George Mason University **Physics 311**

Transistor Circuits

The purpose of this lab is to understand basic transistor parameters and to analyze and build a common emitter amplifier.

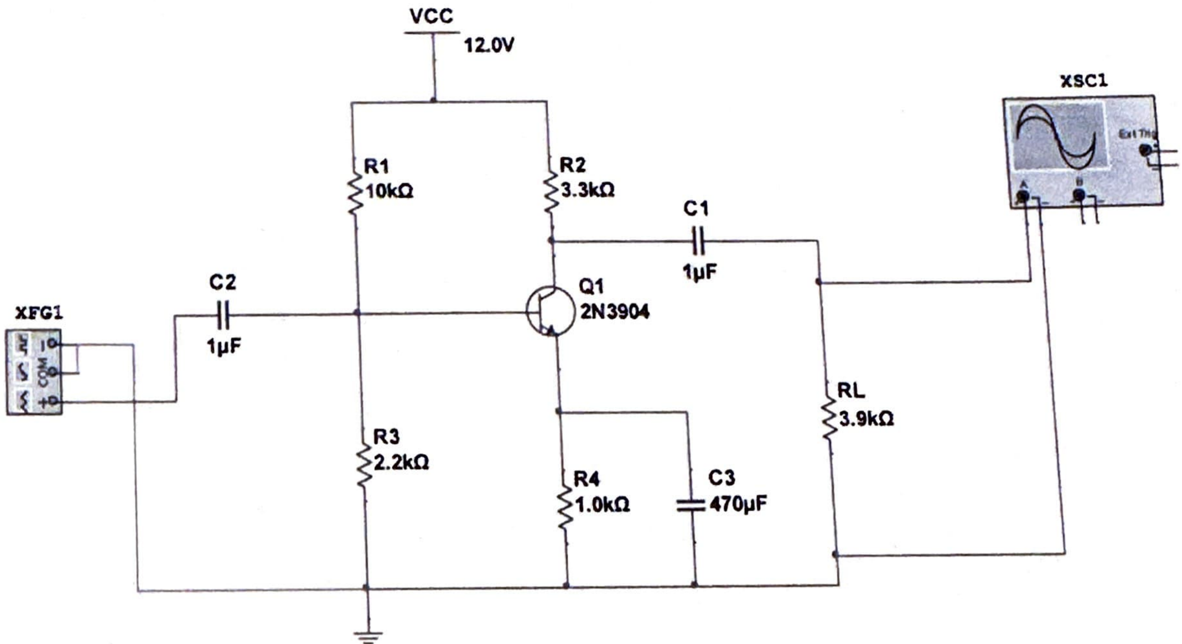

Figure 1: Transistor Amplifier Circuit

Part 1: Simulation – Predicted measurements

1. Simulate the circuit in Multisim. Do not connect the function generator or the oscilloscope at this time. Choose a digital multimeter and measure the following parameters: V_B, V_C, V_E, V_{CE}. Write down all values in your lab notebook.
2. Is the amplifier operating at or close to the load line midpoint?
3. Connect the function generator, and set it to provide an input signal of 20mV_{pp}. Set the frequency to 100 Hz.
4. Connect the scope to the transistor collector. Adjust the function generator to obtain the maximum output signal possible without clipping. Observe the shape of this output waveform. Reduce the input signal to obtain an output signal of approximately 4 V_{pp} (the exact value is not critical).

5. Set the oscilloscope coupling to DC. Measure and sketch the combined AC and DC signals at the base (V_B), emitter (V_E), and collector (V_C). Record the positive and negative peak values obtained at the collector in the waveform sketch.
6. Adjust the function generator to provide 20 mVpp input signal to the transistor base. Using your oscilloscope, measure and record V_{in} and V_{out} of the amplifier. Calculate and record the value of unloaded voltage gain.
7. Turn off the circuit power and connect the 3.9 kΩ load. Measure the input signal and output signal across the load. Record these values. Calculate the amplifier loaded voltage gain. (V_{in}, V_{out}, A_{VL}).
8. Turn off the circuit and replace the 3.9 kΩ load with 47 kΩ load. Repeat the measurements from step 7. $A_{VL} = ?$
9. Submit the Multisim file together with your report.

Part 2: Building the circuit

10. Build the circuit on your breadboard and repeat all measurements from the simulation (Step 1 through 8). Compare and discuss the difference between your simulated values and your measured values and the calculated values.
11. Is the amplifier operating at the midpoint for each load? How does the load resistance value impact the output of the amplifier?
12. What is the purpose of the 470 μF capacitor?
13. What is the purpose of the two resistors connected to the base?

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Operational Amplifier Circuits I

In this lab, you will get acquainted with essential operational amplifier circuits and parameters.

Your task is to design and build an inverting voltage amplifier using a 741 op-amp and the following resistor: $R_i = 2.2k\Omega$, $R_f = 15k\Omega$ $R_L = 1k\Omega$. DC supply voltage is set to +/- 12 V.

1. Draw a circuit diagram and build the circuit. Apply a 500m$V_{p\text{-}p}$, 1 kHz sinewave signal to the input of the amplifier.
2. Calculate the expected gain (A_v) for the amplifier.
3. Measure and record V_{in}, V_{out} and A_v.
4. Compare your calculated value of A_v with your measured values. What is the difference?
5. Now turn of the power and replace R_f with a resistor in the range of 2.2kΩ to 39 kΩ. Record your R_f and reapply power.
6. Calculate A_v.
7. Measure v_{in}, v_{out} and A_v and compare your measured A_v to your calculated A_v. Is there a significant difference? If yes, how would you explain it?
8. Comparing your measurements with two different feedback resistors, what did you learn? How does the feedback resistor influence your output?
9. Explain the gain-bandwidth product of an amplifier. How can you measure the gain bandwidth product of an amplifier? Explain.
10. Determine the gain-bandwidth product of <u>your</u> amplifier.