

第十四章作业

[14-9]

解: 1)

$$\frac{1}{Z_0} = j\omega_0 C + \frac{1}{R + j\omega_0 L} = \frac{R}{R^2 + \omega_0^2 L^2} + j[\omega_0 C - \frac{\omega_0 L}{R^2 + \omega_0^2 L^2}]$$

$$= G' + j(B_C - B_L')$$

$$Q = \frac{B_L}{G} = \frac{\omega_0 L}{R} = 100 \Rightarrow \omega_0 L = 100R$$

$$\text{又 } \frac{1}{Z_0} = G' = \frac{R}{R^2 + (\omega_0 L)^2} \leq 10^{-5} = \frac{R}{R^2 + 10000R^2}$$

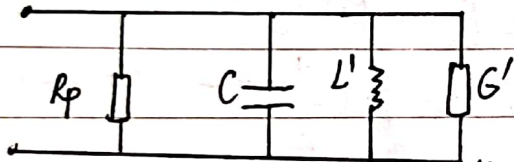
$$\Rightarrow R = \frac{10^5}{10001} = 10\Omega$$

$$\Rightarrow B_C - B_L' = 0 \Rightarrow \omega_0 C = \frac{\omega_0 L}{R^2 + \omega_0^2 L^2} = \frac{100}{10001R}$$

$$\Rightarrow C = \frac{10}{100 \times 2\pi \times 10^5} = 1.59\text{ nF}$$

$$L = \frac{100R}{\omega_0} = \frac{1000}{2\pi \times 10^5} = 1.59\text{ mH}$$

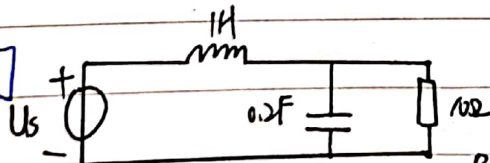
2)



$$Q' = \frac{B_C}{G + G_P} = \frac{\omega_0 C}{\frac{R}{R^2 + \omega_0^2 L'^2} + \frac{1}{R_P}} = \frac{100}{\frac{1}{10001R} + \frac{1}{20000R}}$$

$$= 66.7$$

[14-10]



$$Z_{eq} = j\omega L + \frac{1}{j\omega C} + \frac{1}{R} = j\omega L + \frac{1}{1 + j\omega CR}$$

$$= \frac{R}{1 + (\omega CR)^2} + j[\omega L - \frac{\omega CR^2}{1 + (\omega CR)^2}]$$

$$\text{谐振时, } \text{Im}(Z_{eq}) = 0 \Rightarrow \omega_0 L = \frac{\omega_0 CR^2}{1 + (\omega_0 CR)^2}$$

$$\Rightarrow \omega_0 = \frac{\sqrt{CR^2 - 1}}{CR} = 2.18\text{ rad/s}$$

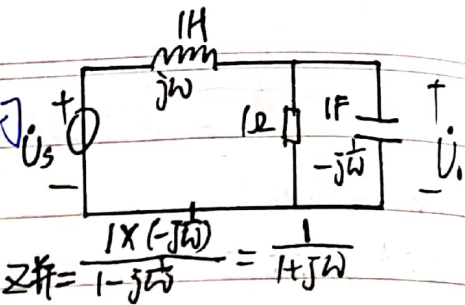
$$Q = \frac{\omega_0 C}{G} = 4.36$$

$$U_C = \sqrt{U_L^2 + U_S^2} = \sqrt{14.0^2} U_S$$

$$= \sqrt{1 + 4.36^2} \times 10$$

$$= 44.73\text{ V}$$

[14-14]



$$Z_{并} = \frac{1 \times (-j\omega)}{1 - j\omega} = \frac{1}{1 + j\omega}$$

$$\dot{U}_0 = \frac{Z_{并}}{j\omega + Z_{并}} \dot{U}_S = \frac{-j\omega}{1 - j\omega + j\omega + 1} \dot{U}_S = \frac{1}{1 + j\omega} \dot{U}_S$$

$$H(\omega) = \frac{\dot{U}_0}{\dot{U}_S} = \frac{1}{1 + j\omega} = \frac{1}{(1 + \omega^2)^{1/2} + j\omega}$$

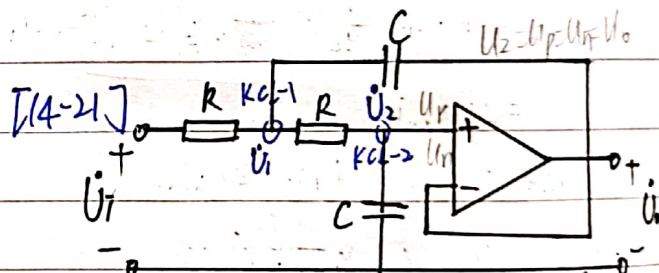
$$|H(\omega)| = \frac{1}{\sqrt{(1 + \omega^2)^2 + \omega^2}} \quad \omega \rightarrow 0 \text{ 时, } |H(\omega)| \rightarrow 1$$

$$|H(\infty)| = 0$$

∴ 为低通滤波器

$$|H(\omega_c)| = 0.707 |H(\omega)|_{\max} = 0.707$$

$$\Rightarrow \omega_c = 1.27\text{ rad/s}$$



$$\text{由 } KCL-1: \frac{\dot{U}_1 - \dot{U}_2}{R} + j\omega C(\dot{U}_0 - \dot{U}_1) + \frac{\dot{U}_0 - \dot{U}_1}{R} = 0$$

$$KCL-2: \frac{\dot{U}_1 - \dot{U}_2}{R} - j\omega C \dot{U}_2 = 0$$

$$\text{又由运放虚短特性: } \dot{U}_2 = \dot{U}_0$$

$$\Rightarrow \dot{U}_1 = (1 + j\omega CR) \dot{U}_0$$

$$H(\omega) = \frac{\dot{U}_0}{\dot{U}_1} = \frac{1}{(1 + \omega^2 C^2 R^2) + j2\omega CR}$$

$$|H(0)| = 1, |H(\infty)| = 0 \Rightarrow \text{为低通滤波器}$$

$$|H(\omega_c)| = 0.707 |H(\omega)|_{\max} = 0.707$$

$$\frac{1}{\sqrt{(1 + \omega^2 C^2 R^2)^2 + 4\omega^2 C^2 R^2}} = \frac{1}{2}$$

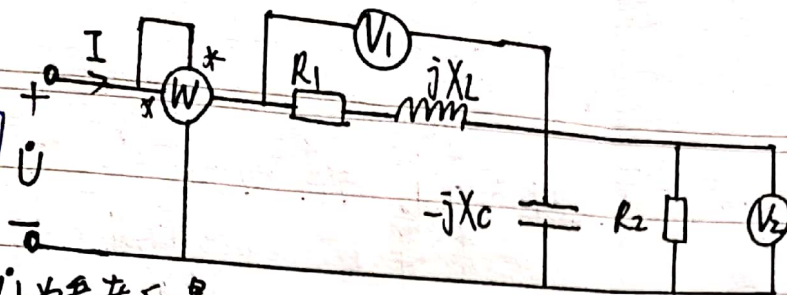
$$\text{令 } \omega^2 C^2 R^2 = t \text{ 则 } (1 + t)^2 + 4t = 2 \Rightarrow t = \sqrt{2} - 1$$

$$\Rightarrow \omega = \frac{\sqrt{2}}{RC} = \frac{0.64}{RC}$$



扫描全能王 创建

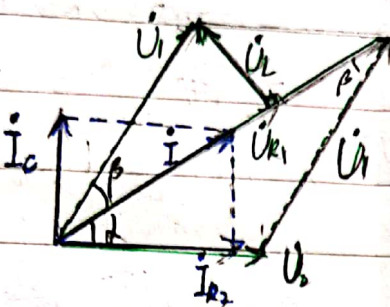
[14-26]



选 \dot{U}_2 为参考向量

$$\cos \alpha = \frac{72^2 + 150^2 - 102^2}{2 \times 150 \times 72} = \frac{4}{5}$$

$$\cos \beta = \frac{150^2 + 102^2 - 72^2}{2 \times 150 \times 102} = \frac{77}{85}$$



$$\begin{aligned} \therefore U_{R1} &= U_1 \cos \beta = \frac{462}{5} \text{ V} \quad I = \frac{I_{R2}}{\cos \alpha} = \frac{5}{4} I_{R2} \\ &= I_{R1} \cdot R_1 \quad U_{R2} = I_{R2} \cdot R_2 \end{aligned}$$

$$\therefore \frac{\frac{5}{4} I_{R2} \cdot R_1}{I_{R2} \cdot R_2} = \frac{462}{5 \times 72} \quad \therefore \frac{R_1}{R_2} = \frac{77}{75}$$

$$\text{又 } P = \frac{U_{R1}^2}{R_1} + \frac{U_{R2}^2}{R_2} = \frac{462^2}{25 \cdot \frac{77}{75} R_2} + \frac{72^2}{R_2} = 1500$$

$$\therefore \frac{13500}{R_2} = 1500$$

$$\therefore R_2 = 9 \Omega, \quad R_1 = 9.24 \Omega$$

$$\tan \beta = \frac{X_L}{R_1} = \frac{36}{77} \quad \therefore X_L = 4.32 \Omega$$

$$\tan \alpha = \frac{I_C}{I_{R2}} = \frac{R_2}{X_C} = \frac{3}{4} \quad \therefore X_C = 12 \Omega$$

$$\therefore R_1 = 9.24 \Omega, R_2 = 9 \Omega, X_L = 4.32 \Omega, X_C = 12 \Omega$$

