

华东交通大学 2017 — 2018 学年第一学期考试卷

(B) 卷

课程名称: 电路原理II 考试时间: 120 分钟 考试方式: 闭卷

专业: 2016 级电气工程、自动化、建筑电气、电子信息、轨道交通信号。

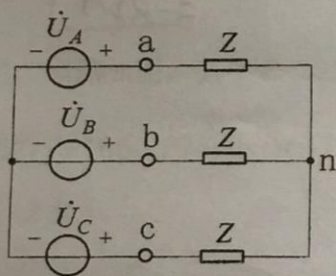
学生姓名: 学号: 教学班级: 教学小班序号:

题号	一	二	三	四	五	六	七	八	九	十	总分
得分											
阅卷人											

一、 计算题(每题 6 分, 共 30 分)

1. 对称三相电路, 已知相电压 $\dot{U}_m = 150\angle 0^\circ$, 写出线电压

$\dot{U}_{ab}$ 、 $\dot{U}_{ac}$ 。



$$\dot{U}_{ab} = 150\sqrt{3} \angle 30^\circ \text{ V} \quad 3'$$

$$\dot{U}_{ac} = 150\sqrt{3} \angle -30^\circ \text{ V} \quad 3'$$

得分	评阅人

2. 某支路上电流为 $i = 1 + \sqrt{2} \cos(\omega t - 10^\circ) + 2\sqrt{2} \cos(3\omega t)$ A、电压为

$u = 20 + 10 \cos(\omega t) + 10\sqrt{2} \cos(3\omega t) + 5 \cos(9\omega t)$ V, 求电流有效值、电压有效值和该支路消耗的功率。

$$I = \sqrt{1^2 + 1^2 + 2^2} = \sqrt{6} = 2.45 \quad 2'$$

$$U = \sqrt{20^2 + \left(\frac{10}{\sqrt{2}}\right)^2 + 10^2 + \left(\frac{5}{\sqrt{2}}\right)^2} = 23.72 \quad 2'$$

$$P = 1 \times 20 + 1 \times \frac{10}{\sqrt{2}} \times \cos 10^\circ + 2 \times 10 \times \cos 0^\circ = 46.96 \text{ W} \quad 2'$$

3. 已知某电压响应的象函数 $U(s) = \frac{1.5s+2}{s(s+1)(s+2)}$ V, 求对应此象函数的原函数 $u(t)$ 。

$$V(s) = \frac{K_1}{s} + \frac{K_2}{s+1} + \frac{K_3}{s+2}$$

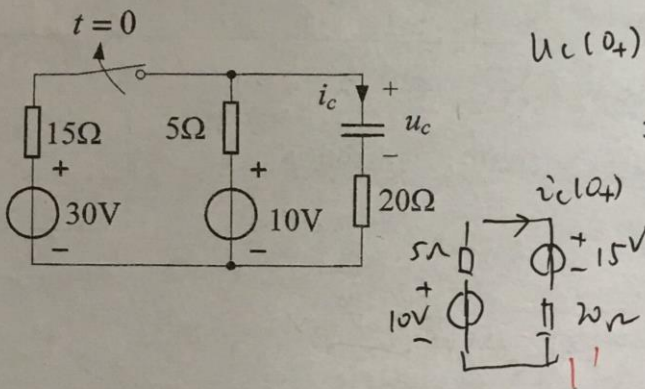
$$K_1 = 1$$

$$K_2 = -0.5$$

$$K_3 = -0.5$$

$$u(t) = \mathcal{L}^{-1}\{V(s)\} = 1 - 0.5e^{-t} - 0.5e^{-2t} \text{ V}$$

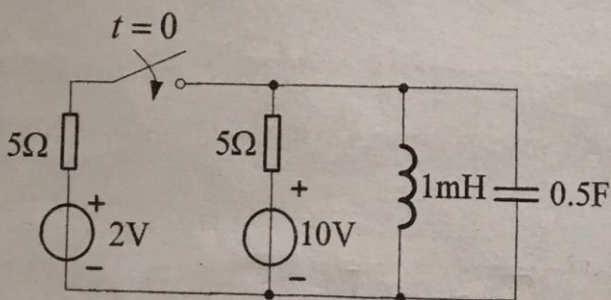
4. 电路原已稳态, $t=0$ 时开关打开, 求 $u_c(0_+)$ 、 $i_c(0_+)$ 。



$$u_c(0_+) = u_c(0_-) = 5 \times \frac{30-10}{15+5} + 10 = 15 \text{ V}$$

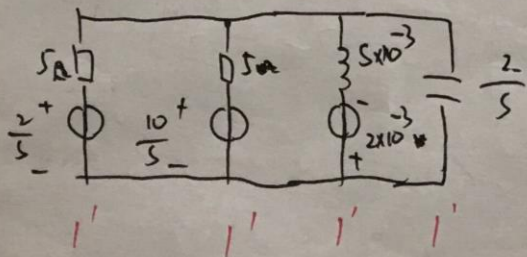
$$i_c'(0_+) = \frac{10-15}{5+20} = -0.2 \text{ A}$$

5. 电路原处于稳态, $t=0$ 时开关闭合, 画出开关闭合后的运算电路图。



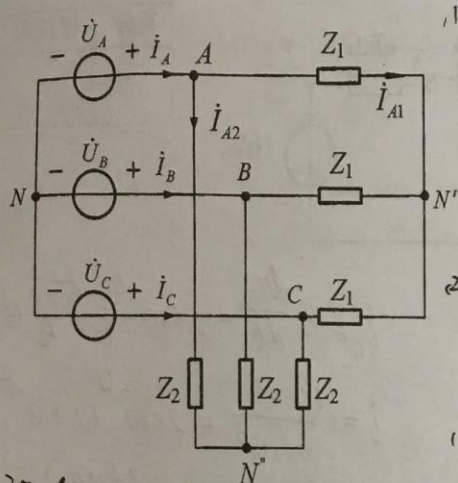
$$i_c(0_-) = \frac{10}{5} = 2 \text{ A}$$

$$u_c(0_-) = 0$$



二、已知对称三相电路，星形负载阻抗 $Z_1 = (10 + j10)\Omega$ ， $Z_2 = (4 + j3)\Omega$ ，电源线电压

$U_l = 380V$ 。求(1)电流 $\dot{I}_{A1}$ 、 $\dot{I}_{A2}$ 。(2)电流 $\dot{I}_A$ 。(3)电源发出的有功功率 P 。(16分)



$$\dot{I}_{A1} = \frac{\dot{U}_A}{Z_1} = \frac{220\angle 0^\circ}{10 + j10} = 15.56\angle -45^\circ \text{ A}$$

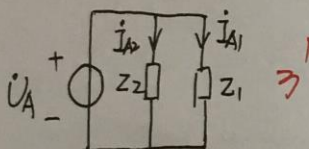
得分	评阅人

$$\dot{I}_{A2} = \frac{\dot{U}_A}{Z_2} = \frac{220\angle 0^\circ}{4 + j3} = 44\angle -36.87^\circ \text{ A}$$

$$\dot{I}_A = \dot{I}_{A1} + \dot{I}_{A2} = 15.56\angle -45^\circ + 44\angle -36.87^\circ = 59.44\angle -39^\circ$$

$$P = 3U_A I_A \cos \varphi = 3 \times 220 \times 59.44 \times \cos 39^\circ = 30487 \text{ W}$$

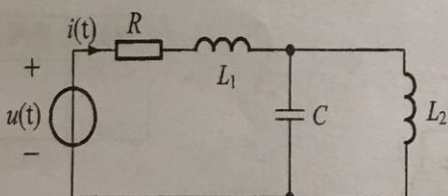
$$\text{设 } \dot{U}_A = 220\angle 0^\circ \text{ V}$$



三、电路如图，其中 $R = 20\Omega$ ， $\omega L_1 = 0.625\Omega$ ， $\omega L_2 = 5\Omega$ ， $\frac{1}{\omega C} = 45\Omega$ ，外加电压

$u(t) = 100 + 276\cos\omega t + 100\cos 3\omega t \text{ V}$ ，求电路中电流 $i(t)$ 和电阻吸收的平均功率。

(12分)

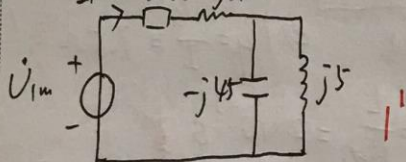


得分	评阅人

$$\textcircled{1} U_0 = 100 \text{ V 时, } C \text{ 开路, } L_1, L_2 \text{ 短路,}$$

$$I_0 = \frac{100}{20} = 5 \text{ A, } P_0 = I_0^2 R = 5^2 \times 20 = 500 \text{ W}$$

$$\textcircled{2} U_1 = 276\cos\omega t, \dot{U}_{1m} = 276\angle 0^\circ \text{ V}$$

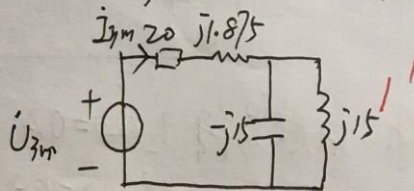


$$Z_{\Sigma} = 20 + j0.625 + (-j45) \parallel j5 = 20 - j5 = 20.6\angle -14^\circ \Omega$$

$$\dot{I}_{1m} = \frac{\dot{U}_{1m}}{Z_{\Sigma}} = \frac{276\angle 0^\circ}{20.6\angle -14^\circ} = 13.4\angle 14^\circ \text{ A}$$

$$P_1 = \frac{1}{2} I_{1m}^2 R = \frac{1}{2} \times 13.4^2 \times 20 = 1756.6 \text{ W}$$

$$\textcircled{3} U_3 = 100\cos 3\omega t, \dot{U}_{3m} = 100\angle 0^\circ \text{ V}$$

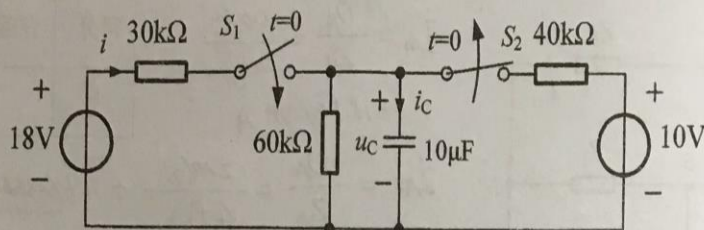


$$\textcircled{4} \text{ 发生并联谐振 } \therefore \dot{I}_{3m} = 0, P_3 = 0$$

$$\therefore i(t) = 5 + 13.4\cos(\omega t + 14^\circ) \text{ A}$$

$$P = 500 + 1756.6 + 0 = 2256.6 \text{ W}$$

电流 i_C 、电流 i 。(14分)



得分	评阅人

$$\text{Ans } u_{c(0-)} = \frac{60}{60+40} \times 10 = 6 \text{ V} \quad 2'$$

$$\therefore U_C(0_+) = U_C(0_-) = 6V.$$

$$U_C(\infty) = \frac{60}{30+60} \times 18 = 12 \text{ V}$$

$$R = 30 \parallel 60 = \frac{30 \times 60}{30 + 60} = 20 \text{ k}\Omega \quad 3'$$

$$\therefore \tau = RC = 20 \times 10^3 \times 10 \times 10^{-6} = 0.2 \text{ s}$$

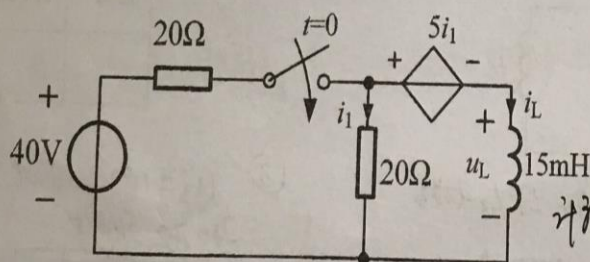
$$\therefore u_c = u_c(\infty) + [u_c(0_+) - u_c(\infty)] e^{-\frac{t}{\tau}} \quad \text{v. } (t \geq 0)$$

$$i_c = C \frac{du_c}{dt} = 3 \times 10^{-4} e^{-5t} \text{ A (t} \geq 0)$$

$$i = \frac{18 - 11.6}{30 \times 10^{-3}} = 2 \times 10^{-4} (1 + e^{-5t}) \text{ A}$$

(t ≥ 0) 1'

(14 分)

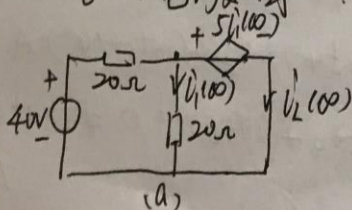


得分	评阅人

解 由题易得 $i_2(0_-) = 0 \text{ A}$ 2'

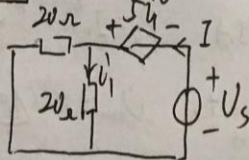
$$\therefore i_L(0_+) = i_L(0_-) = 0 \text{ A}$$

$t \rightarrow \infty$ 电压为 mV (a)



$$20 \text{ l}_1(100) = 5 \text{ l}_1(100)$$

$$\therefore b_1(100) = 0, \quad \therefore b_2(100) = \frac{40}{20} = 2A \quad 3'$$



$$\left. \begin{aligned} u_s &= -5\dot{v}_1 + 20\dot{v}_1 \\ I &= \dot{v}_1 + \frac{20\dot{v}_1}{20} = 2\dot{v}_1 \end{aligned} \right\}$$

(b) $\Rightarrow R_{eq} = \frac{U_s}{I} = 7.5 \Omega$ 3'

$$\therefore T = \frac{L}{R_{eq}} = 2 \times 10^{-3} \text{ s}$$

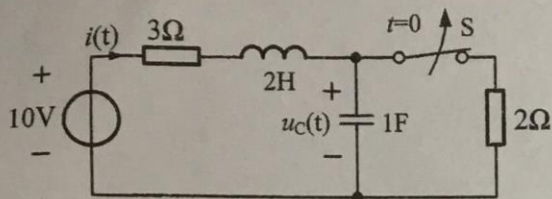
$$i. l_1 = l_1(\infty) + [l_1(0) - l_1(\infty)] e^{-\frac{t}{\tau}}$$

$$= 2(1 - e^{-500t}) A \quad (t \geq 0)$$

$$u_L = L \frac{di_L}{dt} = 15 e^{-500t} \text{ V. } (t \geq 0)_{2'}$$

六、电路原处于稳态，若开关 S 在 $t=0$ 时打开，用运算法求 $t>0$ 时的 $i(t)$ 、 $u_c(t)$ 。(14 分)

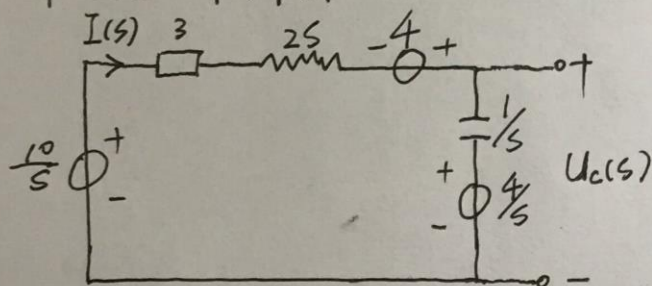
得分	评阅人



解： $t < 0$ 时，开关闭合，电路已达稳态

$$i_L(0^-) = 2A, \quad u_C(0^-) = 4V \quad \dots\dots 2'$$

运算电路如下所示



由 KVL 可知

$$I(s) \cdot (3 + 2s + \frac{1}{s}) = \frac{10}{s} + 4 - \frac{4}{s}$$

$$\Rightarrow I(s) = \frac{4s+6}{2s^2+3s+1} \quad \dots\dots 1'$$

$$\text{则 } u_C(s) = I(s) \cdot \frac{1}{s} + \frac{4}{s} = \frac{4s+6}{s(2s^2+3s+1)} + \frac{4}{s} = \frac{8s^2+16s+10}{s(2s^2+3s+1)} \quad \dots\dots 1'$$

由部分分式法

$$I(s) = \frac{4s+6}{2s^2+3s+1} = \frac{4s+6}{(2s+1)(s+1)} = \frac{8}{2s+1} + \frac{-2}{s+1} \quad \dots\dots 2'$$

$$\text{则由拉氏反变换 } i(t) = (4e^{-\frac{1}{2}t} - 2e^{-t}) \cdot \varepsilon(t) \quad \dots\dots 1'$$

$$u_C(s) = \frac{8s^2+16s+10}{s(2s^2+3s+1)} = \frac{8s^2+16s+10}{s(2s+1)(s+1)} = \frac{10}{s} + \frac{-16}{2s+1} + \frac{2}{s+1} \quad \dots\dots 2'$$

$$\text{则由拉氏反变换 } u_C(t) = (10 - 8e^{-\frac{1}{2}t} + 2e^{-t}) \cdot \varepsilon(t) \quad \dots\dots 1'$$