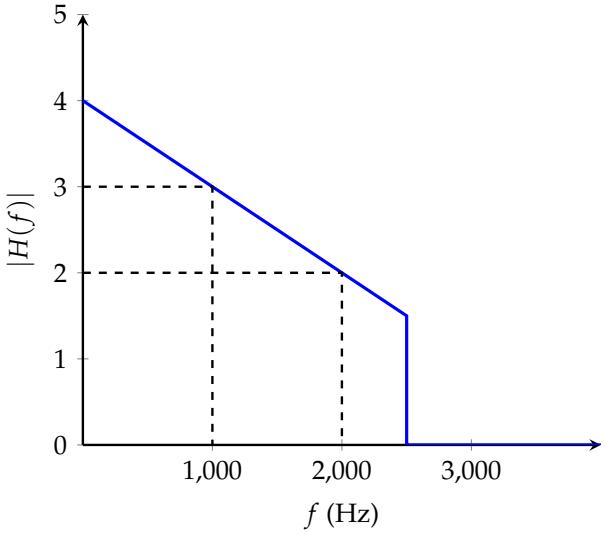
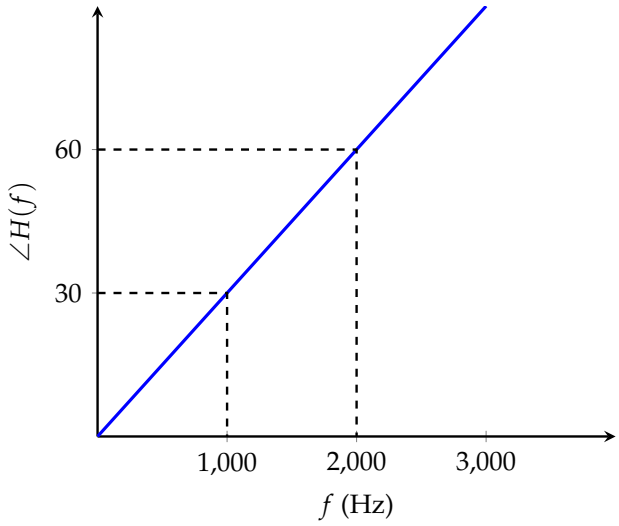
Discussion 4B

1. Using the Transfer Function to Determine the Output (Hambley Example 6.1)

The transfer function $H(f)$ of a filter is shown in Figure 1.



(a) Transfer Function Magnitude



(b) Transfer Function Phase

Figure 1: Transfer Function $H(f)$

If the input signal is given by

$$v_{\text{in}}(t) = 2\cos\left(2000\pi t + 40^\circ\right) + 2\cos\left(4000\pi t\right) \tag{1}$$

find an expression for the output of the filter $v_{\text{out}}(t)$.

2. *RC* **Filter (Hambley Example 6.3)**

Suppose you have the *RC* circuit shown in Figure 2.

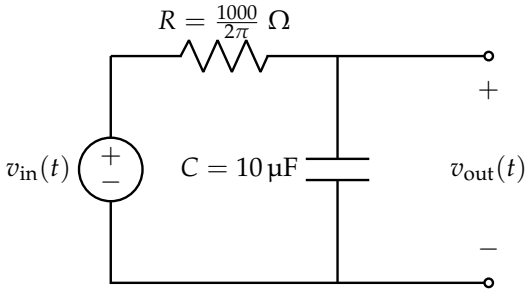


Figure 2: RC Lowpass Circuit

(a) **Determine the transfer function $H(f)$ of the given circuit. Then, classify what type of filter this circuit is.** Recall that the transfer function $H(f)$ is defined as the ratio of the output phasor to the input phasor.

$$H(f) = \frac{\mathbf{V}_{\text{out}}}{\mathbf{V}_{\text{in}}} \tag{2}$$

(b) Suppose, that you are given:

$$v_{\text{in}}(t) = 5\cos(20\pi t) + 5\cos(200\pi t) + 5\cos(2000\pi t) \tag{3}$$

Find an expression for the output signal $v_{\text{out}}(t)$.

3. LR Filter (Hambley Exercise 6.5)

Suppose you are given the following circuit:

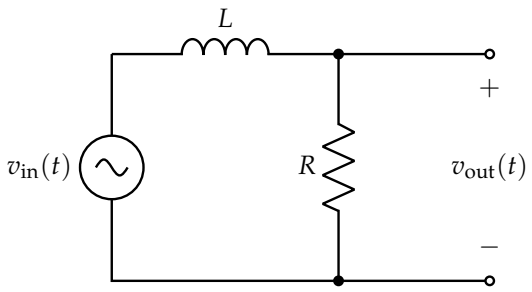


Figure 3: LR Circuit

Derive the transfer function of this filter, classify what type of filter it is, and determine an expression for the half-power frequency f_B.