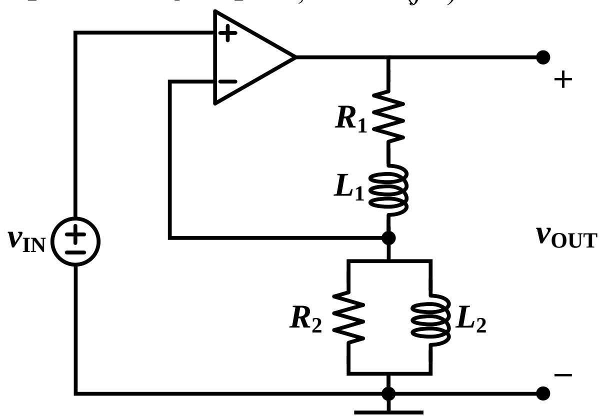
電路學(EE2210)第十一次隨堂考

2015年6月10日
時間：15 分鐘
Close Book

學號：________________

姓名：________________

For the circuit as shown,
(a) Determine the transfer function $\mathbf{H}(j\omega) = \mathbf{V_{out}}(j\omega)/\mathbf{V_{in}}(j\omega)$ in terms of R_1, R_2, L_1, and L_2.
(b) Find $\mathbf{H}(j\omega)$ at low frequency ($\omega \to 0$).
(c) Find $\mathbf{H}(j\omega)$ at high frequency ($\omega \to \infty$).
(d) For a special case with $R_1 = R_2 = R$ and $L_1 = L_2 = L$, Find $\mathbf{H}(j\omega)$ when $\omega = R/L$.



Solution:
(a)

$$\mathbf{V_{out}} = \mathbf{V_{in}} + \left[\left(\frac{\mathbf{V_{in}}}{R_2 \| j\omega L_2}\right) \times (R_1 + j\omega L_1)\right]$$

$$\Rightarrow \mathbf{H}(j\omega) = \frac{\mathbf{V_{out}}}{\mathbf{V_{in}}}(j\omega) = 1 + \left(\frac{R_1 + j\omega L_1}{R_2 \| j\omega L_2}\right) = 1 + \left[\frac{(R_1 + j\omega L_1)(R_2 + j\omega L_2)}{j\omega L_2 R_2}\right] = 1 + \frac{R_1}{R_2} + \frac{L_1}{L_2} + \frac{j\omega L_1}{R_2} + \frac{R_1}{j\omega L_2}$$

$$= 1 + \frac{R_1}{R_2} + \frac{L_1}{L_2} + j\left(\frac{\omega L_1}{R_2} - \frac{R_1}{\omega L_2}\right)$$

(b)

$$\mathbf{H}(j\omega)\big|_{\omega \to 0} = -j\frac{R_1}{\omega L_2}$$

(c)

$$\mathbf{H}(j\omega)\big|_{\omega \to \infty} = j\frac{\omega L_1}{R_2}$$

(d)
When $R_1 = R_2 = R$, $L_1 = L_2 = L$,

$$\Rightarrow \mathbf{H}(j\omega) = \Rightarrow \mathbf{H}(j\omega) = 1 + 1 + 1 + j\left(\frac{\omega L}{R} - \frac{R}{\omega L}\right)$$

$$\therefore \mathbf{H}(j\omega)\big|_{\omega = \frac{R}{L}} = 3$$