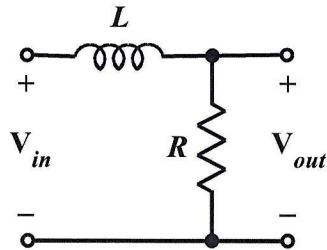


EE 3340
Homework Problem #021

A passive RL filter circuit is given below.



- a. Determine an expression for the voltage transfer function, V_{out}/V_{in} . Also, determine expressions for the magnitude and the phase angle of that transfer function.

$$\frac{1}{j\omega L} (V_{in} - V_{out}) = \frac{V_{out}}{R} \Rightarrow \frac{1}{j\omega L} V_{in} = \left(\frac{1}{R} + \frac{1}{j\omega L} \right) V_{out}$$

$$\Rightarrow \frac{V_{out}}{V_{in}} = \frac{\frac{1}{j\omega L}}{\frac{1}{R} + \frac{1}{j\omega L}} = \frac{1}{1 + j\omega \frac{L}{R}}$$

$$\left| \frac{V_{out}}{V_{in}} \right| = \frac{1}{\sqrt{1 + \left(\frac{\omega L}{R} \right)^2}}$$

$$\angle \frac{V_{out}}{V_{in}} = -\tan^{-1} \left(\omega \frac{L}{R} \right)$$

- b. Classify the filter as LP, HP, BP or BS, and explain your reasoning.

$$\lim_{\omega \rightarrow 0} \left| \frac{V_{out}}{V_{in}} \right| = \frac{1}{1} = 1$$

$$\lim_{\omega \rightarrow \infty} \left| \frac{V_{out}}{V_{in}} \right| = \lim_{\omega \rightarrow \infty} \frac{R}{\omega L} = 0$$

This is a Low Pass (LP) filter characteristic.