

Name: _____

Section: _____

EE334 Homework PS2a- FilterI

Problems from Hambley:

- P6.24, P6.33, P6.37, P6.39, P6.40,

Additional Problems (Instructor Option):

- As assigned by instructor

P6.24* The half-power frequency of the filter is

$$f_B = \frac{1}{2\pi RC} = 500 \text{ Hz}$$

The transfer function is given by Equation 6.9 in the text:

$$H(f) = \frac{1}{1 + j(f/f_B)}$$

The given input signal is

$$v_{in}(t) = 5 \cos(500\pi t) + 5 \cos(1000\pi t) + 5 \cos(2000\pi t)$$

which has components with frequencies of 250, 500, and 1000 Hz.

Evaluating the transfer function for these frequencies yields:

$$H(250) = \frac{1}{1 + j(250/500)} = 0.8944 \angle -26.57^\circ$$

$$H(500) = 0.7071 \angle -45^\circ$$

$$H(1000) = 0.4472 \angle -63.43^\circ$$

Applying the appropriate value of the transfer function to each component of the input signal yields the output:

$$v_{out}(t) = 4.472 \cos(500\pi t - 26.57^\circ) + 3.535 \cos(1000\pi t - 45^\circ) + 2.236 \cos(2000\pi t - 63.43^\circ)$$

P6.33 (a) Applying the voltage-division principle, we have:

$$H(f) = \frac{V_{out}}{V_{in}} = \frac{R_2}{R_1 + R_2 + j2\pi fL} = \frac{R_2/(R_1 + R_2)}{1 + j2\pi fL/(R_1 + R_2)} = \frac{R_2/(R_1 + R_2)}{1 + j(f/f_B)}$$

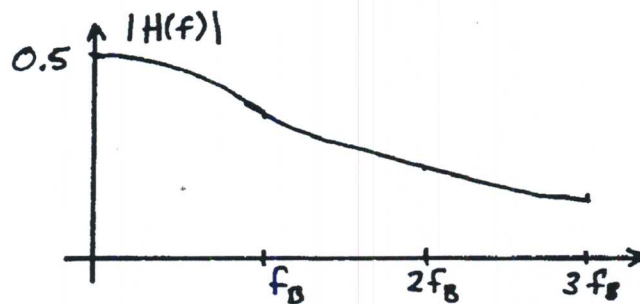
where $f_B = (R_1 + R_2)/(2\pi L)$

(b) Evaluating for the component values given, we have:

$$f_B = 31.83 \text{ kHz}$$

$$H(f) = \frac{0.5}{1 + j(f/f_B)}$$

A sketch of the transfer function magnitude is:



P6.37 The passband of a filter is the range of frequencies of the components that are passed to the output.

P6.39 A logarithmic frequency scale is one for which equal distances correspond to multiplying frequency by the same factor. A linear frequency scale is one for which equal distances correspond to adding the same amount to the starting frequency.

P6.40* (a) We have:

$$20 \log |H(f)| = -10$$

$$\log |H(f)| = -0.5$$

$$|H(f)| = 10^{-0.5} = 0.3162$$

(b) Similarly,

$$20 \log |H(f)| = 10$$

$$\log |H(f)| = 0.5$$

$$|H(f)| = 10^{0.5} = 3.162$$