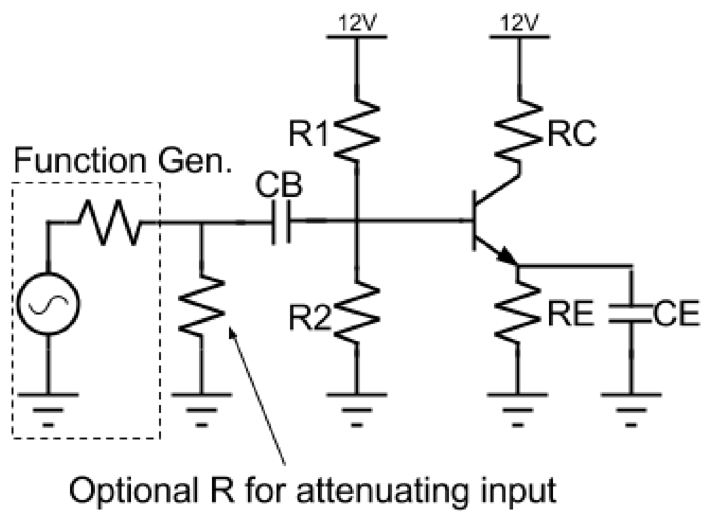

Figure 1: A sample design for a common emitter amplifier.

In this lab you will build and characterize a common emitter amplifier. In the design project, you will use a small number of transistors to design a (possibly multistage) amplifier to a specification. The learning goals are listed below:

- Understand the design process for amplifiers, a process which applies to most analog circuits
- Master the use of common single stage amplifiers and multistage loading calculations
- Apply all of the techniques that we have studied up to this point to a single design

1 Lab 4 – Design a Common Emitter Amplifier

In this lab you will design a common emitter amplifier to meet a set of give specifications. You may do so by selecting component values for the common emitter amplifier pictured in Figure 1. You may, if you prefer, select a different biasing scheme, make small modifications to this design or select another amplifier, but the schematic in Figure 1 is sufficient to meet the specifications of this lab.

You must begin your design by making hand calculations which help you pick your compnent values. After that you should simulate your design to make sure those component values work in simulation. Finally, you must build your design and experimentally show that it meets the design specifications. Be sure to calculate, simulate and measure the power consumption of your design.

The design specifications are as follows:

- $R_{in} > 1\text{k}\Omega$
- $R_{out} < 5\text{k}\Omega$
- $A_v = 200 \pm 10\%$
- $V_{sw} > 2$V as measured by absence of visible clipping, not by harmonic content.
- $f_{low} < 2$kHz
- Use only one 12 V power supply.
- Your signal source has a source impedance $> 8\ \Omega$ and may not have any DC offset
- Use one transistor: a 2N3904

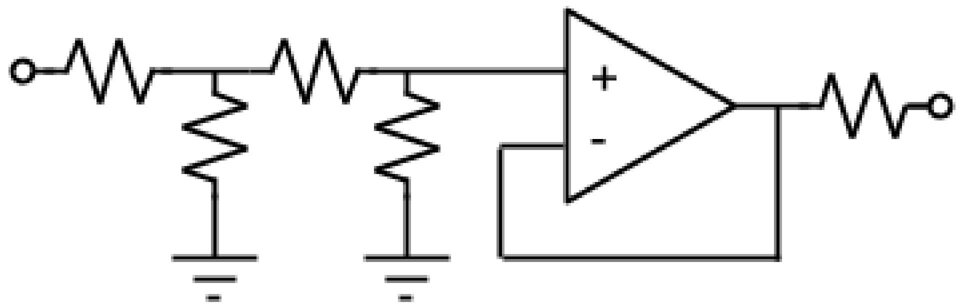

Figure 2: A sample design for an attenuator.

2 Design Project 1

Design an amplifier which meets the following specifications

- $R_{in} > 20\text{k}\Omega$
- $R_{out} < 50\Omega$
- $A_v = 1000 \pm 5\%$
- $V_{sw} > 5\text{V}$ as measured by harmonic content which is at least 10dB below the fundamental.
- $f_{low} < 2\text{kHz}$
- Use only one 10 V power supply. (This constraint does not apply to your attenuator.)
- Input signal source has a source impedance of 50 Ω and may not have any DC offset.
- Use four or fewer transistors, up to two 2N3906s and up to two 2N3904s.
- Optimize for minimum power consumption and minimum component count.

As above, design the amplifier on paper, simulate it, build it, and experimentally verify its performance. You may need to build an attenuator to make your input signal small enough that your output does not exceed your output swing because of the high gain of the amplifier. Figure 2 depicts an attenuator design that can easily achieve 60dB or more of attenuation. Applying Thevenin analysis makes it much easier to design your attenuator.