

EE334 Homework PS2b- FilterII

Problems from Hambley:

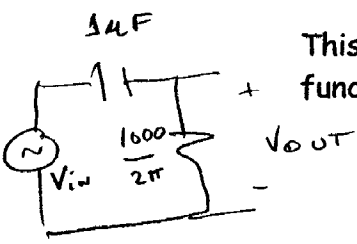
- P6.64, P6.75, P6.77, P6.89

Additional Problems (Instructor Option):

- As assigned by instructor

P6.64* The input signal is given by
 $v_{in}(t) = 5 + 5 \cos(2000\pi t)$

This signal has components at $f = 0$ Hz and $f = 1000$ Hz. The transfer-function values at these frequencies are:



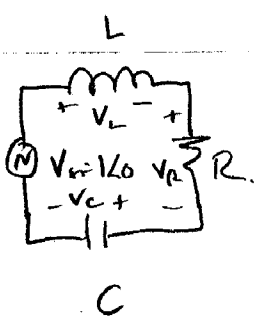
$$H(0) = \frac{j0}{1 + j0} = 0$$

$$H(1000) = \frac{j1}{1 + j1} = 0.7071 \angle 45^\circ$$

Applying these transfer-function values to the respective components yields:

$$v_{out}(t) = 3.536 \cos(2000\pi t + 45^\circ)$$

P6.75*



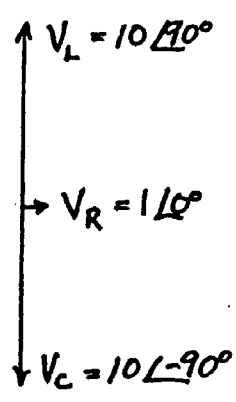
$$f_0 = \frac{1}{2\pi\sqrt{LC}} = 1.125 \text{ MHz}$$

$$Q_s = \frac{2\pi f_0 L}{R} = 10$$

$$B = \frac{f_0}{Q_s} = 112.5 \text{ kHz}$$

$$f_H \cong f_0 + \frac{B}{2} = 1.181 \text{ MHz}$$

$$f_L \cong f_0 - \frac{B}{2} = 1.069 \text{ MHz}$$



At the resonant frequency: $V_R = 1 \angle 0^\circ$ $V_L = 10 \angle 90^\circ$ $V_C = 10 \angle -90^\circ$

P6.77

$$Q_s = \frac{f_0}{B} = \frac{400 \text{ kHz}}{50 \text{ kHz}} = 8 \quad L = \frac{RQ_s}{2\pi f_0} = 63.66 \mu\text{H}$$

$$C = \frac{1}{Q_s R (2\pi f_0)} = 2487 \text{ pF}$$

P6.89 Four types of ideal filters are lowpass, highpass, bandpass, and band reject (or notch) filters. Their transfer functions are shown in Figure 6.34 in the book.

Ideal Filters

In discussing filter performance, it is helpful to consider ideal filters. An ideal filter passes components in the desired frequency range with no change in amplitude or phase and totally rejects the components in the undesired frequency range. Depending on the locations of the frequencies to be passed and rejected, we have different types of filters: lowpass, highpass, bandpass, and band reject. The transfer functions $H(f) = \mathbf{V}_{\text{out}}/\mathbf{V}_{\text{in}}$ of the four types of ideal filters are shown in Figure 6.34.

- An ideal lowpass filter [Figure 6.34(a)] passes components below its cutoff frequency f_H and rejects components higher in frequency than f_H .
- An ideal highpass filter [Figure 6.34(b)] passes components above its cutoff frequency f_L and rejects components lower in frequency than f_L .
- An ideal bandpass filter [Figure 6.34(c)] passes components that lie between its cutoff frequencies (f_L and f_H) and rejects components outside that range.

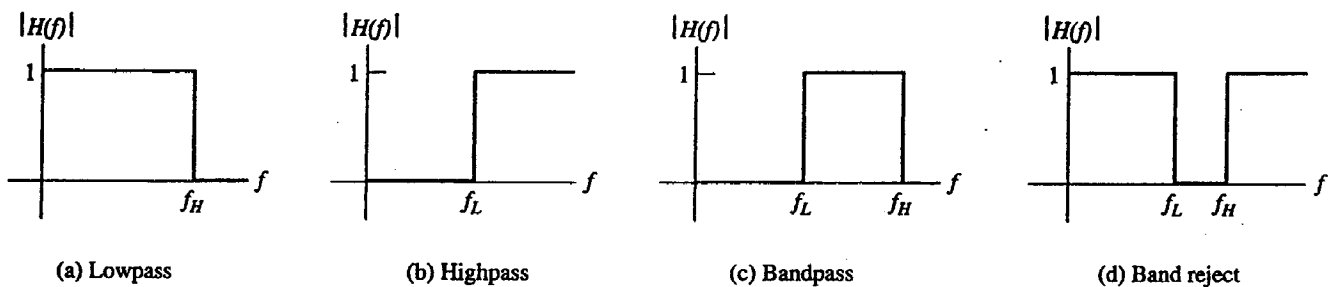


Figure 6.34 Transfer functions of ideal filters.