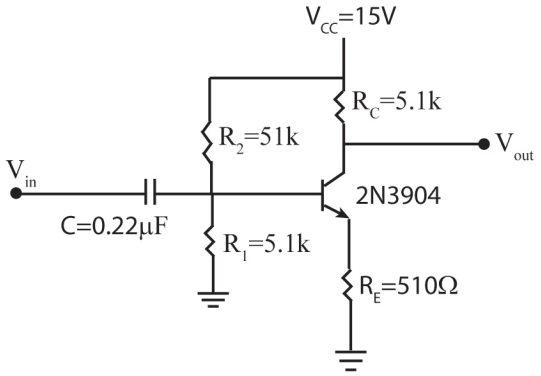
**Experiment 8 – Bipolar Junction Transistor: Common-Emitter Amplifier**

**Physics 242 - Electronics**

## Introduction

Transistors are particularly useful in applications involving the amplification of signal power. In this lab, you will investigate the common emitter amplifier, one of the most commonly used transistor circuits.




## Procedure and Questions

1. Measure the component values first, then build the common emitter amplifier shown above. With the input voltage disconnected, measure the DC voltages $V_{CC}$, $V_C$, $V_E$, and $V_B$ characterizing the quiescent operating point. $V_C$, $V_E$, and $V_B$ refer to the voltages at the collector, emitter, and base terminals of the transistor, measured with respect to ground.

Q1: Assuming $\beta$ = 150 and $v_{BE}$ = 0.6 V, calculate the predicted values of $V_{CE}$ and $I_C$. Show your calculations and use measured component values. Find the percent difference between the measured and predicted values of collector current $I_C$ and collector-emitter voltage $V_{CE}$. Note that you can find your measured $V_{CE}$ from your experimentally measured values as $V_{CE} = V_C - V_E$, and you can find your measured $I_C$ from your measured values as $I_C = \frac{V_{CC}-V_C}{R_C}$.

Q2: Solve for the predicted values $I_C$ and $V_{CE}$, assuming $\beta$ = 50. How much (by what percent) are these predicted values moved from the predicted values you found in Q1 where you assumed that $\beta$ = 150.

2. Use picoscope's waveform generator to provide a 1 kHz sinusoidal input signal, and monitor output waveform on the 'scope. Choose the amplitude for the input signal small enough so that the output waveform is not clipped. Measure the amplitudes of the input and output waveforms (from which the voltage gain can be found). Then increase the amplitude of the input signal until the wave begins to clip, and sketch the waveform, indicating maximum and minimum voltage levels with respect to ground.

Q3: Calculate the expected value of the voltage gain $\frac{v_o}{v_i}$ for your circuit (using measured component values). Find the percent difference between measured and predicted gains.

Q4: Show your sketch. Indicate where clipping occurs.

3. The combination of the capacitor and the parallel combination of $R_1$, $R_2$, and the effective resistance looking into the emitter $R_{E,eff}$ form a high-pass filter for input signals. Vary the frequency of the input signal to find the cut-off frequency $f_c$, the frequency at which the gain has dropped by a factor of $\frac{1}{\sqrt{2}}$ or 0.707.

Q5: Show your calculation of the predicted cut-off frequency, and calculate the percent difference between the predicted and measured values.