電路學(10510EE221002)第十一次隨堂考

2016年12月28日
時間：15 分鐘
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學號：________________________________

姓名：________________________________

For the active filter circuit along with its impedance model (where s is a shorthand notation for $j\omega$) as shown in the following figures,

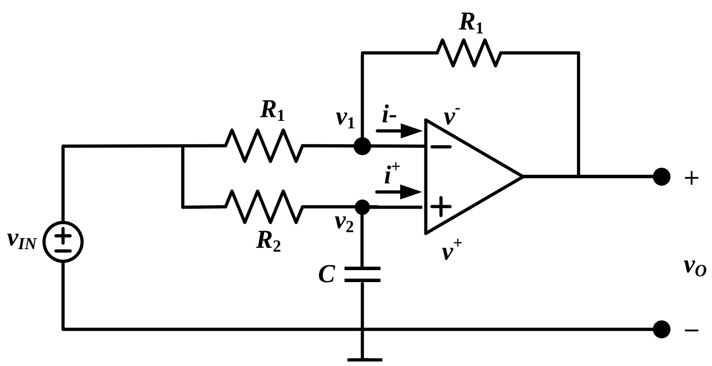
(a) Write down the node equations for $\mathbf{V_1}$ and $\mathbf{V_2}$ of the impedance model.

(b) Simplify these equations from (a) by using the ideal Op Amp assumptions in the impedance model, that is, $\mathbf{V}^{-} \approx \mathbf{V}^{+}$ and $\mathbf{I}^{-} = \mathbf{I}^{+} \approx 0$.

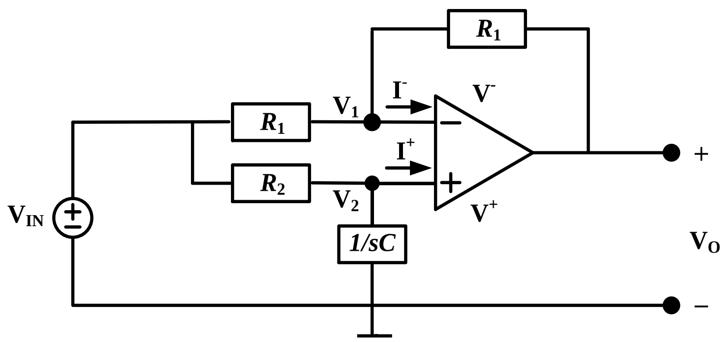
(c) Find the transfer function $\mathbf{H}(j\omega) = \mathbf{V_O}(j\omega)/\mathbf{V_{IN}}(j\omega)$ for this circuit from (b).

(d) Is this RC active filter a low-pass, high-pass, all-pass or bandpass filter?

(1) Circuit



(2) Impedance model



(a)

Node $\mathbf{V_1}$:

$$\frac{V_1 - V_{IN}}{R_1} + \frac{V_1 - V_O}{R_1} + I^{-} = 0$$

Node $\mathbf{V_2}$:

$$\frac{V_2 - V_{IN}}{R_2} + I^{-} + \frac{V_2}{1/sC} = 0$$

(b)

The ideal Op Amp assumptions, $\mathbf{V_2} = \mathbf{V}^{-} = \mathbf{V}^{+} \approx 0$ and $\mathbf{I}^{-} = \mathbf{I}^{+} \approx 0$

Node $\mathbf{V_1}$:

$$V_1 = \frac{V_O + V_{IN}}{2}$$

Node **V_2** :

$$V_2 = \frac{V_{IN}}{1+sR_2C}$$

(c)

$V_1 = V_2$

$$\rightarrow \frac{V_{IN}+V_O}{2} = \frac{V_{IN}}{1+sR_2C}$$

$$\rightarrow \mathbf{H}(j\omega) = \frac{\mathbf{V}_O}{\mathbf{V}_{IN}} = \frac{1-sR_2C}{1+sR_2C}$$

(d)

$$|\mathbf{H}| = \frac{\sqrt{1^2+(\omega RC)^2}}{\sqrt{1^2+(\omega RC)^2}} = 1$$

All-pass filter

(a) Node **V_1** = ______________________________,

Node **V_2** = ______________________________,

(b) Node **V_1** = ______________________________,

Node **V_2** = ______________________________,

(c) $\mathbf{H}(j\omega)$ = ______________________________,

(d) ______________________.