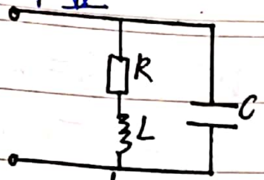
第十四章作业

[14-9]

解：(1)



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

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

$$Q=\frac{B_L}{G'}=\frac{\omega_0 L}{R}=100 \quad \therefore \omega_0 L=100R$$

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

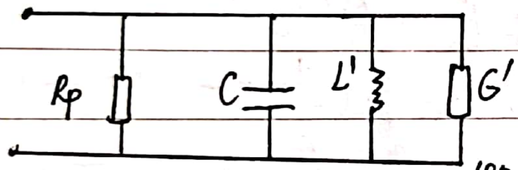
$$\therefore R=\frac{10^5}{10001}=10\Omega$$

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

$$\therefore C=\frac{10}{10001\times 2\pi\times 10^5}=1.59nF$$

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

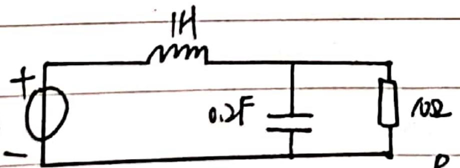
(2)



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

$$=66.7$$

[14-10]



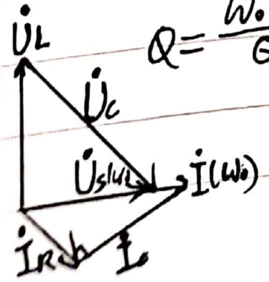
$$Z_{eq}=j\omega L+\frac{1}{j\omega C+\frac{1}{R}}=j\omega L+\frac{R}{1+j\omega CR}$$

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

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

$$\therefore \omega_0=\frac{\sqrt{\frac{CR^2}{L}-1}}{CR}=2.18\,rad/s$$

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

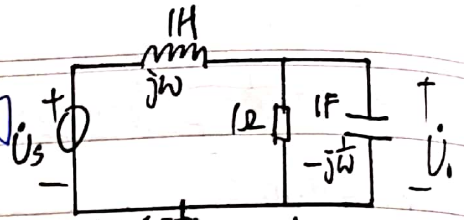


$$U_C=\sqrt{U_L^2+U_S^2}=\sqrt{1+Q^2}\,U_S$$

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

$$=44.73V$$

[14-14]



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

$$\dot U_o=\frac{Z_并}{j\omega+Z_并}\dot U_s$$

$$H(\omega)=\frac{\dot U_o}{\dot U_s}=\frac{\frac{-\frac{j}{\omega}}{1-\frac{j}{\omega}}}{\frac{-\frac{j}{\omega}}{1-\frac{j}{\omega}}+j\omega}=\frac{\frac{1}{1+j\omega}}{j\omega+\frac{1}{1+j\omega}}=\frac{1}{(1-\omega^2)+j\omega}$$

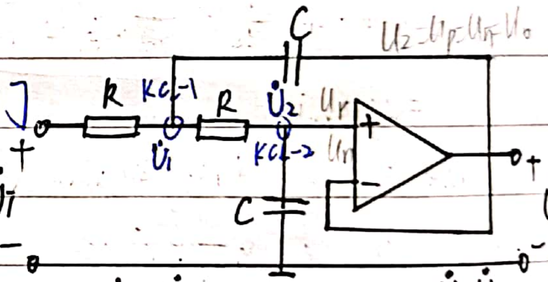
$\therefore |H(\omega)|=\frac{1}{\sqrt{(1-\omega^2)^2+\omega^2}}$ $\quad\omega\to 0$时，$|H(\omega)|\to 1$，$|H(\infty)|=0$

∴为低通滤波器

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

$$\therefore \omega_c=1.27\,rad/s$$

[14-21]



由KCL-1：$\frac{\dot U_i-\dot U_1}{R}+j\omega C(\dot U_o-\dot U_1)+\frac{\dot U_o-\dot U_1}{R}=0$

KCL-2：$\frac{\dot U_1-\dot U_2}{R}-j\omega C\dot U_2=0$

又由运放虚短特性：$\dot U_2=\dot U_o$

$$\therefore \dot U_i=(1+j\omega CR)\dot U_o$$

$$H(\omega)=\frac{\dot U_o}{\dot U_i}=\frac{1}{(1-\omega^2C^2R^2)+j2\omega CR}$$

$\because |H(0)|=1$，$|H(\infty)|=0$ ∴为低通滤波器

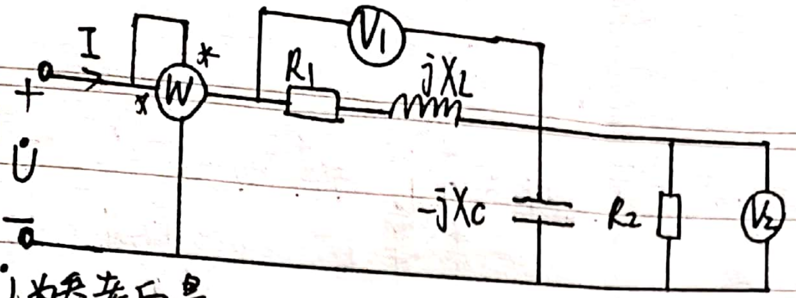
$$|H(\omega_c)|=0.707|H(\omega)|_{max}=0.707$$

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

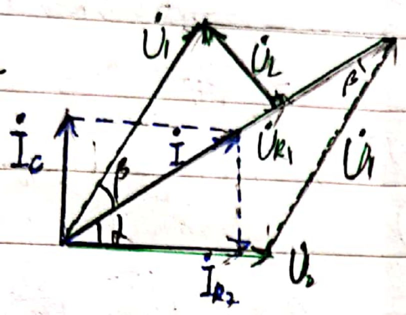
令 $\omega^2C^2R^2=t$ 则 $(1-t)^2+4t=2$ $\quad\therefore t=\sqrt{2}-1$

$$\therefore \omega=\frac{\sqrt{t}}{RC}=\frac{0.64}{RC}$$

[14-26]



选 $\dot{U}_2$ 为参考向量



$$\cos\alpha=\frac{72^2+150^2-102^2}{2\times150\times72}=\frac{4}{5}$$

$$\cos\beta=\frac{150^2+102^2-72^2}{2\times150\times102}=\frac{77}{85}$$

$\therefore U_{R1}=U_1\cos\beta=\frac{462}{5}V$ 　 $I=\frac{I_{R2}}{\cos\alpha}=\frac{5}{4}I_{R2}$

$=I_{R1}\cdot R_1$ 　 $U_{R2}=I_{R2}\cdot R_2$

$\therefore \frac{\frac{5}{4}I_{R2}\cdot R_1}{I_{R2}\cdot R_2}=\frac{462}{5\times72}$ 　 $\therefore \frac{R_1}{R_2}=\frac{77}{75}$

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

$\therefore \frac{13500}{R_2^2}=1500$

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

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

$\tan\alpha_2=\frac{I_C}{I_{R2}}=\frac{R_2}{X_C}=\frac{3}{4}$ 　 $\therefore X_C=12\Omega$

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