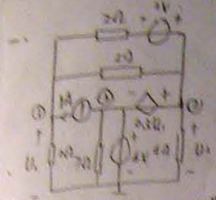
2001年电路分析key

一、

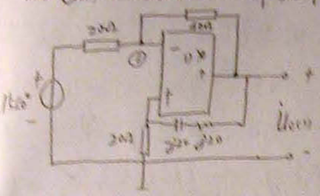


由节点电压法：

$$\begin{cases}(\frac{1}{2}+\frac{1}{2}+\frac{1}{2})U_1-\frac{1}{2}U_2-\frac{1}{2}U_3=-\frac{1}{2}\times 2+1\\ U_2=0.5U_1+4\end{cases}\Rightarrow\begin{cases}U_1=4V\\ U_2=6V\end{cases}$$

二、1) 直流 $U_{i(0)}=5V$ 单独作用下，$U_+=U_-=0$，输出 $U_{o(0)}=40\times(-\frac{5}{20})V=-10V$

2) $U_{i(1)}=15\sqrt{2}\cos 1000t$ 单独作用下，相量电路如图示



$$\begin{cases}(\frac{1}{20}+\frac{1}{40})\dot{U}_1-\frac{1}{40}\dot{U}_{o(1)}=\frac{15\angle 0^\circ}{20}\\ \dot{U}_1=\dot{U}_{o(1)}\end{cases}\Rightarrow\dot{U}_{o(1)}=15\angle 0^\circ$$

于是 $u_o=-10+15\sqrt{2}\cos 1000t\,(V)$，$U_o=\sqrt{10^2+15^2}=18.03V$

三、① $P=P_1+P_2=14KW$，$Q_2=P_2\cdot tg\varphi_2=10\times tg(\arccos 0.707)=10KVar$

$\tilde{S}=(14+j10)(KVA)$，$\cos\varphi=\frac{P}{S}=0.8$[illegible]

② 并上电容后，P不变，[illegible] $S'=\frac{P}{\cos\varphi'}=14.72KVA$，又 $Q'=\sqrt{S'^2-P^2}$

所以 [illegible] $=Q-Q'=10-\sqrt{14.72^2-14^2}=W_cU^2=2\pi f C\cdot 220^2$

[illegible] μF

戴维南电路

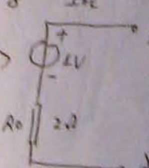
[illegible]，再求出a、b端口的戴维南等效电路，$Z_0=\frac{20\times j20}{20+j20}+j10-j5n^2$

要获得最大功率，$Z_0=n^2R_L\Rightarrow 10+j20-j5n^2=R_Ln^2\Rightarrow\begin{cases}20-5n^2=0\\ n^2R_L=10\end{cases}\Rightarrow\begin{cases}n=2\\ R_L=2.5\Omega\end{cases}$

$\dot{U}_{oc}=\frac{\dot{U}_s}{20+j20}\cdot j20=50\angle 45^\circ V$，$P_{max}=\frac{U_{oc}^2}{4R_0}=\frac{50^2}{4\times 10}=62.5W$

解：用互易定理，$\frac{U_{oc}}{8}=\frac{I}{I_{sc}}\Rightarrow U_{oc}=4V$，用短路法求$R_0$，$\frac{I_{sc}}{8}=\frac{1}{4}\Rightarrow I_{sc}=2A$，

$R_0=\frac{U_{oc}}{I_{sc}}=2\Omega\Rightarrow$



解：流过R_2电流为$\dot{I}$，流过R_1线电流$\dot{I}_A$，$\dot{I}$如图所设，A相的单相计算电路如图示

$\dot{I}_A' = \frac{220\angle 0^\circ}{22} = 10\angle 0^\circ$，$\dot{I}_B = 10\angle -120^\circ A$，$\dot{I}_C' = 10\angle 120^\circ A$ 又 $\dot{I} = \frac{\dot{U}_{AC}}{R_2} = \frac{-380\angle 150^\circ}{38} = 10\angle -30^\circ A$

提 $\dot{I}_A = \dot{I} + \dot{I}_A' = 10\angle -30^\circ + 10\angle 0^\circ = 19.32\angle -15^\circ A$，$\dot{I}_C = \dot{I}_C' - \dot{I} = 19.32\angle 135^\circ A$

功率表读数 $P = Re[\dot{U}_{AC}\dot{I}_A^*] = 380 \times 19.32\cos(-30^\circ + 15^\circ) = 7091W$

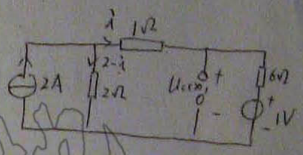
七. 解：设1-1'端子电压为U_1，2-2'端子电压为U_2，列写KVL方程 $\begin{cases} U_1 = 2I_1 + I_1 + I_2 \\ U_2 = 2I_1 + 4I_2 + I_1 + I_2 \end{cases}$

$\Rightarrow \begin{cases} U_1 = U_2 - 4I_2 \\ I_1 = \frac{1}{3}U_2 - \frac{5}{3}I_2 \end{cases} \Rightarrow$ T参 $\begin{bmatrix} 1 & 4\Omega \\ \frac{1}{3}S & \frac{5}{3} \end{bmatrix}$

八. 解：当$0 \le t < 3$，三要素法解，$U_C(\infty) = 2 \times 2 = 4V$，开路电阻 $R_0 = 3\Omega$，$\tau = R_0C = 3S$

$U_C(t) = 4 - 4e^{-\frac{1}{3}t}$ (V) $(0 \le t < 3)$

当 $t \ge 3$ 时，$U_C(3_+) = U_C(3_-) = 4 - 4e^{-1} = 2.5V$. 电路如图示



$1 = -7\lambda + 2(2-\lambda) \Rightarrow \lambda = \frac{1}{3}A$，$U_C(\infty) = 6\lambda + 1 = 3V$.

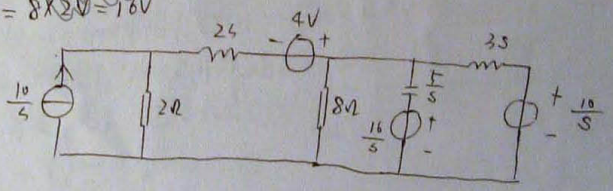
$R_0 = 3 // 6 = 2\Omega$，$\tau = 2S$，此时 $U_C(t) = 3 + 0.5e^{-\frac{1}{2}t}$ (V) $(t \ge 3)$

故 $U_C(t) = \begin{cases} 4 - 4e^{-\frac{1}{3}t} & 0 \le t < 3S \\ 3 + 0.5e^{-\frac{1}{2}(t-3)} & t \ge 3S \end{cases}$ $U_R(t) = \begin{cases} 0 & 0 < t < 3S \\ (2 - 0.5e^{-\frac{1}{2}(t-3)}) & t \ge 3S \end{cases}$

九. 1. 解：稳态时流过2H电感电流 $i_L(0_-) = 2A$，流过3H电感电流 $i_L'(0_-) = 0$

$U_C(0_-) = 8 \times 2 = 16V$

运算电路



2. $H(s) = \mathcal{L}^{-1}[h(t)] = 1 + \frac{2}{s+2} + \frac{4}{(s+3)^2+16}$

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