+10^4L^2} \Rightarrow L = 0.2H$$

$$\omega C = \frac{\omega L}{400+\omega^2L^2} \Rightarrow C = \frac{L}{400+\omega^2L^2} = 250\mu F$$

$$j\omega L = j\times100\times0.2 = 20j \quad \frac{1}{j\omega C} = -40j$$

$$\dot I_1 = \frac{\dot U}{20+20j} = 5\angle -45^\circ A \quad \dot I_2 = \frac{\dot U}{-40j} = \frac{5}{\sqrt2}\angle 90^\circ A$$

五 解：

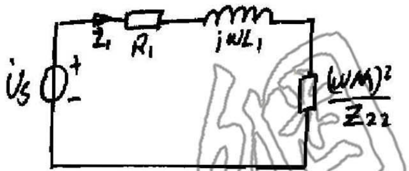


$Z_{11} = R_1 + j\omega L_1 = 4+j8\Omega$

$Z_{22} = R_2 + j\omega L_2 + \frac{1}{j\omega C} = 4\Omega$

$\frac{(\omega M)^2}{Z_{22}} = \frac{16}{4} = 4\Omega$

原边等效电路如下：



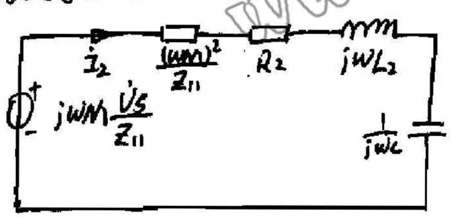
①原边等效电路直流作用时：$I_0 = \frac{12}{4} = 3A$

②交流作用时：$\dot U_S = \frac{48}{\sqrt2}\angle 45^\circ$ V

$\dot I_1 = \frac{\dot U_S}{4+j8+4} = 3\angle 0^\circ$ A

∴ $i_1 = 3 + 3\sqrt2\cos(2t)$ A

副边等效电路如下：



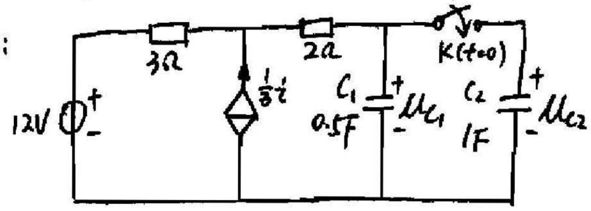
$\frac{(\omega M)^2}{Z_{11}} = \frac{16}{4+j8} = \frac{4}{1+2j}$

$j\omega M\frac{\dot U_S}{Z_{11}} = \frac{\dot U_S\times4\angle90^\circ}{4+8j} = \frac{\dot U_S\angle90^\circ}{1+2j}$

∴ $\left(\frac{4}{1+2j}+4\right)\dot I_2 = \frac{\dot U_S\angle90^\circ}{1+2j} \Rightarrow \dot I_2 = 3\angle90^\circ$ A

∴ $i_2 = 3\sqrt2\cos(2t+90^\circ)$ A $P = U_0I_0 + U_1I_1\cos\varphi = 12\times3 + \frac{48}{\sqrt2}\times3\times\frac{\sqrt2}{2} = 108W$

六 解：



$u_{c1}(0-)=12V \quad u_{c2}(0-)=0V$

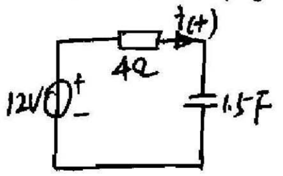
根据电荷守恒定律：$C_1u_{c1}(0-)+C_2u_{c2}(0-)=C_1u_{c1}(0+)+C_2u_{c2}(0+)$

$u_{c1}(0+)=u_{c2}(0+)$

$\therefore \ 0.5\times12=(C_1+C_2)u_{c1}(0+)=1.5u_{c1}(0+)$

$\therefore \ u_{c1}(0+)=u_{c2}(0+)=4V \quad u_{c1}(+\infty)=u_{c2}(+\infty)=12V$

求u_{c1}两端等效电路：① 开路电压 $U_{oc}=12V$



② 短路电流 i_{sc}：

$3(i_{sc}-\frac{1}{3}i_{sc})+2i_{sc}=12 \Rightarrow i_{sc}=3A$

$R_{eq}=\frac{12}{3}=4\Omega$

$\tau=RC=4\times1.5=6s$

$u_{c2}(t)=12+(4-12)e^{-\frac{t}{6}}$

$=12-8e^{-\frac{t}{6}}V \ (t\geq0)$

$i(t)=\frac{12-u_{c2}(t)}{4}=2e^{-\frac{t}{6}}A \ (t\geq0)$

求$i(t)$的错误解法：

$i_{c1}(t)=C_1\frac{du_{c1}}{dt}=0.5\times\frac{4}{3}e^{-\frac{t}{6}}=\frac{2}{3}e^{-\frac{t}{6}} \ (t\geq0)$ X

$i_{c2}(t)=C_2\frac{du_{c2}}{dt}=\frac{4}{3}e^{-\frac{t}{6}} \ (t\geq0)$ X why？用拉氏变换求解便知。

$\therefore i(t)=i_{c1}(t)+i_{c2}(t)=2e^{-\frac{t}{6}} \ (t\geq0)$

七解：

① 当$Z_L=0$时 $\dot{I}_1=18\angle0^\circ A \quad \dot{I}_2=9\angle180^\circ A$

$\dot{U}_1=Z_{11}\dot{I}_1+Z_{12}\dot{I}_2$

$Z_{11}\cdot18\angle0^\circ+Z_{12}\cdot9\angle180^\circ=90\angle0^\circ$

$\begin{cases}Z_{11}\cdot18-9Z_{12}=90\\Z_{11}\cdot15-5Z_{12}=90\end{cases}$

$\Rightarrow\begin{cases}Z_{11}=8\Omega\\Z_{12}=6\Omega\end{cases}$

② $\dot{U}_1=\dot{U}_S=90\angle0^\circ V \quad \dot{I}_1=18\angle0^\circ A \quad \dot{U}_2=0 \quad \dot{I}_2=9\angle180^\circ A$

$\hat{\dot{U}}_1=90\angle0^\circ V \quad \hat{\dot{I}}_1=? \quad \hat{\dot{U}}_2=30\angle0^\circ V \quad \hat{\dot{I}}_2=5\angle180^\circ A$

$\sum_{k=0}^{n}\dot{U}_K\hat{\dot{I}}_K=0$ （特勒根定理）

$-90\angle0^\circ\cdot\hat{\dot{I}}_1=-90\angle0^\circ\cdot18\angle0^\circ-30\angle0^\circ\cdot9\angle180^\circ$

$\therefore \hat{\dot{I}}_1=15\angle0^\circ A$

$\begin{cases}Z_{21}\cdot18-9Z_{22}=0\\Z_{21}\cdot15-5Z_{22}=30\end{cases}$

$\Rightarrow Z_{21}=6\Omega \quad Z_{22}=12\Omega$

$\therefore Z=\begin{bmatrix}8&6\\6&12\end{bmatrix}\Omega \quad Y=Z^{-1}=\begin{bmatrix}\frac{1}{5}&-\frac{1}{10}\\-\frac{1}{10}&\frac{2}{15}\end{bmatrix}S$

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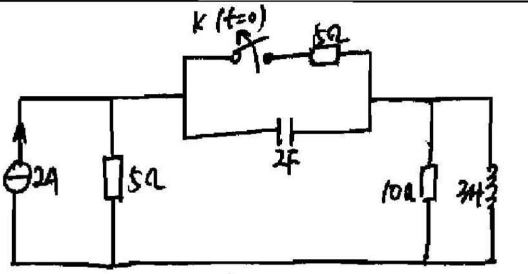
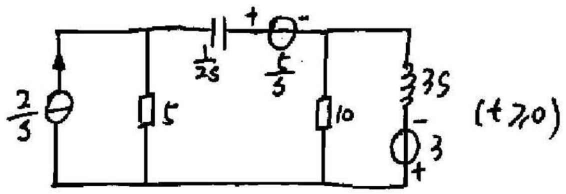
八1.解：



$u_C(0_-) = 5V$

$i_L(0_-) = \cancel{2A}\ 1A$

↓



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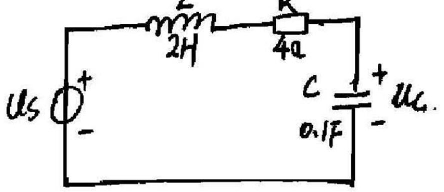

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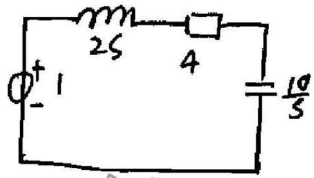


方法一： $I(s) = \dfrac{1}{2s+4+\frac{10}{s}}$ $\quad U_C(s) = \dfrac{\frac{10}{s}}{2s+4+\frac{10}{s}} = \dfrac{5}{s^2+2s+5}$

$K_1 = \dfrac{P(s)}{Q'(s)}\Big|_{s=-1+2i} = \dfrac{5}{2s+2}\Big|_{s=-1+2i}$ $\quad |K_1|e^{j\theta} = \frac{5}{4}\angle -90°$

$\therefore u_C(t) = 2\times\frac{5}{4}e^{-t}\cos(2t-90°)\varepsilon(t) = \frac{5}{2}e^{-t}\sin 2t\,\varepsilon(t)$

方法二： $LC\dfrac{d^2u_C(t)}{dt^2} + RC\dfrac{du_C(t)}{dt} + u_C = \varepsilon(t)$ $\quad u_C(0_-)=0 \quad i_L(0_-)=0$

$2\dfrac{d^2u_C(t)}{dt} + 4\dfrac{du_C(t)}{dt} + 10u_C = 0$

$p^2+2p+5=0 \qquad p = \dfrac{-2\pm\sqrt{4-20}}{2} = -1\pm 2i$

通解：$u_C' = e^{-t}(C_1\cos 2t + C_2\sin 2t)\ V$

特解：$u_C'' = 1V$

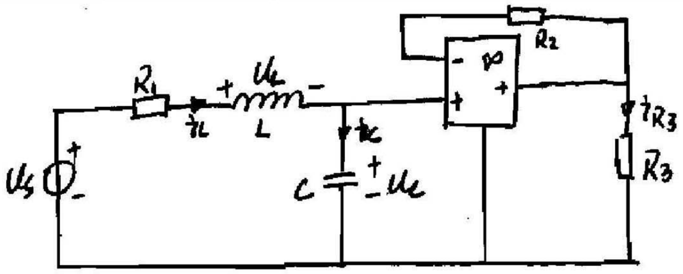
$\therefore u_C(t) = e^{-t}(C_1\cos 2t + C_2\sin 2t) + 1$

$$\begin{cases} C_1 + 1 = 0 \Rightarrow C_1 = -1 \\ \dfrac{du_C(t)}{dt} = -e^{-t}(C_1\cos 2t + C_2\sin 2t) + e^{-t}(-2C_1\sin t + 2C_2\cos 2t) \\ \quad\Rightarrow -C_1 + 2C_2 = 0 \Rightarrow C_2 = -\frac{1}{2} \end{cases}$$

$\therefore u_C(t) = \left[e^{-t}\left(-\cos 2t - \frac{1}{2}\sin 2t\right) + 1\right]\varepsilon(t)$

$h(t) = \dfrac{ds(t)}{dt} = \frac{5}{2}e^{-t}\sin(2t)\varepsilon(t)\ V$

九、解：



取 u_C, i_L 为自变量

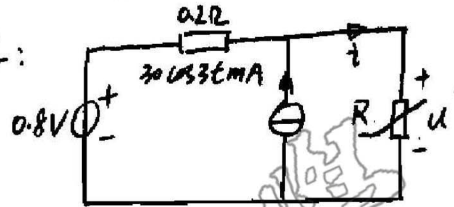
$i_C = i_L \Rightarrow \frac{du_C}{dt} = \frac{1}{C} i_L$ ①

$R_1 i_L + u_L + u_C = u_S \Rightarrow u_L = u_S - u_C - R_1 i_L$

$\frac{di_L}{dt} = -\frac{1}{L} u_C - \frac{R_1}{L} i_L + \frac{1}{L} u_S$ ②

$$\therefore \begin{bmatrix} \frac{du_C}{dt} \\ \frac{di_L}{dt} \end{bmatrix} = \begin{bmatrix} 0 & \frac{1}{C} \\ -\frac{1}{L} & -\frac{R_1}{L} \end{bmatrix} \begin{bmatrix} u_C \\ i_L \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{1}{L} \end{bmatrix} u_S$$

十、解：



应用叠加原理：

① 直流分量：$0.2i + 0.1i^2 = 0.8 \Rightarrow i = -4A$ (舍) $i = 2A$

$\therefore U_Q = 0.4V \quad I_Q = 2A$

② 交流分量：

$R = \frac{du}{di}\Big|_{i=2A} = 0.2i\Big|_{i=2A} = 0.4\Omega$

$i = \frac{u}{0.2+0.4} = 10\cos 3t \ mA$

$\therefore u_1 = i \times 0.4 = 4\cos 3t \ mV$

$\therefore u = U_Q + u = 0.4 + 0.004\cos 3t \ V$

$i = I_Q + i = 2 + 0.01\cos 3t \ A$