

华东交通大学 2019 —2020 学年第 一 学期考试卷

(A) 卷

课程名称: 电路原理 II 考试时间: 120 分钟 考试方式: 闭卷 2019.12.18

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	36	12	12	14	14	12					
阅卷人											

一、 计算题(每题 6 分, 共 36 分)

得分

1、对称三相负载 Y 型连接时, 已知负载相电压 $\dot{U}_B = 10\angle 30^\circ \text{V}$, 求

负载线电压 $\dot{U}_{AB}, \dot{U}_{CB}, \dot{U}_{AC}$ 。

解: $\because \dot{U}_B = 10\angle 30^\circ \text{V}$

$\therefore \dot{U}_{BC} = \sqrt{3}\dot{U}_B\angle 30^\circ = 10\sqrt{3}\angle 60^\circ \text{V}$

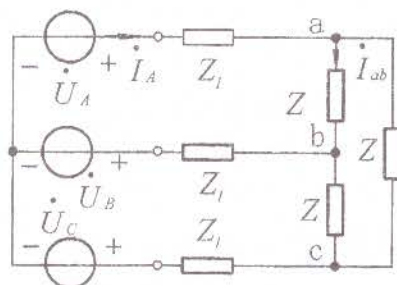
$\therefore \dot{U}_{AB} = 10\sqrt{3}\angle 180^\circ \text{V}$

$\dot{U}_{CB} = -\dot{U}_{BC} = 10\sqrt{3}\angle -120^\circ \text{V}$

$\dot{U}_{AC} = -\dot{U}_{CA} = 10\sqrt{3}\angle 120^\circ \text{V}$

2、对称三相电路中, 已知负载各相阻抗为 $Z = (8 - j6)\Omega$, 线路阻抗为 $Z_l = j2\Omega$,

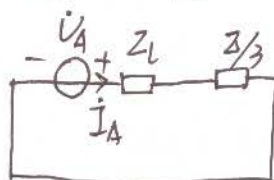
电源线电压为 380V。求电源侧电流有效值 I_A 以及负载侧相电流有效值 I_{ab} 。



$\therefore I_A = 82.5 \text{ A}$

$I_{ab} = \frac{I_A}{\sqrt{3}} = 47.63 \text{ A}$

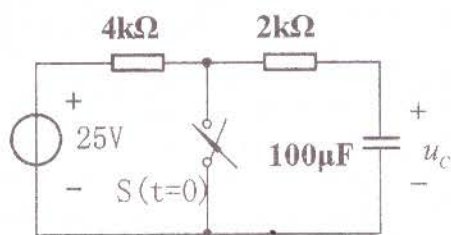
设 $\dot{U}_A = 220\angle 0^\circ \text{V}$



$\dot{I}_A = \frac{\dot{U}_A}{Z_l + \frac{Z}{3}}$

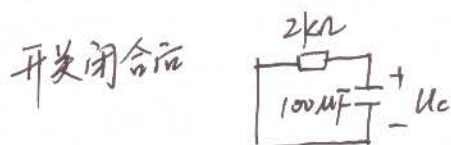
$= \frac{220\angle 0^\circ}{j2 + \frac{8-j6}{3}} = 82.5\angle 0^\circ \text{ A}$

3. 电路如图所示, 开关 S 闭合前电路已处于稳定状态。t=0 时开关 S 闭合, 求 S 闭合后的 $u_c(t)$ 。



$$\begin{aligned} \therefore u_c(t) &= u_c(0+)e^{-\frac{t}{\tau}} \\ &= 25e^{-\frac{t}{0.2}} \\ &= 25e^{-5t} \text{ V } (t > 0) \end{aligned}$$

解: $u_c(0+) = u_c(0-) = 25\text{V}$



$\therefore u_c(t)$ 为零输入响应

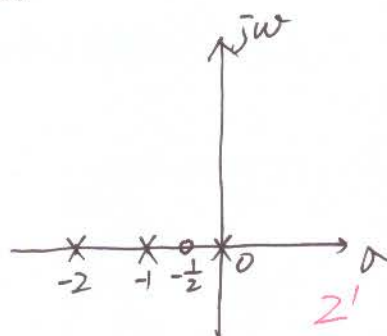
$$\begin{aligned} \tau &= RC = 2 \times 10^3 \times 100 \times 10^{-6} \\ &= 0.2\text{s} \end{aligned}$$

4. 某一端口网络函数 $H(s) = \frac{4s+2}{s^3+3s^2+2s}$, 求零点、极点, 并绘出零、极点图。

解: $H(s) = \frac{4s+2}{s(s+1)(s+2)}$

零点: $z = -\frac{1}{2}$

极点: $p_1=0, p_2=-1, p_3=-2$



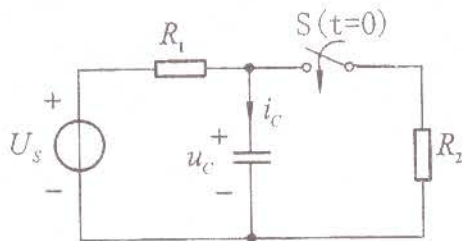
5. 已知某电路在 5 次谐波分量输入下的阻抗 $X_{L5} = 10\Omega$, 容抗 $X_{C5} = 3\Omega$, 求对应此电路在 2 次和 4 次谐波分量输入下的感抗、容抗 $X_{L2}, X_{L4}, X_{C2}, X_{C4}$ 。

$$\therefore \begin{cases} X_{L5} = 5\omega L = 10\Omega \\ X_{C5} = \frac{1}{5\omega C} = 3\Omega \end{cases}$$

$$\therefore \begin{cases} \omega L = 2\Omega \\ \frac{1}{\omega C} = 15\Omega \end{cases}$$

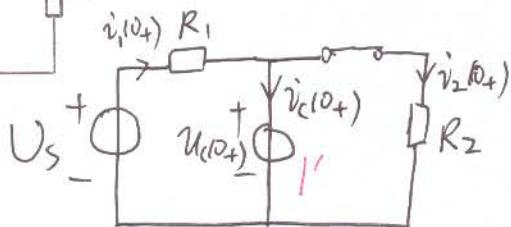
$$\therefore \begin{cases} X_{L2} = 2\omega L = 4\Omega \\ X_{L4} = 4\omega L = 8\Omega \\ X_{C2} = \frac{1}{2\omega C} = 7.5\Omega \\ X_{C4} = \frac{1}{4\omega C} = 3.75\Omega \end{cases}$$

6. 求图示电路中的 $u_C(0_+)$, $i_C(0_+)$ 。 解: 由题知: $u_C(0_-) = U_S$



换路后: $u_C(0_+) = u_C(0_-) = U_S$ 2'

0+ 等效电路:



由图:

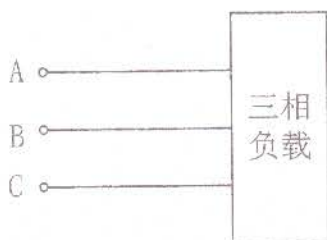
$$i_C(0_+) = i_1(0_+) - i_2(0_+)$$

$$i_1(0_+) = \frac{U_S - u_C(0_+)}{R_1} = 0$$

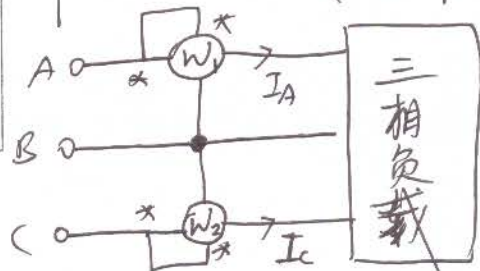
$$i_2(0_+) = \frac{u_C(0_+)}{R_2} = \frac{U_S}{R_2}$$

$$\therefore i_C(0_+) = -\frac{U_S}{R_2}$$

二、如图所示电路中, 已知对称三相电源的线电压为 380V, 对称三相负载吸收的有功功率为 2.5kW, 功率因数为 $\cos\varphi = 0.866$ (滞后)。现在要用两表法测量三相负载的功率, 且要求将功率表接入 A、C 两相。请说明负载是感性还是容性? 画出功率表的接线图, 并求两块表的读数。(12 分)



解: 滞后 $\Rightarrow$ 负载为感性, 2'



得分

功率表只要有 4 接法 对即可得 2 分。

B 相对为公共端, 1 分。

只是 B 公共端, 功率表接法 不对不得分。

负载总的功率: $P = \sqrt{3} U_{AB} I_A \cos\varphi$ 2'

由 $\cos\varphi = 0.866 \Rightarrow \varphi = 30^\circ$

W_1 的读数: $P_1 = U_{AB} I_A \cos(30^\circ + \varphi)$ 1'

W_2 的读数: $P_2 = U_{CB} I_C \cos(30^\circ - \varphi)$ 1'

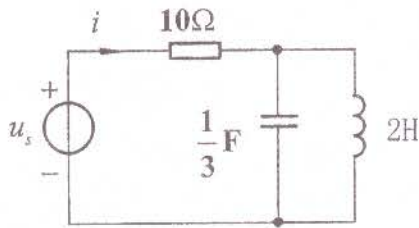
得: $P_1 = \frac{1}{3} P = 833.33 \text{ W}$

$P_2 = P - P_1 = \frac{2}{3} P = 1666.67 \text{ W}$

如果公共端错了, 扣一分; 最终结果对扣一分; 若结果(两)都错, 扣 3 分。

三、电路如图所示，已知 $u_s(t) = [10 + 5\sqrt{2} \cos(\omega t) + 2\sqrt{2} \cos(3\omega t)]V$ ，求电流 $i(t)$ 、其有效值 I 及电路的平均功率。（12 分） $\omega = 1 \text{ rad/s}$

得分	
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$$u_{s(0)} = 10V$$

$$i_{(0)} = 1A$$

$$u_{s(1)} = 5\sqrt{2} \cos \omega t V$$

$$I_{(1)} = \frac{5 \angle 0^\circ}{10 + j6} = 0.43 \angle -31^\circ A$$

$$u_{s(3)} = 2\sqrt{2} \cos 3\omega t V$$

$$I_{(3)} = \frac{2 \angle 0^\circ}{10 - j12} = 0.2 \angle 6.84^\circ A$$

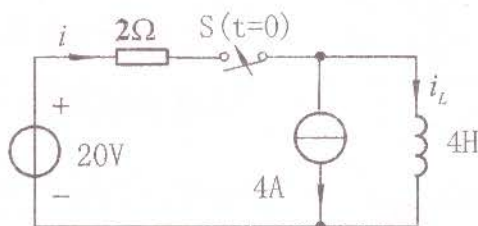
$$i = 1 + 0.43\sqrt{2} \cos(\omega t - 31^\circ) + 0.2\sqrt{2} \cos(\omega t + 6.84^\circ) A$$

$$I = \sqrt{1 + 0.43^2 + 0.2^2} = 1.1 A$$

$$P = U_0 I_0 + U_{(1)} I_{(1)} \cos \varphi_1 + U_{(3)} I_{(3)} \cos \varphi_3 = 12.25 W$$

四、图示电路中，求开关 S 闭合后的电流 i_L 和 i 。（14 分）

得分	
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$$i_L(0+) = i_L(0-) = -4 A$$

$$i_L(\infty) = 6 A$$

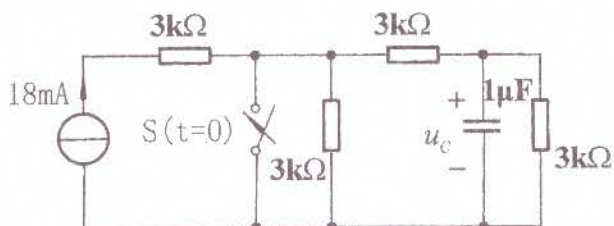
$$\tau = 2 s$$

$$i_L = 6 - 10e^{-\frac{t}{2}} A \quad t \geq 0$$

$$i = 10 - 10e^{-\frac{t}{2}} A \quad t \geq 0$$

五、电路如图所示，开关 S 闭合前电路已处于稳定状态， $t=0$ 时开关 S 闭合，求 S 闭合后的 $u_c(t)$ 。(14 分)

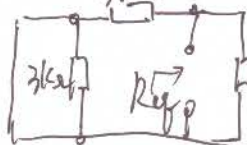
得分



解 由题易得 $u_c(0^-) = 3 \times 10^3 \times \frac{3}{3 + (3+3)} \times 18 \times 10^{-3} = 18V$.

$\therefore u_c(0^+) = u_c(0^-) = 18V$. $\therefore \tau = R_{eq}C = 1.5 \times 10^{-3} s$

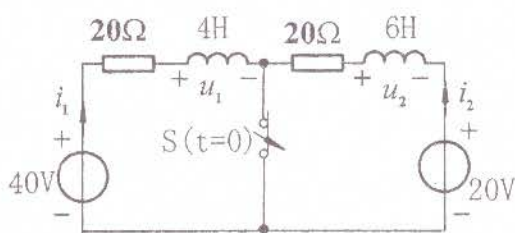
$t \rightarrow \infty$ 时，易得 $u_c(\infty) = 0V$. $\therefore u_c = u_c(\infty) + [u_c(0^+) - u_c(\infty)]e^{-\frac{t}{\tau}}$
 $= 18e^{-\frac{2 \times 10^3 t}{3}} V. (t \geq 0)$



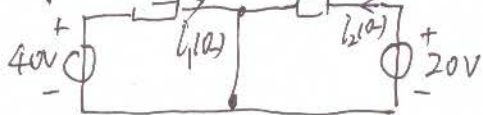
$$R_{eq} = 3 \parallel 3 = 1.5 k\Omega$$

六、图示电路中，开关断开前处于稳态。求开关断开后的 i_1, u_1, u_2 。(12 分)

得分



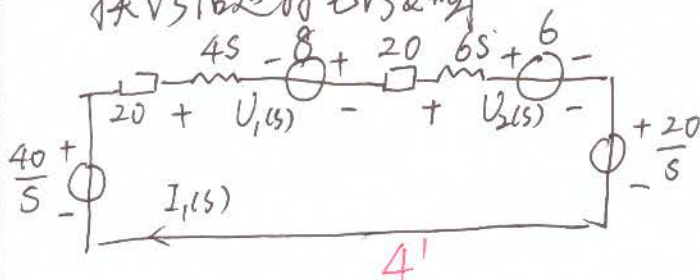
解 $t=0^-$ 时故电路如图



$$i_1(0^-) = \frac{40}{20} = 2A$$

$$i_2(0^-) = \frac{20}{20} = 1A$$

换路后运行电路如图



$$I_1(s) = \frac{\frac{40}{s} + 8 - 6 - \frac{20}{s}}{20 + 4s + 20 + 6s} = \frac{s + 10}{5s(s + 4)}$$

$$= \frac{k_1}{s} + \frac{k_2}{s + 4}$$

$$k_1 = \frac{s + 10}{5(s + 4)} \Big|_{s=0} = \frac{1}{2}, \quad k_2 = \frac{s + 10}{5s} \Big|_{s=-4} = \frac{-3}{10}$$

$$\therefore i_1 = \mathcal{L}^{-1}[I_1(s)] = \frac{1}{2} - \frac{3}{10}e^{-4t} A. (t \geq 0)$$

$$U_1(s) = 4sI_1(s) - 8 = 4.8 \times \frac{1}{s + 4} - 7.2$$

$$\therefore u_1 = \mathcal{L}^{-1}[U_1(s)] = 4.8e^{-4t} - 7.2\delta(t) (t \geq 0)$$

$$U_2(s) = 6sI_1(s) + 6 = 7.2 \times \frac{1}{s + 4} + 7.2$$

$$\therefore u_2 = \mathcal{L}^{-1}[U_2(s)] = 7.2e^{-4t} + 7.2\delta(t) (t \geq 0)$$