Laboratory Goals

- Build a basic transistor amplifier
- Measure amplifier performance using the oscilloscope
- Compare a PSPICE simulation to the calculated and measured values

Pre-lab reading

- *Student Reference Manual for Electronic Instrumentation Laboratories* by Stanley Wolf and Richard Smith, Copyright 1990.
- 2N2222 datasheet at the website

Equipment needed

- Lab notebook, pen
- Agilent E3631A Power Supply
- Agilent 34401A Digital Multimeter
- Agilent 54622 Digital Oscilloscope
- 2 oscilloscope probes (attached to the oscilloscope)
- Agilent 33120A Function Generator
- 1 BNC/EZ Hook test lead
- 1 test lead, red, banana/EZ Hook
- 1 test lead, black, banana/EZ Hook

Parts needed

- Circuit breadboard
- Lab parts kit
- Transistor, BJT, 2N2222
- Resistors, 470Ω, 2.2kΩ, 10kΩ, ¼ Watt
- Resistors, 2 (values to be determined below), ¼ Watt
- Jumper wires

Lab safety concerns

- Make sure all circuit connections are correct, and no shorted wires exist.
- Adjust the power supply to the proper voltage before connecting it to the circuit
- Adjust signal generator to the proper level before connecting it to the circuit
- When using electrolytic capacitors, the arrows must point to the negative side of current flow.

1. Pre-Lab Amplifier Design

- Complete the transistor design (shown below in Figure 1) by finding **R1** and **R2**. You are given:

$\mathbf{I_{cq}}$ = 2 mA	$\mathbf{R_e}$ = 470 Ω	$\mathbf{R_c}$ = 2.2 KΩ
$\mathbf{C_b}$ = 47 µF	$\mathbf{C_c}$ = 47 µF	$\mathbf{V_{cc}}$ = 10 VDC
$\mathbf{V_{be}(on)}$ = .7 V	β = 200	$\mathbf{R_{th}}$ = 10 KΩ

- Create a table in your lab notebook for the measured DC values V_{R1}, V_{R2}, V_{Re}, V_{Rc}, and V_{RL}
- Create a second table for the amplifier's input frequency and amplitude, output amplitude, and gain (i.e., Vout/Vin). Include 1kHz, 10kHz, 50kHz, 100kHz, 500kHz, and 1MHz frequencies (Also include an entry for phase shift at 10kHZ)
- Create a PSPICE model of the circuit using your calculated **R1** and **R2** values. Use 1kHz/100mVpp for your AC input amplitude. Run a **Transient** simulation with the following values:
  - **Print Step:** 1000ns
  - **Final Time:** 3ms
- Bring a diskette copy of the results to your lab section

2. Circuit Construction and Signal Measurement

- Build the circuit shown below in Figure 1. (Use the nearest standard resistor values for your calculated **R1** and **R2**)

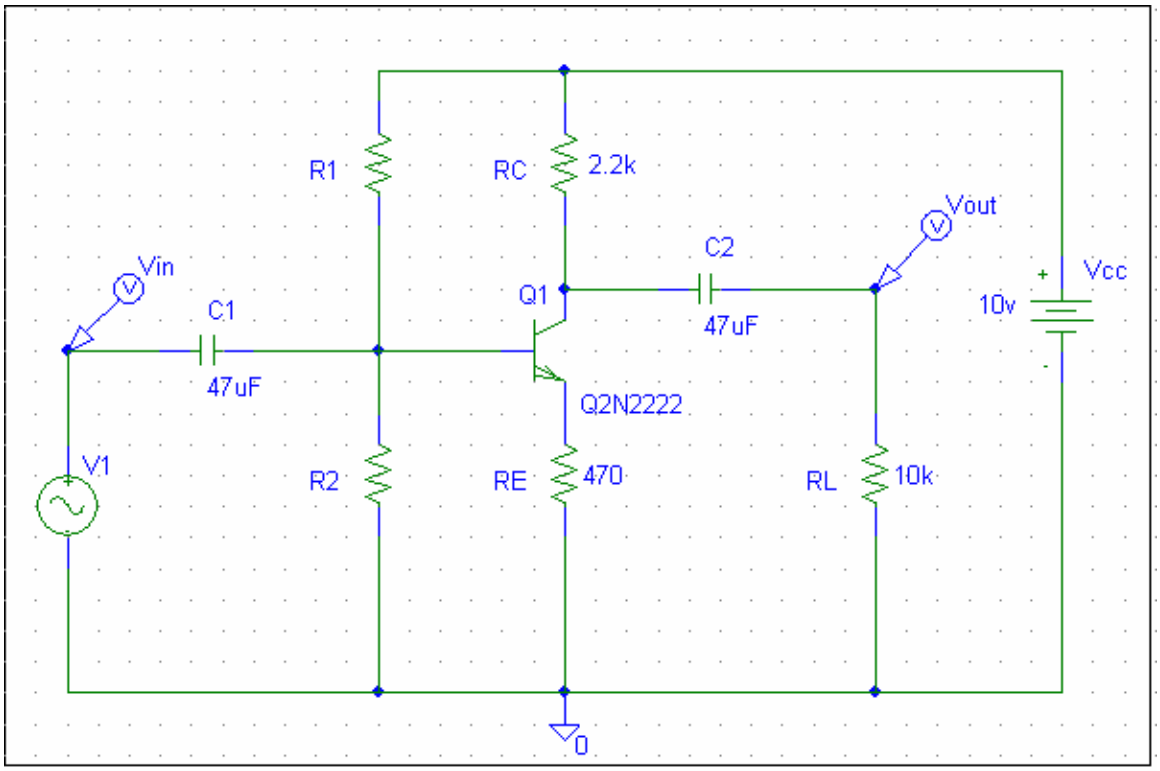

Figure 1 – Bias-stable Transistor Amplifier Schematic

- Adjust the power supply to 10 VDC
- Connect the power supply to the circuit V_{cc} and ground connections
- Measure and record the voltages V_{R1}, V_{R2}, V_{Re}, V_{Rc}, and V_{RL} with the digital multimeter

- Adjust the function generator to output a 100mVpp sine wave at 1kHz

- Connect the BNC/EZ Hook test lead to the generator **OUTPUT**
- Clip the EZ Hook end of the test leads to the circuit input and ground respectively

- Clip the **CH1** oscilloscope probe and ground clip to the circuit input (Vin) and ground respectively
- Clip the **CH2** oscilloscope probe and ground clip to the circuit output (V_{out}) and ground respectively

- Measure and record the circuit input and output amplitudes at each at of the required frequencies on your table. Be sure to also include the phase shift measurement at 10kHz.

- Copy the 1kHZ input and output waveforms to a diskette using the **Quick Print** option on the oscilloscope:

- When all measurements are complete, turn the power supply output off
- Disconnect the test leads from the circuit

Before leaving the lab, take a few minutes to make sure all equipment and test leads are returned to your cabinet, and that you have cleaned up your work space.

3. Analysis

Write a summary report for this lab. Be sure to also include the following topics:

What applications can you think of for this circuit?

Do the PSPICE model's voltages and currents match with your observations and calculations? Are there differences? If so, why?

Explain any difficulties you had with this lab. (Please include suggestions to improve the lab, if you have them).