Skill Experiment 2: Common Emitter (CE) Amplifier

Aim:

To design and study the voltage gain, input and output waveforms, and frequency response of a Common Emitter (CE) Amplifier using an NPN transistor.
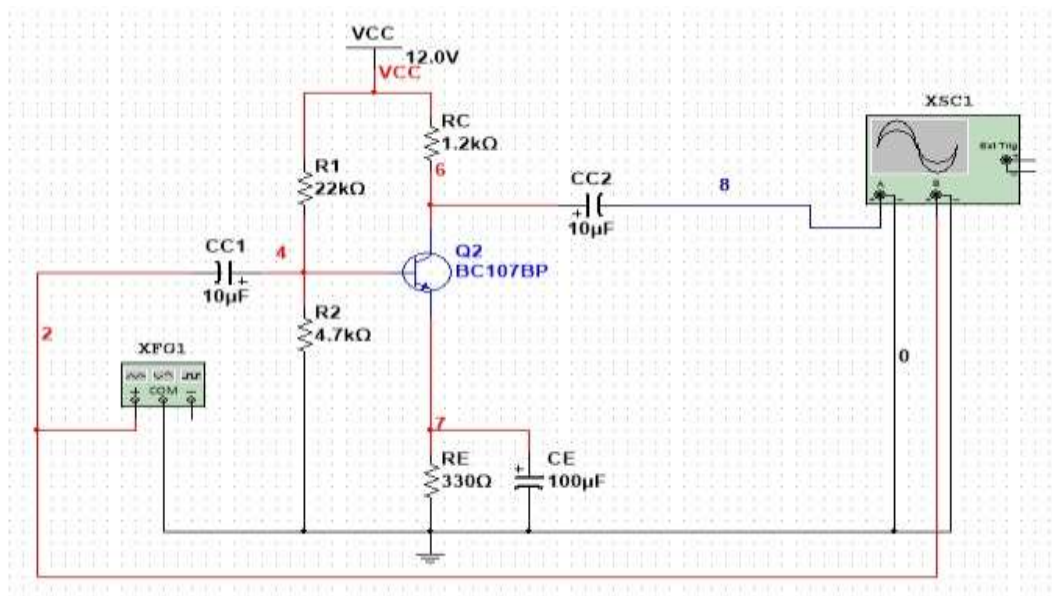
Apparatus Required:

S. No	Component/Equipment	Specification	Quantity
1	NPN Transistor	BC547 / BC107	1
2	Resistors	1kΩ, 10kΩ, 100kΩ	As req.
3	Capacitors	0.1µF, 10µF, 100µF	As req.
4	Signal Generator	1Hz to 1MHz	1
5	Dual DC Power Supply	0–30V	1
6	Breadboard	–	1
7	CRO (Oscilloscope)	20 MHz or higher	1
8	Connecting Wires	–	As req.

Pre-Lab Questions:

1. What is the function of a transistor in amplifier mode?

2. Why is the emitter terminal grounded in CE configuration?

3. What is the role of the coupling and bypass capacitors?

4. Define voltage gain in CE amplifier.

5. What is phase shift in CE amplifier?

Circuit Diagram

Procedure:

1. **_To find the operating point:_**

- Open NI Multisim software.
- Create a new design by selecting File → New → Design.
- From the component library, place the components required onto the workspace.
- Place multimeters or voltage probes at the base, collector, and emitter terminals to measure voltages V_B, V_C, and V_E respectively.
- Optionally, place a current probe at the collector to measure I_C.
- From the top menu, go to Simulate → Analyses and Simulation.
- In the dialog box, select DC Operating Point analysis.
- Click Simulate or press F5 to run the analysis.
- Observe the output values of V_B, V_C, V_E, and I_C either from the probes or from the output table.
- Calculate V_{CE} using the values obtained: $V_{CE} = V_C - V_E$.

2. **_To obtain the frequency response:_**

- Connect an AC input signal source (V_{IN}) with a small amplitude (e.g., 10 mV peak) and frequency sweep capability to the base of the transistor through a coupling capacitor.
- From the top menu, go to Simulate → Analyses and Simulation.
- In the dialog box, select AC Analysis.
- Set the frequency range for sweep (e.g., Start: 1 Hz, Stop: 1 GHz) and use a Decade sweep type and Decibel scale for better visibility of the response.
- Choose the output variable as the gain by adding expression as output voltage / input voltage.
- Run the simulation by clicking Simulate.
- The graph window will display the frequency response (Gain vs Frequency plot).
- On the graph, click the cursor icon to activate measurement cursors.
- Use Cursor 1 and Cursor 2 to find the -3 dB points, i.e., the frequencies where the gain drops 3 dB below the mid-band gain.
- Note down the mid-band gain (flat portion in dB), usually the highest constant region of the gain plot.
- Calculate the bandwidth as the difference between the upper and lower -3 dB frequencies: Bandwidth = $f_H - f_L$.
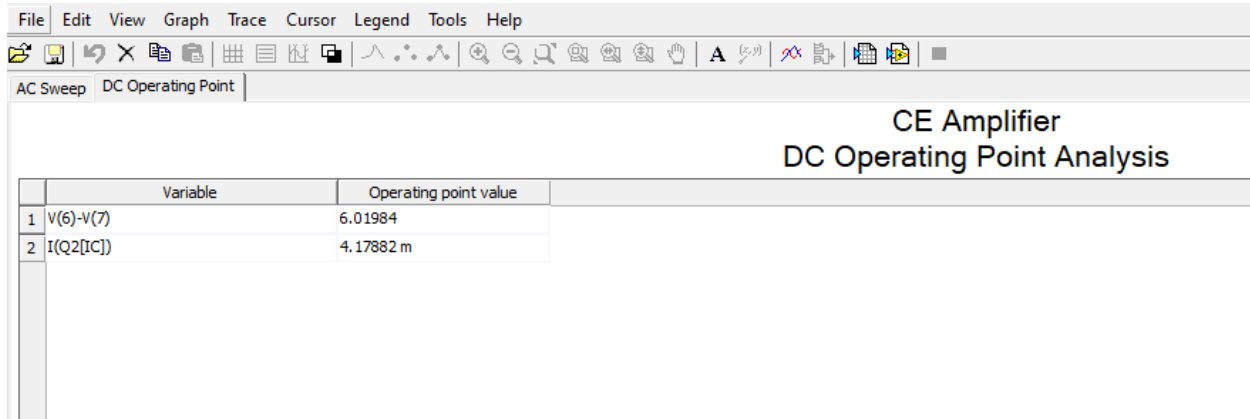
Expected graph:

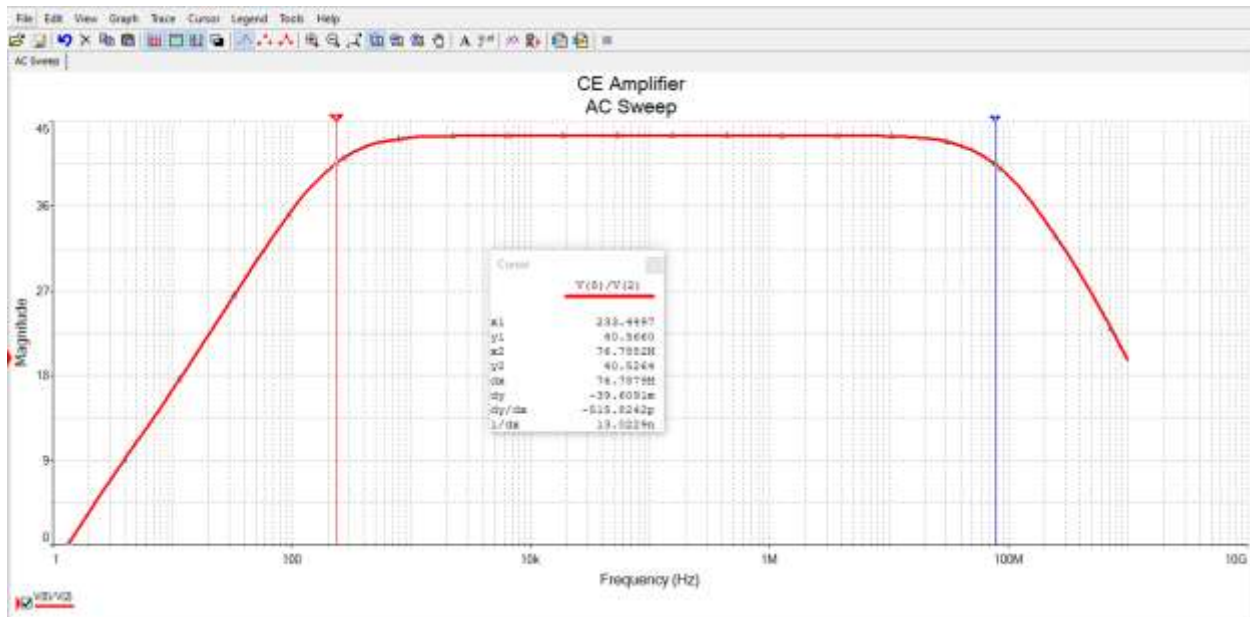

Fig: DC Operating Point of the CE Amplifier

Fig: Frequency response of the CE Amplifier with cursors pointing Midband gain and the Cutoff frequencies to calculate Bandwidth

Post Lab Tasks:

- Calculate the voltage gain (Av).

- Determine the phase shift between input and output.

- Sketch input/output waveforms and frequency response.

- Write observations and conclusions.

Viva Questions:

1. What is the typical phase shift in CE amplifier?

2. Why is voltage gain high in CE configuration?

3. What is the effect of the bypass capacitor?

4. How does input and output impedance behave in CE amplifier?

5. What are the advantages of CE over CB and CC configurations?

Evaluator Remark (if Any):	
	Marks Secured: _____ out of 50
	Signature of the Evaluator with Date