

华东交通大学 2021—2022 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 2021.12.24

学生姓名: _____ 学号: _____ 教学班级: _____ 教学小班序号: _____

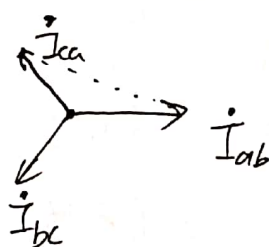
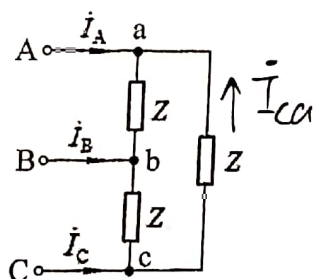
题号	一	二	三	四	五	六	七	八	九	十	总分
得分											
阅卷人											

一、计算下列各小题(每小题 6 分, 共 36 分)

得分

1. 对称三相电路, 负载三角形连接, 已知 $i_{ca} = 10\angle 60^\circ \text{ A}$, 写

出线电流 i_A 、 i_B 、 i_C .



$$i_{ab} = 10\angle -60^\circ \text{ A}$$

$$\therefore i_A = \sqrt{3} i_{ab} \angle -30^\circ$$

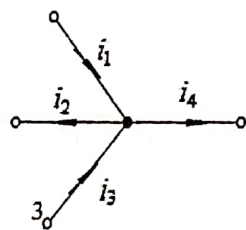
$$= 10\sqrt{3} \angle -90^\circ \text{ A}$$

$$\therefore i_B = 10\sqrt{3} \angle -210^\circ = 10\sqrt{3} \angle 150^\circ \text{ A}$$

$$i_C = 10\sqrt{3} \angle 30^\circ \text{ A}$$

2. 已知 $i_1 = 10 \text{ A}$, $i_2 = 8\sqrt{2} \cos t \text{ A}$, $i_3 = 6\sqrt{2} \cos(2t + 20^\circ) \text{ A}$, 求电流 i_4 及其有效值 I_4 .

值 I_4 .



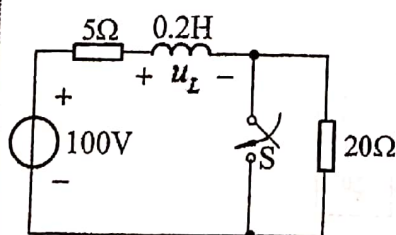
$$\text{KCL: } -i_1 + i_2 - i_3 + i_4 = 0$$

$$\Rightarrow i_4 = i_1 - i_2 + i_3 = 10 - 8\sqrt{2} \cos t + 6\sqrt{2} \cos(2t + 20^\circ)$$

$$\Rightarrow \cancel{i_1} = \cancel{i_2} + \cancel{i_3} \quad \therefore I_4 = \sqrt{10^2 + \left(\frac{8\sqrt{2}}{\sqrt{2}}\right)^2 + \left(\frac{6\sqrt{2}}{\sqrt{2}}\right)^2}$$

$$= 14.14 \text{ A}$$

3. 电路原已稳态, $t=0$ 时开关闭合, 计算 $u_L(0_+)$.

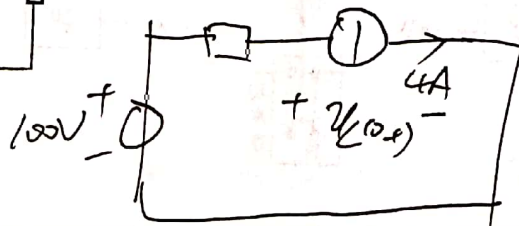


$$i_L(0_-) = \frac{100}{5+20} = 4 \text{ A}$$

$$i_L(0_+) = i_L(0_-) = 4 \text{ A}$$

$$4 \times 5 + u_L(0_+) = 100$$

$$\Rightarrow u_L(0_+) = 80 \text{ V}$$



4. 已知某象函数 $F(s) = \frac{s+3}{s^2+6s+8}$, 求其原函数 $f(t)$ 。

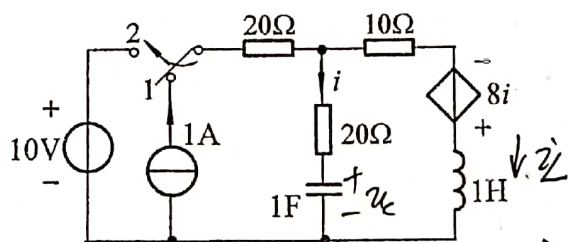
解: $s^2+6s+8 = (s+2)(s+4) \Rightarrow$
 $\Rightarrow p_1 = -2, p_2 = -4$

$$K_1 = (s+2) \frac{s+3}{(s+2)(s+4)} \Big|_{s=-2} = \frac{-2+3}{-2+4} = \frac{1}{2}$$

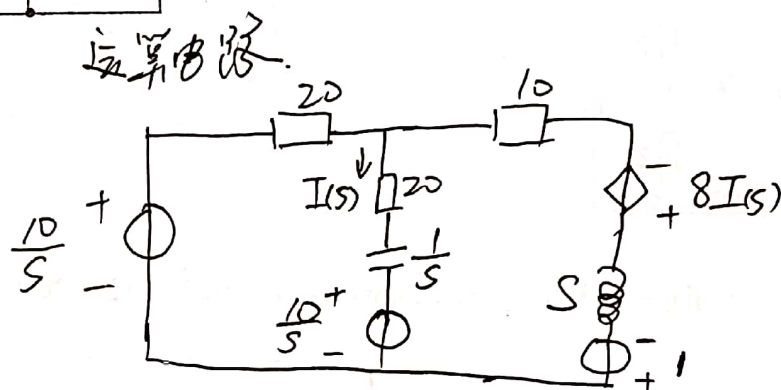
$$K_2 = (s+4) \frac{s+3}{(s+2)(s+4)} \Big|_{s=-4} = \frac{-4+3}{-4+2} = -\frac{1}{2}$$

$$\therefore f(t) = K_1 e^{p_1 t} + K_2 e^{p_2 t} = \frac{1}{2} e^{-2t} - \frac{1}{2} e^{-4t}$$

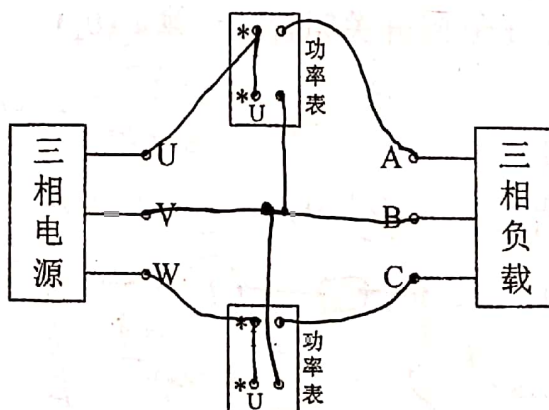
5. 电路在位置 1 时处于稳态, $t=0$ 时由位置 1 合向位置 2, 画出开关在位置 2 的运算电路。



解: S 在 1:
 $i=0,$
 $i_L(0-) = 1A.$
 $u_c(0-) = 10V.$



6. 已知对称三相电源、三相负载和功率表如图所示, 请画出用两表法测量三相负载有功功率的接线图。



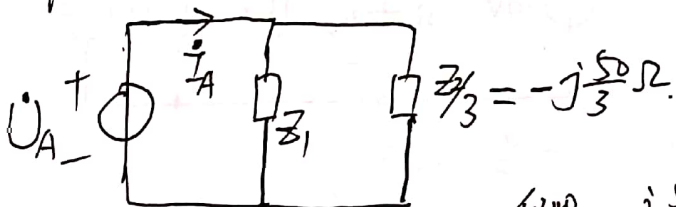
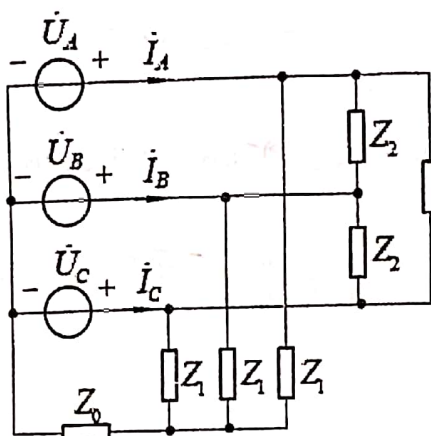
二、对称三相电路如图，已知电源线电压有效值为 380V，

$Z_1 = 10 \angle 53.1^\circ \Omega$, $Z_2 = -j50 \Omega$, $Z_0 = 1 + j2 \Omega$ 。试求

得分

(1) 线电流 I_A 、 I_B 和 I_C ；(2) 三相负载吸收的总功率 (14 分)

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



$$Z_{eq} = Z_1 // \frac{Z_3}{3} = \frac{10 \angle 53.1^\circ \cdot -j\frac{50}{3}}{10 \angle 53.1^\circ - j\frac{50}{3}} = 15.8 \angle -18.4^\circ \Omega$$

$$\begin{aligned} I_B &= I_A \angle -120^\circ \\ &= 13.9 \angle -138.4^\circ \text{ A} \end{aligned}$$

$$\begin{aligned} I_C &= I_A \angle 120^\circ \\ &= 15.8 \angle 101.6^\circ \text{ A} \end{aligned}$$

$$I_A = \frac{U_A}{Z_{eq}} = 13.9 \angle -18.4^\circ \text{ A}$$

$$P = 3 U_A I_A \cos \varphi = 3 \times 220 \times 13.9 \times \cos(-18.4^\circ)$$

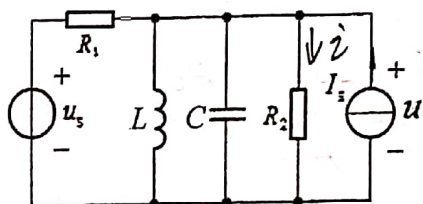
$$\varphi = \varphi_{U_A} - \varphi_{I_A} = 0 - (-18.4^\circ) = 18.4^\circ$$

$$= 8704.99 \text{ W} \approx 8705 \text{ W}$$

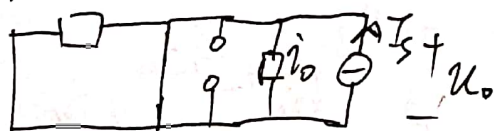
三、电路如图，已知： $R_1 = R_2 = 100 \Omega$, $\omega_1 L = \frac{1}{\omega_1 C} = 50 \Omega$, $I_s = 4 \text{ A}$,

得分

$u_s = 400 \cos \omega_1 t + 200 \cos 3\omega_1 t \text{ V}$ 。求响应 u 及 R_2 吸收的平均功率。(12 分)



解： I_s 单独作用。



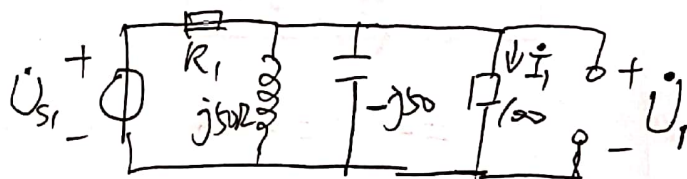
$$u_0 = 0$$

$$i_0 = 0$$

$$p_0 = 0$$

$$u_{s1} = 400 \cos \omega_1 t \text{ V}$$

$$\dot{U}_{s1} = \frac{400}{\sqrt{2}} \angle 0^\circ \text{ V}$$



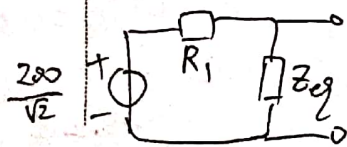
LC 并联谐振。

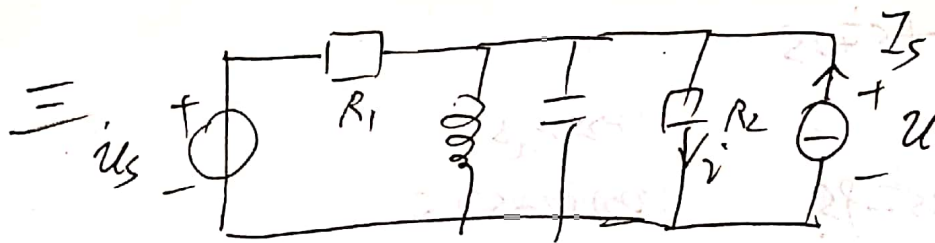
$$\therefore \dot{U}_1 = \frac{1}{2} \dot{U}_{s1}, i_1 = \sqrt{2} \text{ A}$$

$$\Rightarrow u_1(t) = 200 \cos(\omega_1 t) \text{ V}$$

$$P_1 = I_1^2 \cdot R_2 = 2 \times 100 = 200 \text{ W}$$

$$u_{s3} = 200 \cos 3\omega_1 t \text{ V}$$

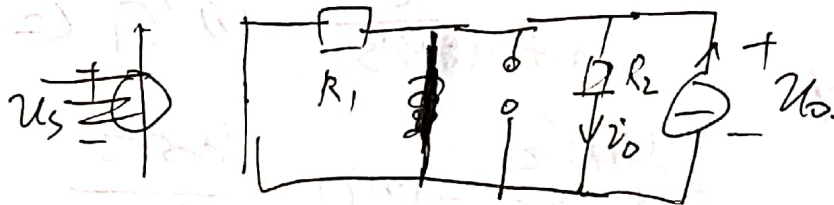




$$\Rightarrow u = u_0 + u_1 + u_3$$

$$= 200 \cos \omega t + 35.11 \cos(3\omega t - 69.44^\circ)$$

1°. $I_s = 4A$ 单独作用。

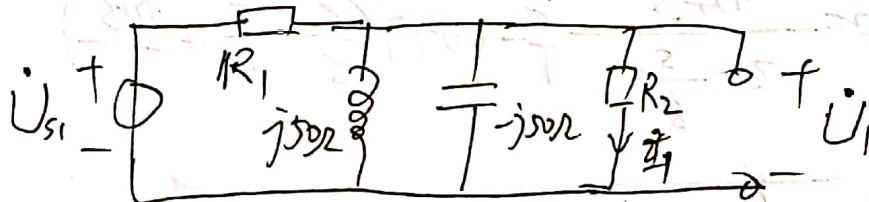


$$P = P_0 + P_1 + P_2$$

$$= 206.17W$$

$$\Rightarrow i_0 = 0, u_0 = 0, P_0 = 0$$

2°. $u_{s1} = 400 \cos \omega t$ 单独作用, $\dot{U}_{s1} = \frac{400}{\sqrt{2}} \angle 0^\circ = 200\sqrt{2} \angle 0^\circ V$



LC 并联谐振:

$$\dot{I}_1 = \dot{U}_{s1} / (R_1) = \frac{200\sqrt{2} \angle 0^\circ}{200} = \sqrt{2} \angle 0^\circ A; P_1 = 2 \times 100 = 200W$$

$$\Rightarrow i_1(t) = 2 \cos \omega t A$$

$$\dot{U}_1 = \frac{1}{2} \dot{U}_{s1} = 100\sqrt{2} \angle 0^\circ V \Rightarrow u_1(t) = 200 \cos \omega t V$$

3°. $u_{s3} = 200 \cos(3\omega t)$ 单独作用, $\dot{U}_{s3} = 100\sqrt{2} \angle 0^\circ V$



$$\Rightarrow \dot{I}_3 \rightarrow R_1$$

$$\dot{U}_{s3}$$

$$Z_{eq} = j150 // (-j\frac{50}{3}) // 100$$

$$= 3.4 - j18.11$$

$$= 18.43 \angle -79.37^\circ$$

$$\dot{I}_3 = \frac{100\sqrt{2} \angle 0^\circ}{13.4 - j18.11} = \frac{100\sqrt{2} \angle 0^\circ}{22.49 \angle -53.93^\circ}$$

$$= 1.35 \angle 53.93^\circ A$$

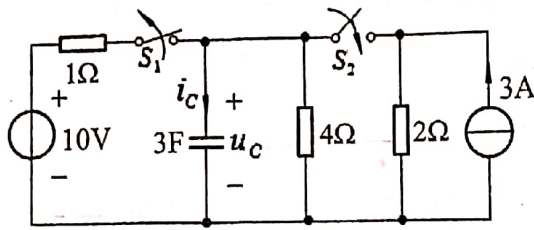
$$\dot{U}_3 = \dot{I}_3 \cdot Z_{eq} = 24.83 \angle -69.44^\circ V$$

$$P_2 = \frac{U_3^2}{R_2} = 6.17W$$



四、图示电路中，开关动作前， S_1 闭合， S_2 打开，电路处于稳态。 $t=0$ 时两开关动作，试求 $t>0$ 时的 u_C 和 i_C 。(12 分)

得分

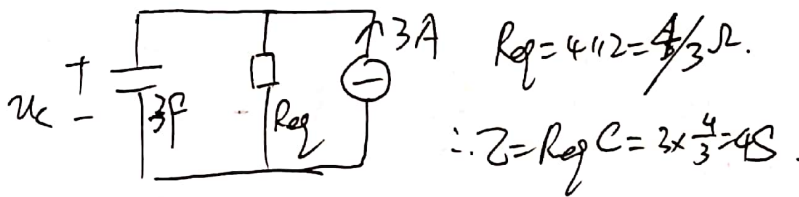


$$u_C(\infty) = 3R_{eq} = 4V$$

$$\therefore u_C(t) = u_C(\infty) + [u_C(0_+) - u_C(\infty)]e^{-t/\tau}$$

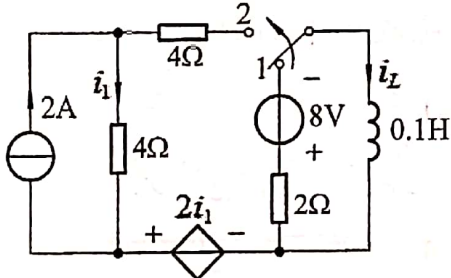
$$= 4 + 4e^{-\frac{1}{4}t} \text{ (V), } t \geq 0$$

解: $u_C(0_-) = \frac{4}{5} \times 10 = 8V$
 $\therefore u_C(0_+) = u_C(0_-) = 8V$



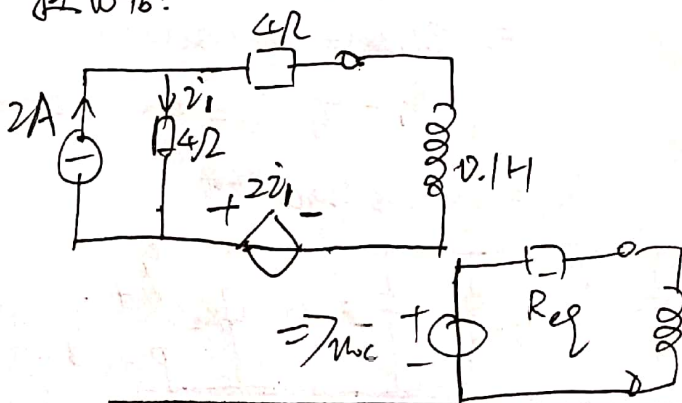
五、图示电路中，开关合在 1 时已达稳定状态。 $t=0$ 时开关由 1 合向 2，求 $t>0$ 时的电流 i_L 和 i_1 。(12 分)

得分



解: $i_L(0_-) = -\frac{8}{2} = -4A$
 $\therefore i_L(0_+) = i_L(0_-) = -4A$

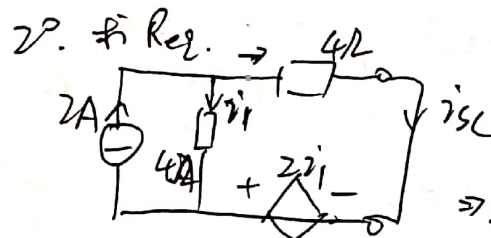
换源后:



1° 求 u_{oc} .

$$u_{oc} = 4i_1 + 2i_1 = 6i_1$$

$$= 6 \times 2 = 12V$$



$$\Rightarrow i_1 = 2 - i_{sc}$$

$$4i_1 = 4i_{sc} - 2i_1$$

$$\Rightarrow i_{sc} = 1.2A$$

$$\therefore R_{eq} = \frac{u_{oc}}{i_{sc}} = 10\Omega$$

$$\therefore \tau = \frac{L}{R_{eq}} = 0.01s$$

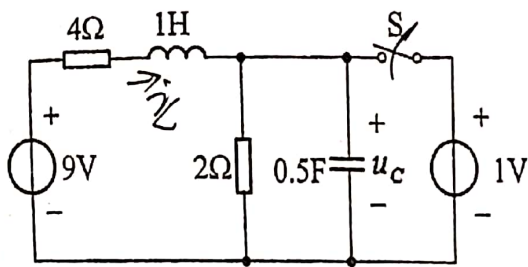
$$\Rightarrow i_L(t) = i_L(\infty) + [i_L(0_+) - i_L(\infty)]e^{-t/\tau}$$

$$= 1.2 - 5.2e^{-100t} A$$

$$i_1(t) = 2 - i_L = 0.8 + 5.2e^{-100t} A \text{ (} t \geq 0 \text{)}$$



六、电路已处于稳态， $t=0$ 时开关 S 打开，试求电压 u_c 。（14 分）

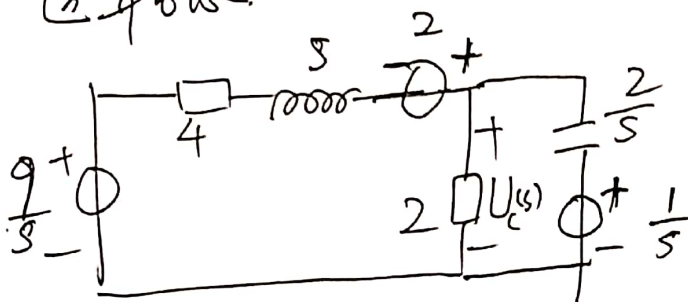


得分

解: $u_c(0^-) = 1V$.

$$i_L(0^-) = \frac{9-1}{4} = 2A$$

运算电路



列方程:

$$\left(\frac{1}{s+4} + \frac{1}{2} + \frac{s}{2}\right) U_c(s) - \frac{\frac{9}{s} + 2}{s+4} - \frac{1/s}{2/s} = 0$$

$$\Rightarrow \left(\frac{1}{s+4} + \frac{s+1}{2}\right) U_c(s) - \frac{9+2s}{s(s+4)} - \frac{1}{2} = 0$$

$$\Rightarrow U_c(s) = \frac{s^2 + 8s + 18}{s(s+2)(s+3)}$$

$$= \frac{3}{s} - \frac{3}{s+2} + \frac{1}{s+3}$$

$$\therefore u_c(t) = \mathcal{L}^{-1}[U_c(s)]$$

$$= 3(1 - e^{-2t} + \frac{1}{3}e^{-3t})\epsilon(t)$$

