

EE-241. Introductory Electronics Laboratory

Lab 6 Handout*

Filters, frequency response, and tone control

Fall 2009

Objectives

At the end of this lab you should know

- Design and frequency response of low-pass and high-pass filters.
- Controlling tone (treble and bass) of an audio signal.

Theory

Background section in Experiment 7 of Y. Tsvividis *pg.* 53 - 56.

Prelab Problems

1. Why is there a phase difference between the input and output signals of an RC circuit with an AC input. What will be the phase difference for an RL circuit?
2. What is cutoff frequency of a high-pass and a low-pass filter? Calculate the cutoff frequency of the high-pass filter (marked by a dotted box) in Fig. 4 of lab 5 handout.
3. Derive an expression for gain and phase (between input and output signals) of a low-pass filter. Show that at cutoff frequency, values of gain and phase of the filter are 0.7071 and -45 degrees respectively. Also draw its phasor diagram. 4. Repeat question 3 for a high-pass filter.
4. Using expressions derived in question 3 and 4, plot frequency response of low-pass and high-pass filter in MATLAB. Clearly mention the assumed values of resistance and capacitance.

HINT 1 use angular frequency ω instead of f .

HINT 2 plot gain and phase separately.

HINT 3 use logarithmic scale for angular frequency. See Fig. 6 for reference.

5. The RC circuit in rectifier (see page 69) is also an instance of a filter. Explain how this filter can be useful in a sound system powered by a 60-Hz alternating voltage.

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