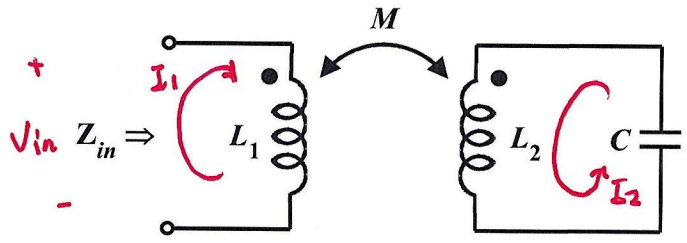
EE 3340

Homework Problem #030

Symbolically determine the input impedance of the circuit shown below.



$$j\omega L_1 I_1 + j\omega M I_2 = V_{in}$$

$$j\omega M I_1 + j\omega L_2 I_2 + \frac{1}{j\omega C} I_2 = 0$$

$$\begin{bmatrix} j\omega L_1 & j\omega M \\ j\omega M & j\omega L_2 + \frac{1}{j\omega C} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} V_{in} \\ 0 \end{bmatrix}$$

$$I_1 = \frac{\begin{vmatrix} V_{in} & j\omega M \\ 0 & j\omega L_2 + \frac{1}{j\omega C} \end{vmatrix}}{\begin{vmatrix} j\omega L_1 & j\omega M \\ j\omega M & j\omega L_2 + \frac{1}{j\omega C} \end{vmatrix}} = \frac{\left(j\omega L_2 + \frac{1}{j\omega C}\right) V_{in}}{j\omega L_1 \left(j\omega L_2 + \frac{1}{j\omega C}\right) + \omega^2 M^2}$$

$$Z_{in} = \frac{V_{in}}{I_{in}} = \frac{j\omega L_1 \left(j\omega L_2 + \frac{1}{j\omega C}\right) + \omega^2 M^2}{j\omega L_2 + \frac{1}{j\omega C}}$$

$$= j\omega \frac{L_1 + \omega^2 C \left(M^2 - L_1 L_2\right)}{1 - \omega^2 L_2 C}$$