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ADANA ALPARSLAN TÜRKEŞ SCIENCE AND TECHNOLOGY UNIVERSITY

FACULTY OF ENGINEERING

EEE 222 ELECTRICAL CIRCUIT LABORATORY II

2020-2021 Spring Term

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EXPERIMENT IV

INTRODUCTION TO

Low-Pass and High-Pass Filters

1. Objectives

The objective of this experiment is to analyze low-pass and high-pass passive filters.

2. Introduction

A filter is a device that changes the amplitude of an AC voltage as the frequency of the input voltage changes. Filters have 2 terminals. The input terminals take in the input voltage, which passes through the filter and onto the output terminals, where the resulting output waveform can be observed. Figure 2.1 represents a basic filter structure.

Figure 2.1. The basic representation of a filter.

The signals passed from the input to the output fall within a band of frequencies called the passband. Input voltages outside this band have their magnitudes attenuated by the circuit and are thus effectively prevented from reaching the output terminals of the circuit. Frequencies that are not in a circuit's **passband** are in its **stopband**.

There are several types of filters. Frequency selective circuits are categorized by the location of the passband. In this experiment we will deal with 2 types of them; low-pass and high-pass filters. Both filters have one passband and one stopband, which are defined by **cut-off frequency** that separates them. Figure 2.2 shows ideal frequency response representations of low pass and high pass filters.

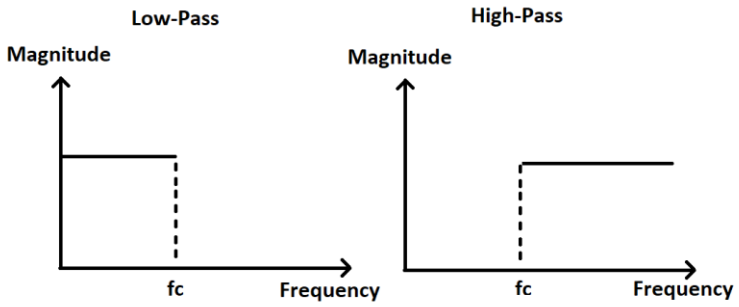

Figure 2.2. Frequency responses of ideal low pass and high pass filters.

3. Preliminary Work

3.1. Please study the related chapter of your course book to get detailed information about passive low-pass and high-pass filters. You are responsible for all of the content.

3.2. Circuits that are shown in Figure 3.1 are simple low-pass and high-pass filter circuits.

- Calculate Vout of both circuits in terms of Vin, R, and L.

- Calculate voltage gain Vout/Vin in terms of R and L.

- Determine the cut of frequencies.

- Explain which one is the low-pass, and which one is the high-pass filter.

- Simulate the circuits, observe frequency responses, and comment on them. Bring the simulation outcomes together with you to the laboratory.

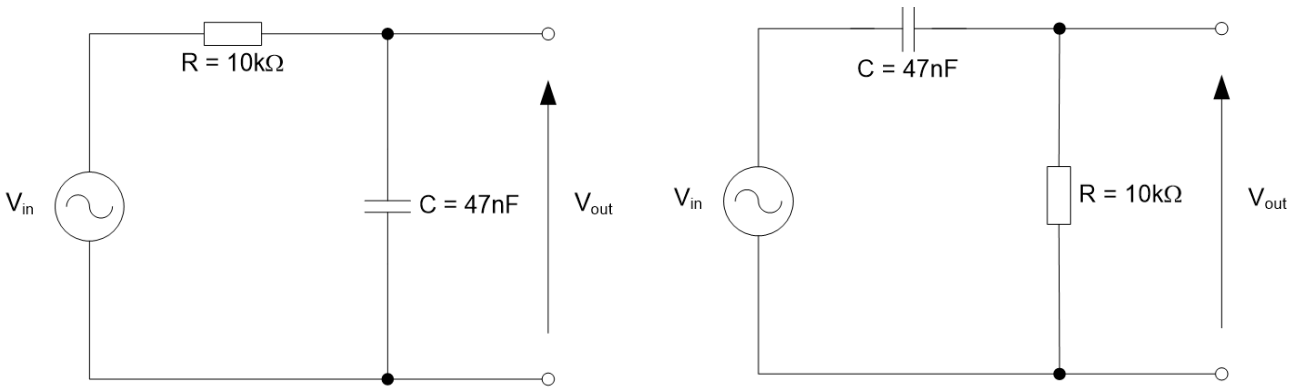

Figure 3.1. Passive low-pass and high-pass circuits.

4. Experimental Work

4.1. Assemble the ***low-pass filter*** circuit which is in Figure 3.1. Follow the instructions below step by step.

a) Setup the signal generator so that it produces a sinusoidal waveform, with a peak to peak voltage of 10V. Use the oscilloscope to verify this.

b) Use channel 1 of the oscilloscope to display Vin and Channel 2 to display Vout. You may need to set up the triggering function of scope, especially for the lower frequencies.

c) Starting from 50 Hz, vary the frequency of the input signal up to 2500 Hz in a sufficient number of steps. For each increment, note down the peak to peak voltage of the output for each frequency, and table it to your laboratory report. Then, plot a graph of the amplitude of Vout against the frequency.

d) From your graph, mark off 70.7% of your peak voltage, and note down the corresponding cutoff frequency, fc.

e) The cut-off frequency can also be calculated by the circuit components R and C. Calculate and compare it with your experimental result.

4.2. Assemble the ***high-pass filter*** circuit which is in Figure 3.1.

a) Repeat the tests as outlined in the previous section but this time start your frequency readings at 50 Hz and work your way up to 10 kHz. Record all your results in your report sheet.

b) On the graph that you draw, indicate the cut-off frequency.

c) Calculate the cutoff frequency.

d) Compare the calculated and the measured values of the cut-off frequency.