Experiment 1

Single-Stage Common-Emitter Amplifier

The simulation procedures are implemented by **Proteus** software using **ISIS** tool. Open ISIS and select New Design in File menu.

Part 1: DC Simulation:

The aim of this part is to find the dc operation point of the common-emitter amplifier. Draw the circuit as shown in Figure 1.

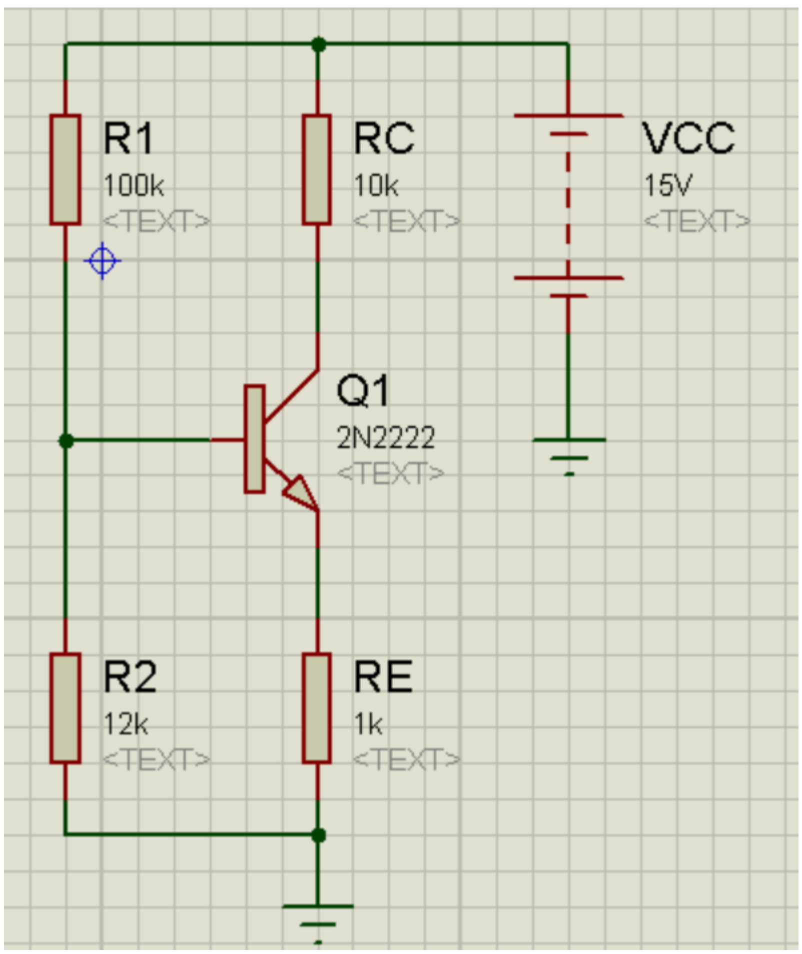

Figure 1: BJT Amplifier DC Circuit.

Select transistor, resistors and battery from Component Mode button. Select ground from Terminals Mode button. Place all the required components and route the wires (make connections). Double click on the component to edit the properties of each component. Select DC Voltmeter from Virtual Instruments Mode button and connect it across resistor to find the voltage drop on it as shown in Figure 2. Also find V_{BE} and V_{CE}.

Select DC Ammeter from Virtual Instruments Mode button and connect it to find the current through transistor terminals (I_B, I_C and I_E) as shown in Figure 3. Calculate common-emitter current-gain, $\beta = \frac{I_C}{I_B}$, and common-base current-gain, $\alpha = \frac{I_C}{I_E}$.

Figure 3: Ammeter Connections.

Part 2: Voltage Gain Simulation:

Draw the circuit as shown in Figure 4. Select VSINE (from Component Mode button) as input voltage source and adjust it at a frequency 10 KHz and amplitude 100 mV. Connect Oscilloscope (from Component Mode button) at input and output nodes. Find peak values of input and output voltages using Cursor as shown in Figure 5. Vs= and vo= . Calculate voltage gain by $A_V = \frac{V_{out}}{V_s}$. Compare input signal with output signal.

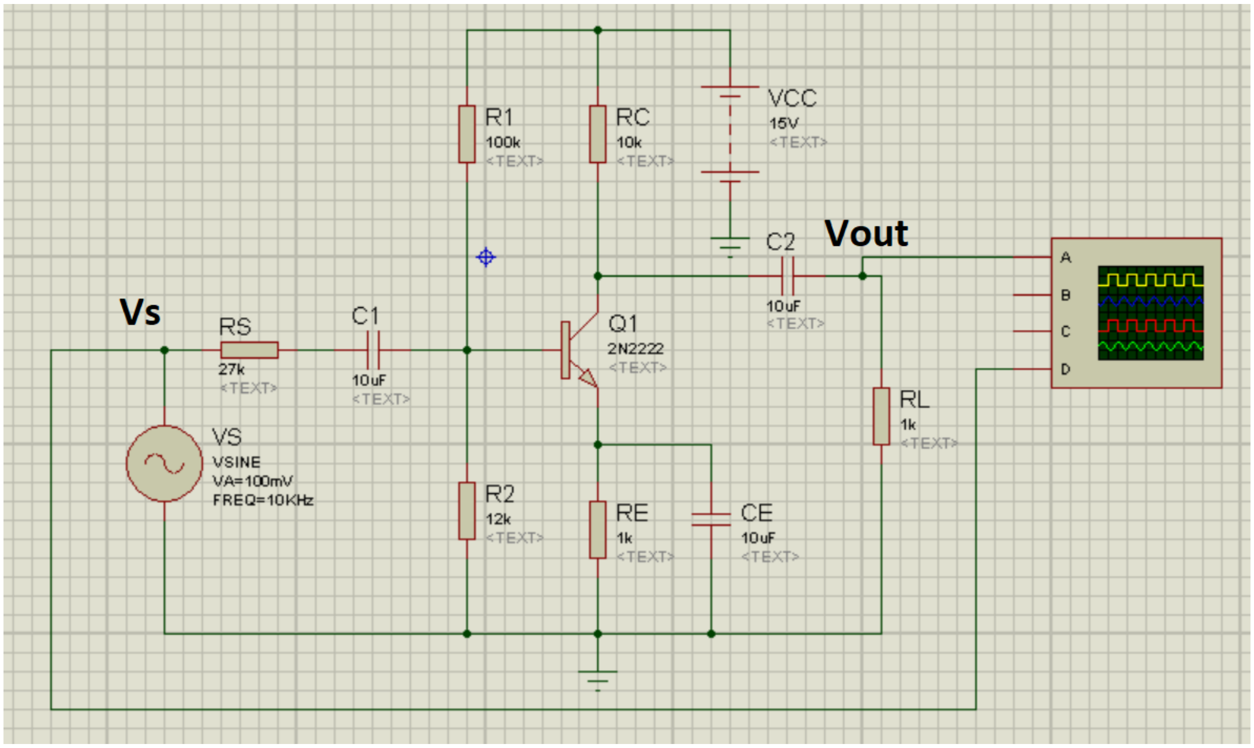

Figure 4: BJT Common-Emitter Configuration.

Part 3: Input Resistance Calculation:

Remove R_S and V_S . Connect an external supply V_x in series with a resistor R_x as shown in Figure 6. Connect oscilloscope to nodes V_x and V_{x1}. Find the peak values of V_x and V_{x1} using Cursor as shown in Figure 7.

Vx= and Vx1=.

Calculate input current, I_x , by: $I_x = \frac{V_x - V_{x1}}{R_x}$

Calculate input resistance, R_{in}, as: $R_{in} = \frac{V_x}{I_x}$

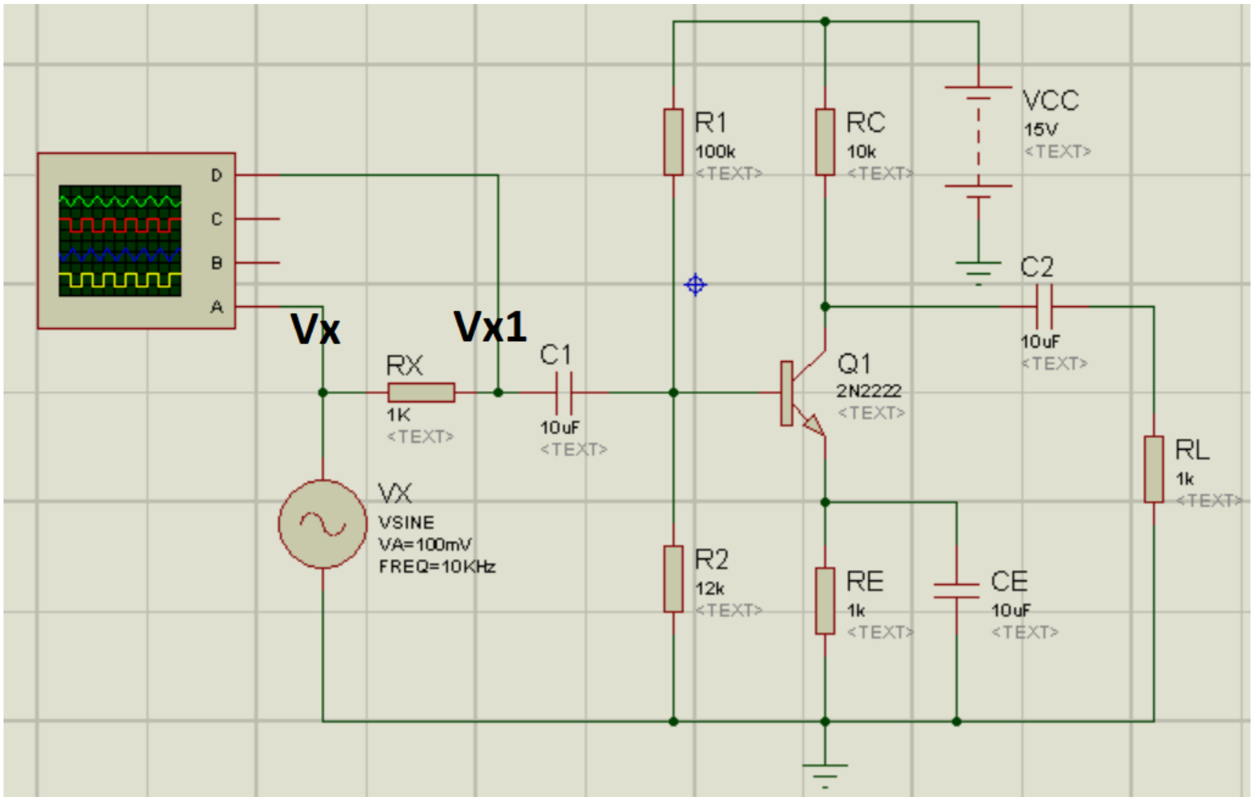

Figure 6: Setup for Calculating Input Resistance.

Part 4: Output Resistance Calculation:

Remove input source V_S and R_L. Connect V_x and R_x at amplifier's output as shown in Figure 8. Connect oscilloscope to nodes V_x and V_{x1}. Find the peak values of V_x and V_{x1} using Cursor as shown in Figure 9.

Vx= and Vx1=.

Calculate output current, I_x, by: $I_x = \frac{V_x - V_{x1}}{R_x}$

Calculate output resistance, R_{out}, as: $R_{out} = \frac{V_x}{I_x}$

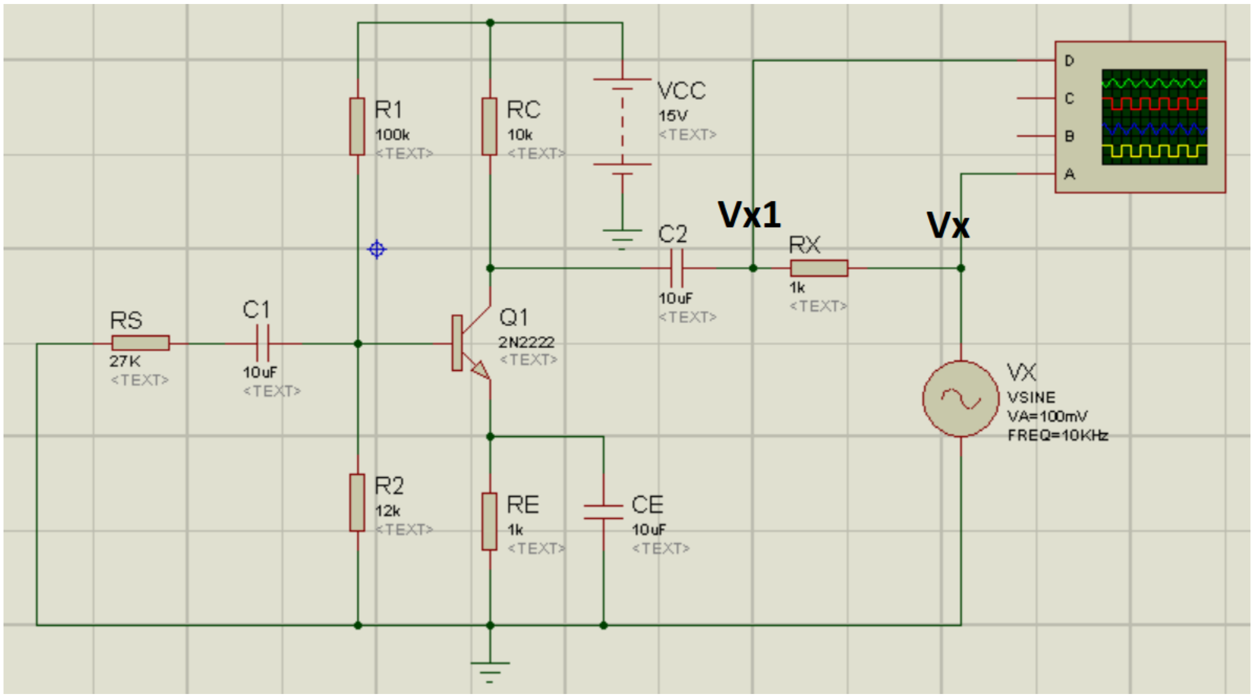

Figure 8: Setup for Calculating Output Resistance.

Experiment 2

RC Coupled Multistage Amplifier

Part 1: Simulation of Single-Stage Common-Emitter Amplifier:

Draw the circuit as shown in Figure 1. Connect the signal generator (VSINE) with 50 $mV_{p\text{-}p}$ at 1KHz to the input of the amplifier. Connect oscilloscope to find the no-load AC output voltage. Run the simulation. The AC input and output signal will be displayed on the oscilloscope screen as shown in Figure 2. From simulation the peak values of input and output signals are $V_s = 25mV$ and $V_o = 240mV$. Calculate the open-circuit unloaded voltage gain by $A_o = \frac{V_o}{V_s}$. Determine input resistance, $r_{in(stage)}$, and output resistance , $r_{o(stage)}$, as described in the previous experiment.

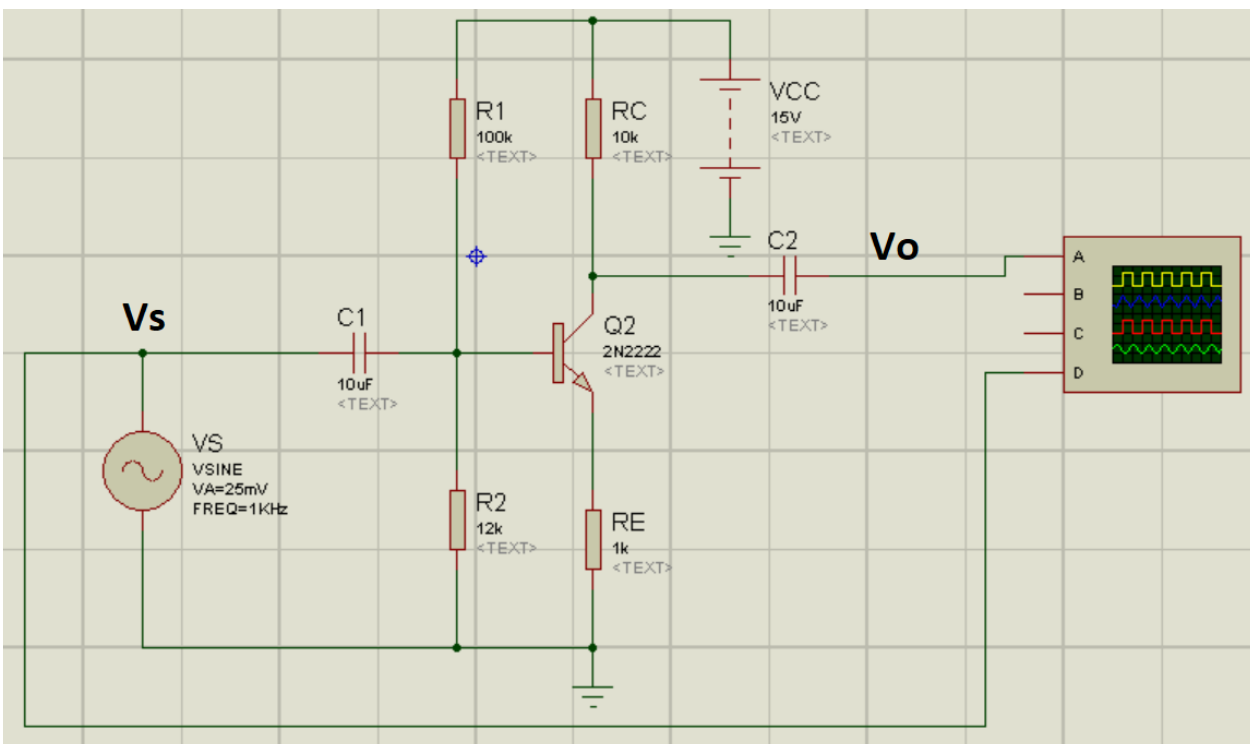

Figure 1: Single-Stage Common-Emitter Amplifier.

From Figure 3, you can calculate input current, I_x, by: $I_x = \frac{V_x - V_{x1}}{R_x} =$ and the input resistance, $r_{in(stage)}$, by: $r_{in(stage)} = \frac{V_x}{I_x}$. From Figure 4, the output current, I_x, can be determined by: $I_x = \frac{V_x - V_{x1}}{R_x} =$ and the output resistance, $r_{o(stage)}$, by: $r_{o(stage)} = \frac{V_x}{I_x}$.

Part 2: Simulation of Two-Stage Common-Emitter Amplifier:

Draw the two-stage common-emitter amplifier as displayed in Figure 5. At input node the signal generator VSINE set at $50mV_{p\text{-}p}$ and 1KHz. Connect oscilloscope at the input and the output of the cascaded two-stage amplifier. Determine the overall voltage gain (G_V) using the signals displayed in Figure 6, $G_V = \frac{V_L}{V_S} =$.

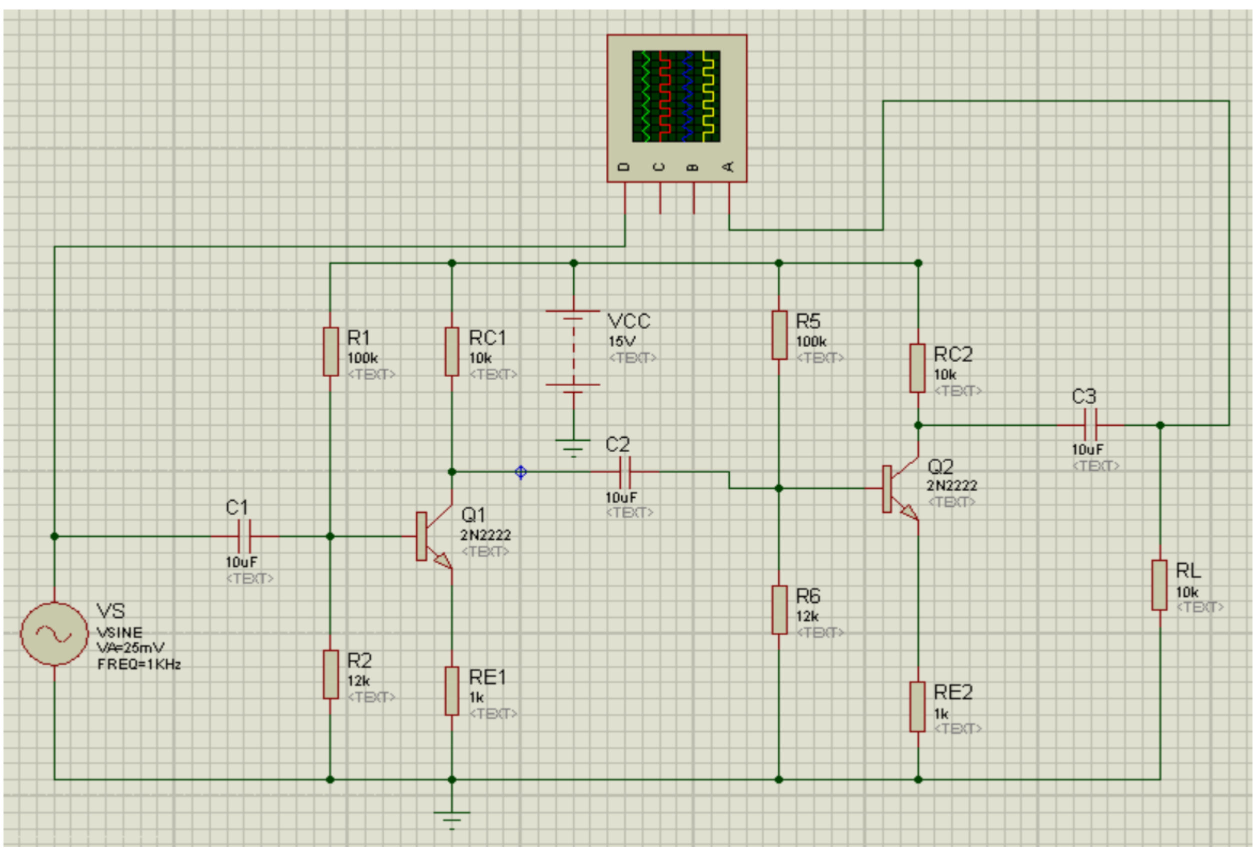

Figure 5: Two-Stage Common-Emitter Amplifier Simulation.

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Experiment 3

Direct Coupled Multistage Amplifier

Part 1:

Connect the direct coupled two-stage common-emitter amplifier as shown in Figure 1. At the input node adjust DC power supply at 1.5V. Connect DC Voltmeter. Record DC voltage, $V_{RC1} =$, $V_{RE1} =$, $V_{C1} =$, $V_{RC2} =$, $V_{RE2} =$, and $V_{C2} =$.

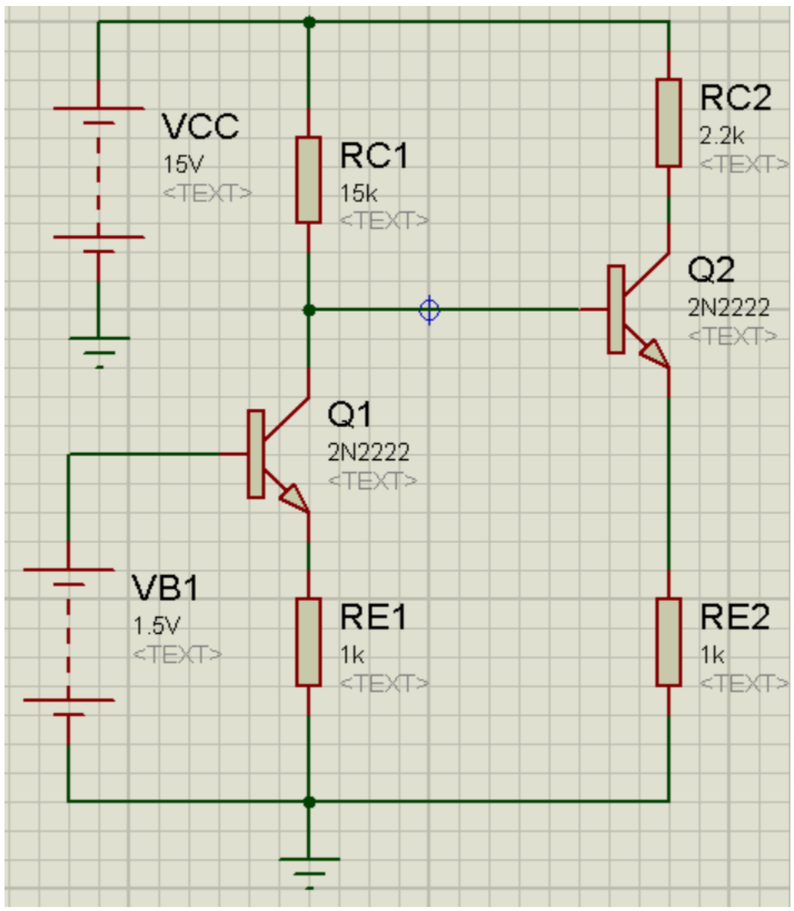

Figure 1: Direct Coupled Two-Stage Common-Emitter amplifier.

In Figure 3, adjust the DC power supply to set V_{B1}=1.4V and use DC voltmeter to record DC voltage at collector node of Q_2, $V_{C2} =$. Increase DC power supply until V_{B1} is 1.6V and record DC voltage $V_{C2} =$. The overall voltage gain, A_v, can be determined by: $A_v = \frac{\Delta V_{C2}}{\Delta V_{B1}}$.

Connect 10KΩ load to the amplifier between the collector of Q_2 and ground. Repeat the previous steps. G_v, can be calculated by: $G_v = \frac{\Delta V_{C2}}{\Delta V_{B1}}$

Part 2:

In the second stage of the amplifier, change the NPN transistor (Q_2) to PNP transistor as shown in Figure 7. Repeat the procedure steps to find the unloaded overall voltage gain, A_v, by $A_v = \frac{\Delta V_{C2}}{\Delta V_{B1}}$.

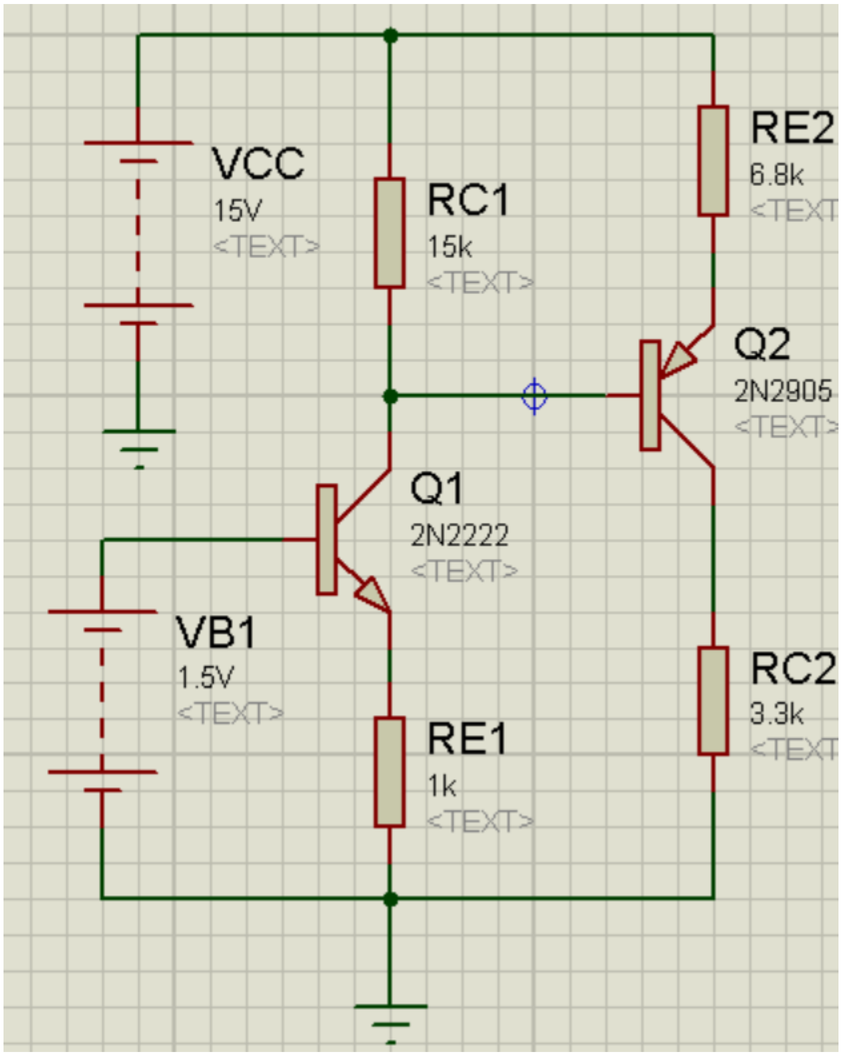

Figure 7: Direct Coupled Two-Stage Amplifier Using NPN Transistor in the Second Stage.

Experiment 4

Frequency Response of Single-Stage Common-Emitter Amplifier

Connect the common-emitter amplifier as shown in Figure 1. Connect function generator (VSINE) at the input of the amplifier circuit. Set input voltage at 10 mV and frequency at 10 Hz. Connect the oscilloscope at the input and the output of the amplifier circuit. Observe the amplified signal in Figure 2. Record amplitude of output signal in the table. Increase frequency from function generator to 10 MHz and repeat the above step. Calculate voltage gain for different frequencies and gain in dB. Plot the frequency response.

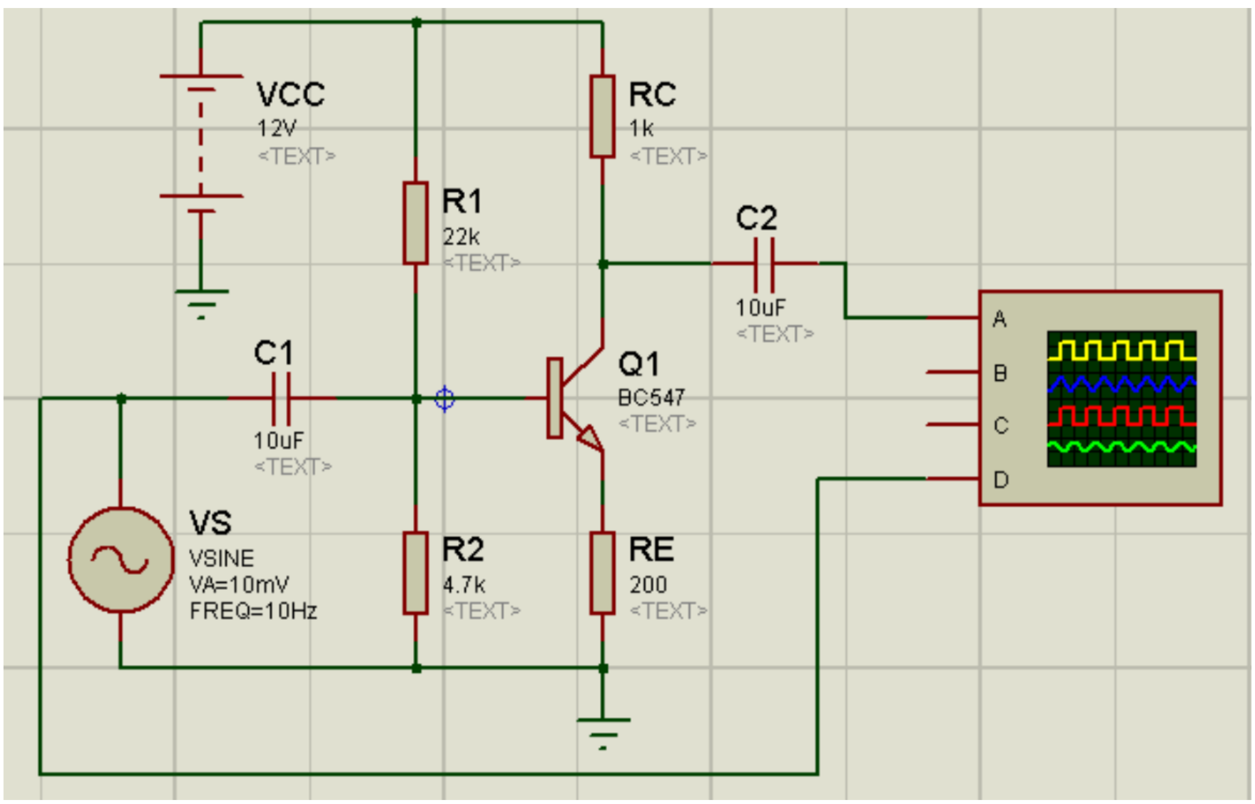

Figure 1: Single-Stage Common-Emitter Amplifier.

Table 1: Voltage Gain Results

Frequency at input	Output Voltage	Voltage Gain	Gain in dB
10 Hz			
50 Hz			
500 Hz			
500 kHz			
1 MHz			
10 MHz			

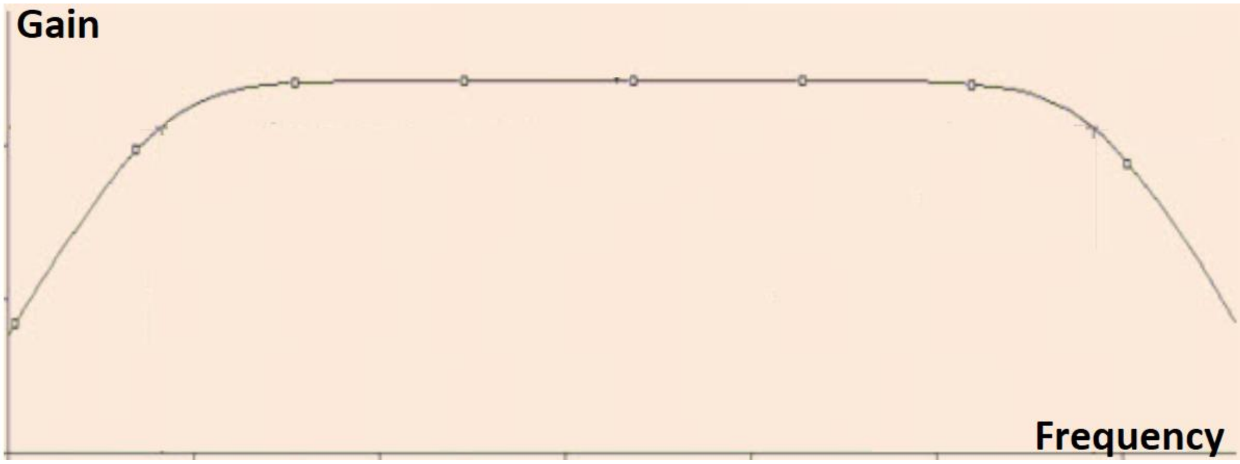

Figure 8: Frequency Response of Common-Emitter Amplifier.

Experiment 5

Frequency Response of Two-Stage Common-Emitter Amplifier

Connect the two-stage common-emitter amplifier as shown in Figure 1. Connect function generator (VSINE) at the input of the amplifier circuit. Set input voltage V_1=1 mV and frequency at 100 Hz. Connect the oscilloscope at the output of the first amplifier circuit at point V_2. Observe the amplified signal at V_2 (green wave in Figure 2). Record in the table, the amplitude of the output signal, V_2, and the gain of the first stage $A_1 = \frac{V_2}{V_1}$.

Observe the amplified signal at the output of the second amplifier at point V_3 (blue wave in Figure 2). Record the amplitude of the output signal, V_3, and the gain of the second stage $A_2 = \frac{V_3}{V_2}$. Find overall gain of amplifier $A = \frac{V_3}{V_1} = A_1 A_2$.

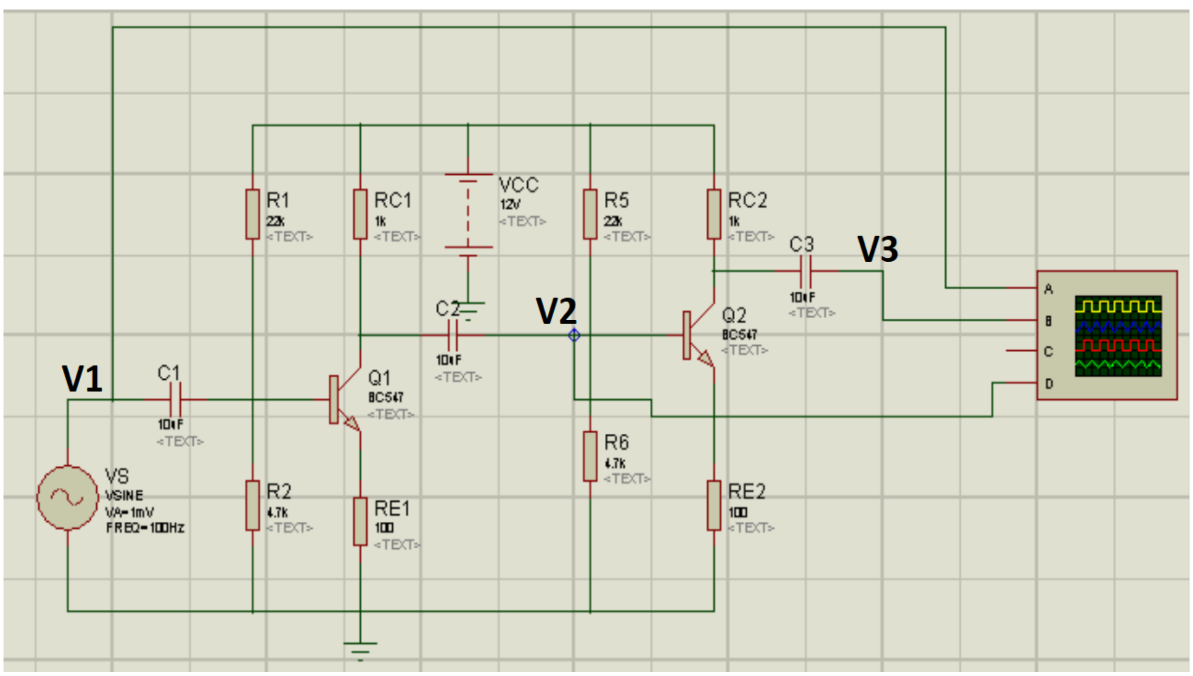

Figure 1: Two-Stage Common-Emitter Amplifier

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Increase frequency from function generator to 10 MHz and repeat the above steps. Calculate voltage gain for different frequencies and gain in dB. Plot the frequency response.

Table 1: Voltage Gain Results

Frequency at input	Output Voltage V3	Voltage Gain	Gain in dB
100 Hz			
:			
500 Hz			
100 kHz			
:			
500 kHz			
: :			