University of Maryland Baltimore County
Department of Computer Science and Electrical Engineering

CMPE 314 Lab 5
Common Emitter Amplifier Circuit

I. Objective

Construct and study the common-emitter amplifier circuit.

II. Introduction

A common-emitter amplifier is one of three basic single-stage bipolar-junction- transistor (BJT) amplifier topologies, typically used as a voltage amplifier. In this circuit the base terminal of the transistor serves as the input, the collector is the output, and the emitter is common to both (for example, it may be tied to ground reference or a power supply rail), hence its name.

III. Equipment and Parts

DC power supply, oscilloscope, function generator, breadboard, NPN transistor, resistors, capacitor, digital multimeter, wires and cables.

IV. Experiments and Procedures

Part (A) Pre-lab Exercise

Study the common-emitter amplifier shown in Figure 1. Set V_{CC}=8 V, R_C=2 kΩ. Assume β_F=100. Remember that a very useful tool you can use is PSPICE which can help you to verify your design and calculation. (Follow the textbook closely for the design.)

(1) Determine the values of R_1, R_2, and R_E so that the transistor is bias stable and the Q-point is in the middle of the forward active region (V_{CEQ}=4 V). Bring these values to the lab. Calculate I_{BQ}, I_{CQ} and V_{CEQ}.

(2) Determine the values of R_1, R_2 (may keep same R_E) so that the transistor is bias stable and the Q-point is near cut-off region. Bring these values to the lab. Calculate I_{BQ}, I_{CQ} and V_{CEQ}.

(3) Determine the values of R_1, R_2 (may keep same R_E) so that the transistor is bias stable and the Q-point is near saturation region. Bring these values to the lab. Calculate I_{BQ}, I_{CQ} and V_{CEQ}.

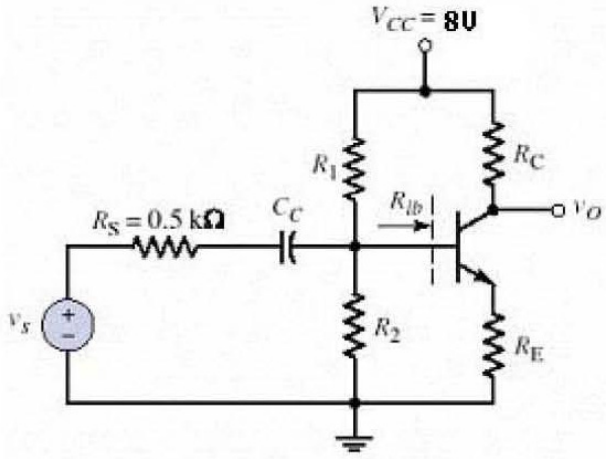

Figure 1: Common emitter circuit with NPN transistor

Part (B) Lab Procedures

(1) Set V_{CC}=8 V. Use the resistors provided for R_1, R_2, R_C, and R_E. Do not apply the AC voltage v_s. Add C_C=1 μF.

(2) Measure I_{BQ}, I_{CQ} and V_{CEQ}. Find the DC forward current gain. Compare the measured values of I_{BQ}, I_{CQ} and V_{CEQ} with the calculated values.

(3) Connect the sinusoidal voltage source v_s with amplitude ±100 mV and at frequency 10 kHz to the circuit as shown. Record down both the input voltage v_s and output voltage v_o waveforms using the 2-channel oscilloscope. Comment on the phase relationship. Find the small signal voltage gain and compare to the theoretical value.

(4) Increase the input sinusoidal voltage, and record down any signal distortion. Comment on whether it is due to cutoff clipping or saturation clipping. What is the maximum symmetric swing?

(5) Use a potentiometer as load resistor (20 MΩ). Vary and measure the resistance, record down the output waveforms. Comment how the small signal gain is influenced by the value of the load resistance, and the output impedance of the amplifier circuit.

(6) Plot the DC loadline and AC loadline.

(7) Change R_1 or R_2 value (near the cutoff region). Repeat from step (2) to (4). Comment on the results.

(8) Change R_1 or R_2 value (near the saturation region). Repeat from step (2) to (4).