2001年电路分析 key

一、结点电压法：$\begin{cases}(\frac{1}{2}+\frac{1}{2}+\frac{1}{2})U_1-\frac{1}{2}U_2-\frac{1}{2}U_2=-\frac{1}{2}\times 2+1\\ U_2=0.5U_1+4\end{cases}\Rightarrow\begin{cases}U_1=4V\\ U_2=6V\end{cases}$

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

2）$U_{S(1)}=15\sqrt{2}\cos 1000t$ 单独作用下

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

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

三、$P=P_1+P_2=14kW$ $Q_2=P_2\cdot\tan\varphi_2=10\times\tan(\arccos 0.707)=10kV$

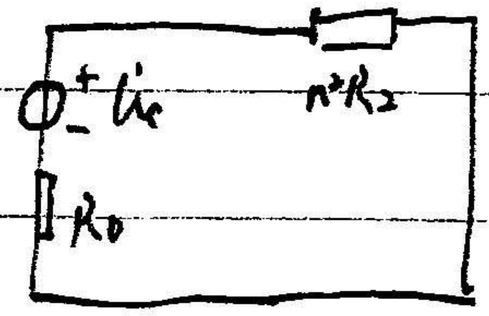
$\tilde{S}=(14+j10)(kVA)$ $\cos\varphi=\frac{P}{S}=0.81$

①并上电容后，P不变 $\cos\varphi'=0.95$ $S'=\frac{P}{\cos\varphi'}=14.74kVA$

又 $Q'=\sqrt{S'^2-P^2}$ 所以 $\Delta Q=Q-Q'=10-\sqrt{14.74^2-14^2}=\omega C U^2=2\pi fCU^2$

故 $C=368\mu F$

四、戴维南定理 $\Rightarrow$



$$R_0=\frac{20\times j20}{20+j20}+j10-j5n^2$$

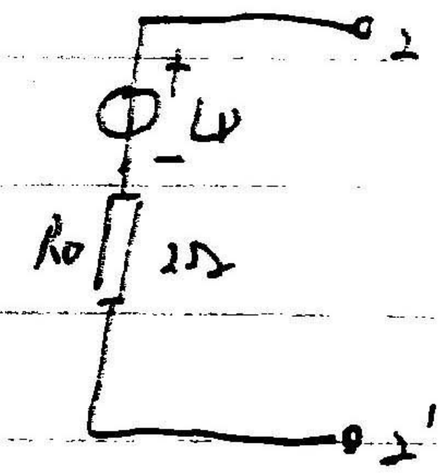
要获得最大功率，$R_0=n^2R_2\Rightarrow 10+j20-j5n^2=Rn^2\Rightarrow\begin{cases}30-5n^2=U\\ n^2R_L=10\end{cases}$

$\Rightarrow\begin{cases}n=2\\ R_L=2.5\Omega\end{cases}$

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

五解　用戴维宁定理　$\frac{U_{oc}}{8} = \frac{1}{I_{oc}} \Rightarrow U_{oc} = 40$　　求R_0：$\frac{I_{sc}}{8} = \frac{1}{4} \Rightarrow I_{oc} = 2A$

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



六解：流过R_L电流为$\dot{I}$，流过R_1的电流I_A'，$\dot{I}_C$如图所示

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 $\dot{I} = \frac{\dot{U}_{AC}}{2+2} = \frac{-32\angle 150^\circ}{32} = 10\angle -30^\circ A$

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

$\dot{I}_C = \dot{I}_C' - \dot{I} = 19.32\angle 135^\circ A$　　功率表读数 $P = Re[\dot{U}_{AC}\dot{I}_A^*] = 30\times 19.32\times\cos[30^\circ + (15^\circ)]$

$= 70.1W$

七、解：设1-1'端子电压为U_1，2-2'端子电压为U_2，

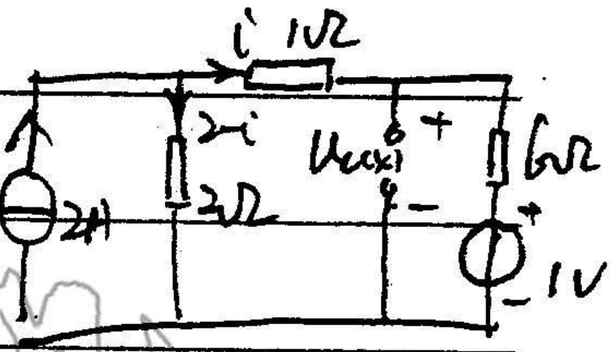
列KVL方程 $\begin{cases} U_1 = 2I_1 + I_1 + I_2 \\ U_2 = 2I_1 + 4I_2 + I_1 + I_2 \end{cases} \Rightarrow \begin{cases} U_1 = U_2 - 4I_2 \\ I_1 = \frac{1}{3}U_2 - \frac{5}{3}I_2 \end{cases}$

$\Rightarrow T$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 $u_C(0_+)=2\times2=4V$，其戴维南电阻 $R_0=3\Omega$，$\tau=R_0C=3s$

$u_C(t)=4-6e^{-\frac{1}{3}t}\varepsilon(t)\ (0\le t<3)$

当 $t\ge3$ 时，$u_C(3+)=u_C(3-)=4-4e^{-1}=2.5V$，电路如图所示



$1=-7i'+2(2-i')\Rightarrow i'=\frac{1}{3}A$，$u_{C(\infty)}=6i'+1=3V$

$R_0=3//6=2\Omega$，$\tau=2s$，故 $u_C(t)=3-0.5e^{-\frac{1}{2}t}\varepsilon(t)-2\varepsilon(t-3)$

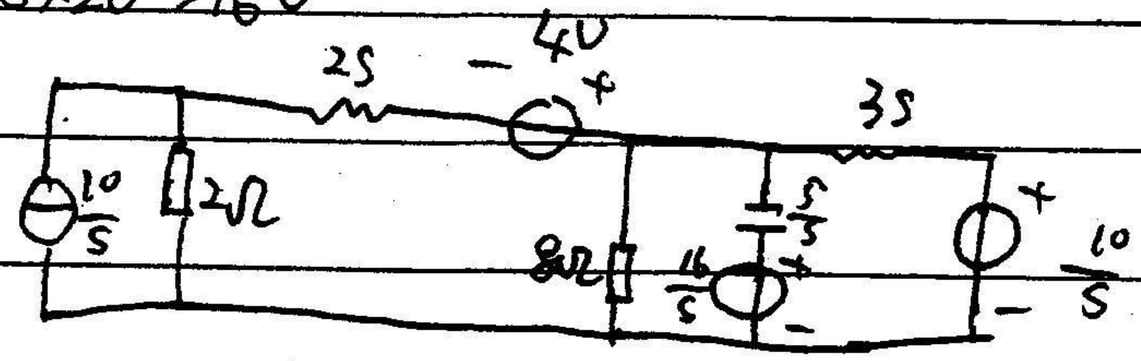
$$u_C(t)=\begin{cases}4-4e^{-\frac{1}{3}t} & 0\le t<3s\\ 3-0.5e^{-\frac{1}{2}(t-3)} & t\ge3s\end{cases}$$

$$u_R(t)=\begin{cases}0 & 0\le t<3s\\ 2-0.5e^{-\frac{1}{2}(t-3)} & t\ge3s\end{cases}$$

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

$u_C(0_-)=8\times2V=16V$

运算电路



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

（01全集）