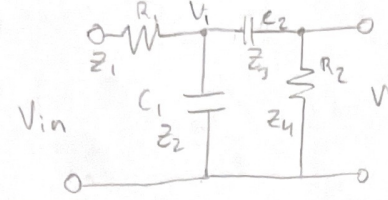
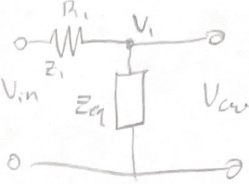


$V_{out} \rightarrow$



3. $\omega_{RC} = \frac{1}{R_1 C_1}$, $C_2 = \frac{C_1}{\alpha}$, $R_2 = \alpha R_1$ $Z_{eq} = Z_{2+3+4} = Z_2 \| Z_{3+4}$

$$Z_{2+3+4} = \left(\frac{jC_2R_2\omega + 1}{-C_1C_2R_2\omega^2 + j\omega(C_1+C_2)}\right)$$

$$V_1 = V_{in}\left(\frac{Z_{eq}}{Z_1 + Z_{eq}}\right)$$

$$= V_{in}\left[\frac{jC_2R_2\omega + 1}{C_1C_2 \cdot -1 \cdot R_1R_2\omega^2 + C_1jR_1\omega + C_2jR_2\omega + C_2jR_2\omega + 1}\right]$$

$$V_{out} = V_1\left(\frac{R_2}{R_2 + Z_3}\right) = V_{in}\left[\frac{jC_2R_2\omega}{-C_1C_2R_1R_2\omega^2 + jC_1R_1\omega + jC_2R_1\omega + jC_2R_2\omega + 1}\right]$$

Using $R_2 = \alpha R_1$ and $C_2 = \frac{C_1}{\alpha}$

$$\Rightarrow V_{out} = V_{in}\left[\frac{\alpha jC_1R_1\omega}{-\alpha C_1^2R_1^2\omega^2 + 2j\alpha C_1R_1\omega + \alpha + jC_1R_1\omega}\right]$$

Using $\omega = \frac{1}{R_1C_1}$

$$V_{out} = V_{in}\left[\frac{\alpha j}{-\alpha + 2\alpha j + \alpha + j}\right] = V_{in}\left[\frac{\alpha j}{j(2\alpha+1)}\right]$$

$$\Rightarrow V_{out} = V_{in}\left[\frac{\alpha}{2\alpha+1}\right] \Rightarrow G(\alpha) = \frac{V_{out}}{V_{in}} = \boxed{\frac{\alpha}{2\alpha+1}}\ a)$$

b) input impedance: Z_{eq} from V_{in}'s perspective

$$Z_{eq} = Z_{2+3+4} \qquad \omega = \frac{1}{R_1C_1}$$

$$\Rightarrow Z_{2+3+4} = \left(\frac{jC_2R_2\omega + 1}{-C_1C_2R_2\omega^2 + j\omega(C_1+C_2)}\right) = \left(\frac{j+1}{-\frac{1}{R_1} + j\left(\frac{1}{R_1} + \frac{\alpha}{R_1}\right)}\right)$$

$$= \boxed{\left(\frac{\alpha R_1(j+1)}{\alpha(j+1)+j}\right)}\ b)\ [\Omega]$$

c) output impedance: Z_{eq} from V_{out}'s perspective

$$Z_{eq} = Z_{1+2+3} = Z_{1+2} \| Z_3 = \frac{\left(R_1 + \frac{1}{j\omega C_1}\right)\left(\frac{1}{j\omega C_2}\right)}{\left(R_1 + \frac{1}{j\omega\left(\frac{1}{C_1+C_2}\right)}\right)} = \left(\frac{\omega(C_1+C_2)(j\omega C_1R_1+1)}{C_1C_2j\omega^2\left(jR_1\omega(C_1+C_2)+1\right)}\right)$$

Using: $C_2 = \frac{C_1}{\alpha}$, $\omega = \frac{1}{R_1C_1}$

$$\Rightarrow \left(\frac{\alpha(j+1)R_1}{j(\alpha+1)-1}\right)\ c)\ [\Omega]$$