CSE 251

Electronic Devices and Circuits

Fall 2022

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Section: 07

Group: 01

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Circuit Diagrams:

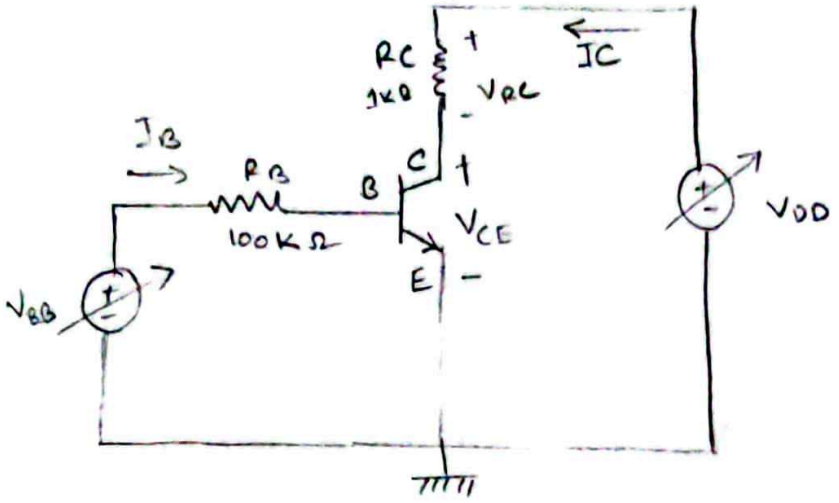

Fig: Circuit for determing I-V characteristics of BJT

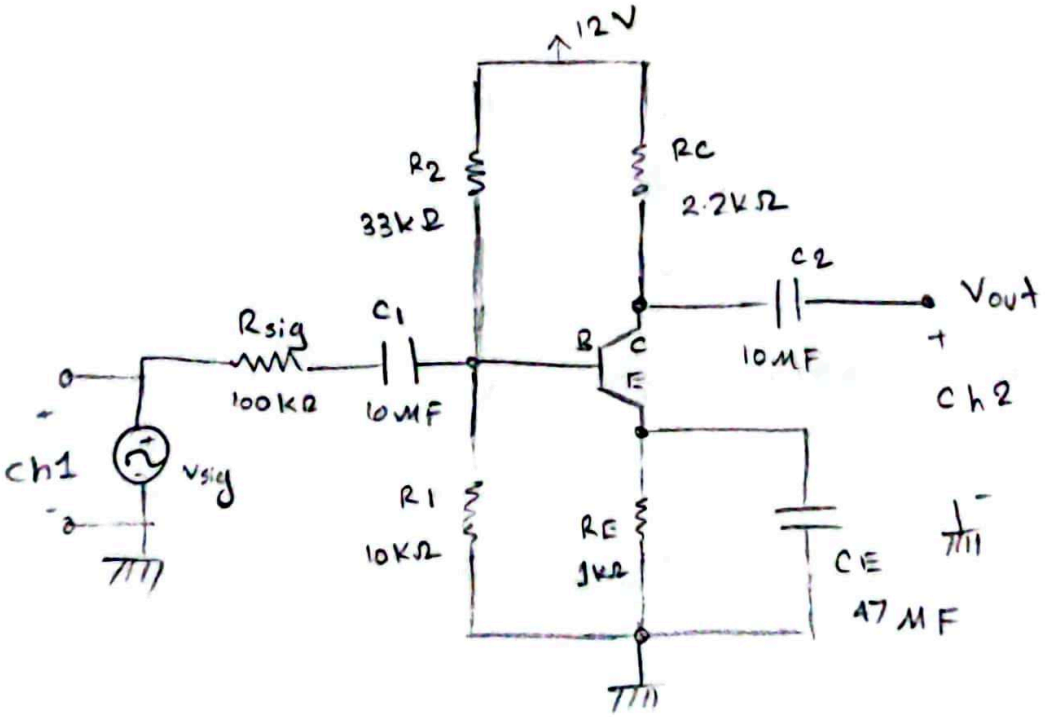

Fig: BJT CE Amplifier Circuit

Data Table 1: Output IV Characteristics

Use Multimeter to get, actual value of R_B = 97.2kΩ and R_C = 0.986kΩ

(1) V_{BB} = 2 V

V_{DD} (V)	$I_B = \frac{V_{BB}-0.7}{R_B[k\Omega]} \times 10^3$ (μA)	V_{CE} (V)	V_{RC} (V)	$I_C = \frac{V_{RC}}{R_C[k\Omega]} \times 10^3$ (μA)	$\beta = \frac{I_C}{I_B}$
0	13.374	6.0mV	23.5mV	23.833	1.782
0.1		31.2mV	51.1mV	51.825	3.875
0.2		47.0mV	114.7mV	116.328	8.698
0.3		58.0mV	267.8mV	270.791	20.247
0.4		62.8mV	285.0mV	289.858	21.673
0.5		76.9mV	0.449V	455.375	34.049
0.6		89.5mV	0.506V	513.184	38.371
0.7		88.8mV	0.598V	606.490	45.348
0.8		95.1mV	0.693V	702.839	52.552
0.9		97.1mV	0.778V	789.046	58.998
1		101.2mV	0.930V	943.204	70.525
2		135.0mV	1.873V	1899.594	142.036
3		179.6mV	2.788V	2827.586	211.424
4		232.3mV	3.742V	3521.298	263.289
5		0.920V	4.003V	4065.922	304.016
6		1.937V	4.054V	4107.505	307.126
7		2.872V	4.080V	4137.931	309.401
8		3.824V	4.13V	4188.640	313.192

(2) V_{BB} = 2.5 V

V_{DD} (V)	$I_B = \frac{V_{BB}-0.7}{R_B[k\Omega]} \times 10^3$ (μA)	V_{CE} (V)	V_{RC} (V)	$I_C = \frac{V_{RC}}{R_C[k\Omega]} \times 10^3$ (μA)	$\beta = \frac{I_C}{I_B}$
0	18.518	5.7mV	4.8mV	4.868	0.262
0.1		22.6mV	55.0mV	55.750	3.012
0.2		40.1mV	112.2mV	113.79	6.144
0.3		56.2mV	220.8mV	223.935	12.092
0.4		55.2mV	313.3mV	317.748	17.158
0.5		72.5mV	0.435V	441.176	23.824
0.6		76.0mV	0.482V	488.843	26.398
0.7		78.2mV	0.620V	628.803	33.956
0.8		84.4mV	0.674V	683.569	36.913
0.9		89.4mV	0.771	781.989	42.230
1		95.5mV	0.861	873.225	47.155
2		122.2mV	1.859	1879.310	101.485
3		149.2mV	2.814	2853.955	154.117
4		174.2mV	3.779	3827.586	206.695
5		225.2mV	4.71	4776.876	257.958
6		0.621V	5.29	5365.111	289.724
7		1.690V	5.36	5436.105	293.557
8		2.556V	5.42	5496.957	296.844

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(2) $V_{BB} = 3$ V

V_{DD} (V)	$I_B = \frac{V_{BB}-0.7}{R_B[k\Omega]} \times 10^3$ (μA)	V_{CE} (V)	V_{RC} (V)	$I_C = \frac{V_{RC}}{R_C[k\Omega]} \times 10^3$ (μA)	$\beta = \frac{I_C}{I_B}$
0	23.662	6.3mV	4.8mV	4.868	0.205
0.1		28.5mV	74.5mV	75.557	3.193
0.2		38.1mV	142.5mV	144.523	6.107
0.3		51.9mV	234.1mV	237.728	10.046
0.4		67.1mV	340.2mV	345.638	14.607
0.5		65.2mV	389.0mV	394.523	16.673
0.6		71.1mV	0.485V	491.866	20.788
0.7		74.0mV	0.547V	554.766	23.445
0.8		78.9mV	0.723V	733.265	30.989
0.9		89.7mV	0.762V	772.819	32.606
1		86.2mV	0.817V	828.600	35.018
2		116.9mV	1.921V	1948.775	82.337
3		132.7mV	2.805V	2844.827	120.227
4		153.2mV	3.91V	3965.517	167.590
5		179.5mV	4.878V	4908.722	207.451
6		220.5mV	5.76V	5841.784	246.884
7		0.410V	6.57V	6663.286	281.602
8		1.2V	6.68V	6774.847	286.317
9		2.10V	6.75V	6845.841	289.317
10		3.08V	6.81V	6906.693	291.889

Task-02: BJT Common Emitter (CE) Amplifier

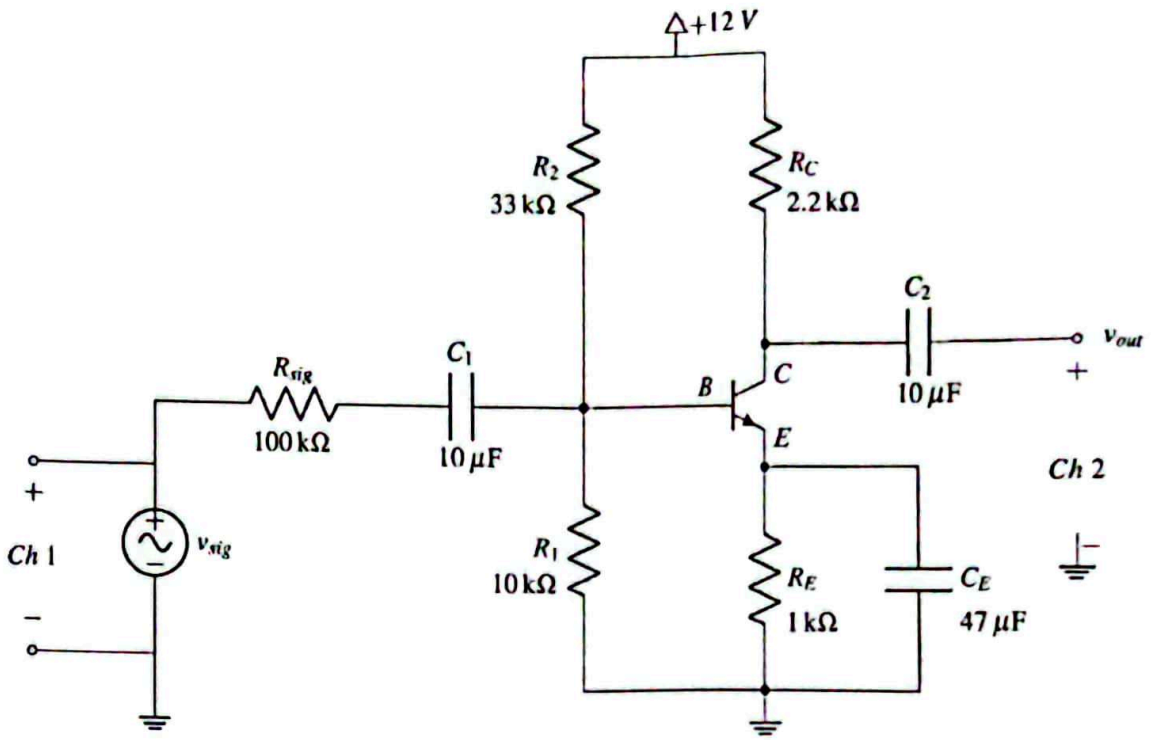


Figure 8: BJT CE Amplifier Circuit

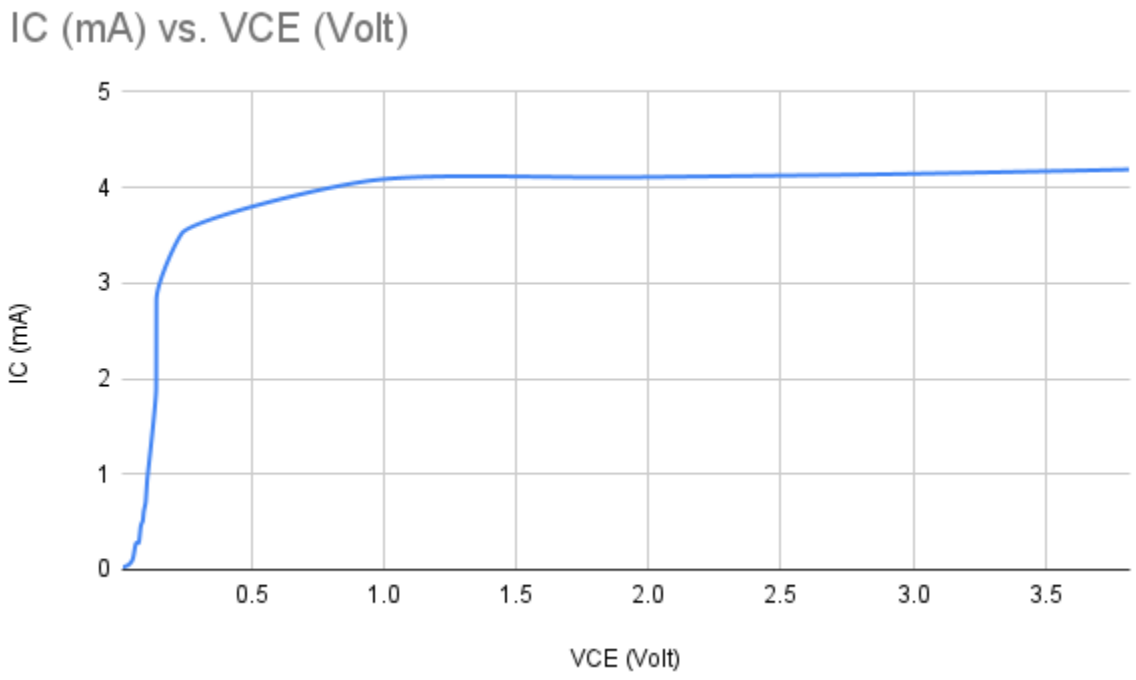
Procedure

1. Construct the circuit given above.
2. Apply a signal voltage of 150 mV (peak-to-peak) and frequency 1 kHz at the input terminals. Connect Ch.1 at the input between base and ground and Ch.2 at the output terminals. Measure peak-to-peak value of both $v_{sig} = v_{in}$ and v_{out}.
3. Observe Ch.1 and Ch.2 at the same time to observe the relationship between input and output voltage.

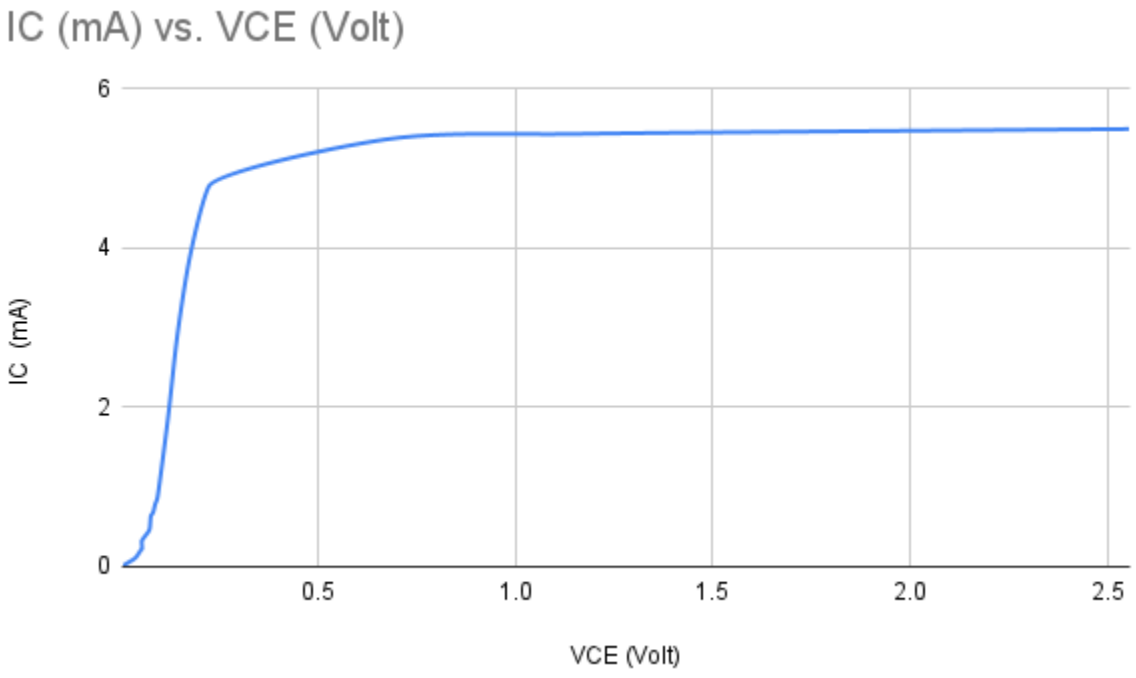
Data Table 2: Common Emitter Amplifier

Amplitude of the input signal, v_{sig} (from signal generator) (mV)	Amplitude of the output signal, v_{out} (from oscilloscope) (V)	Gain = $\frac{\lvert v_{sig} \rvert}{\lvert v_{out} \rvert}$
74.994	140 · 113 mV	0.535

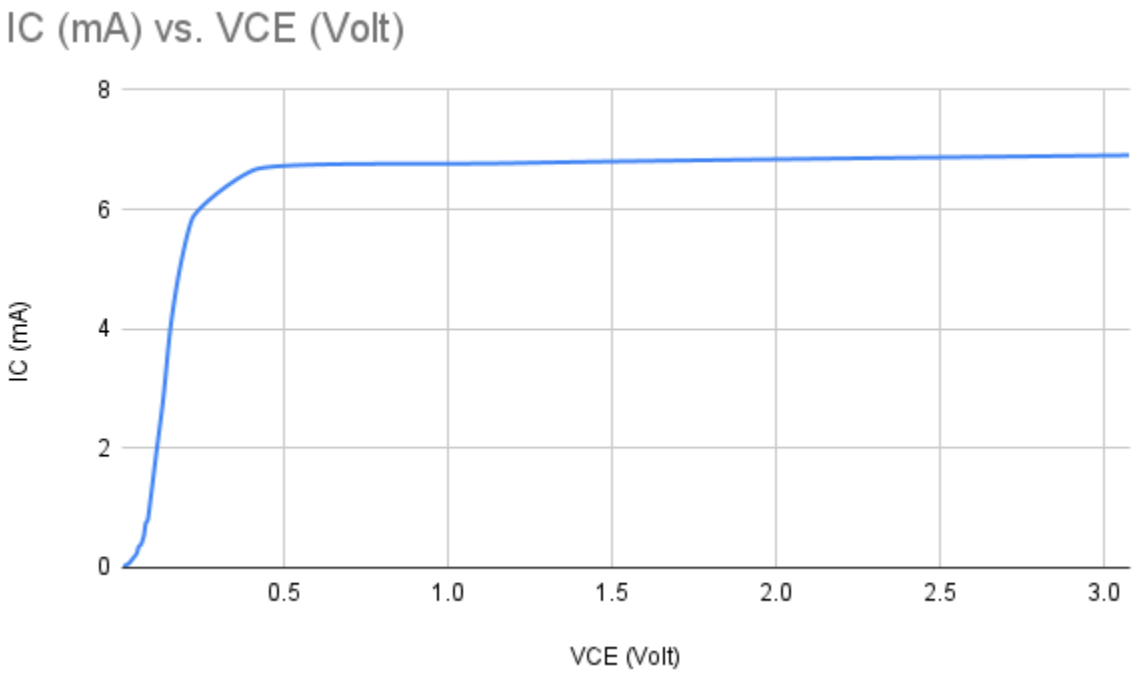
Graph 1: For V_{BB} = 2V



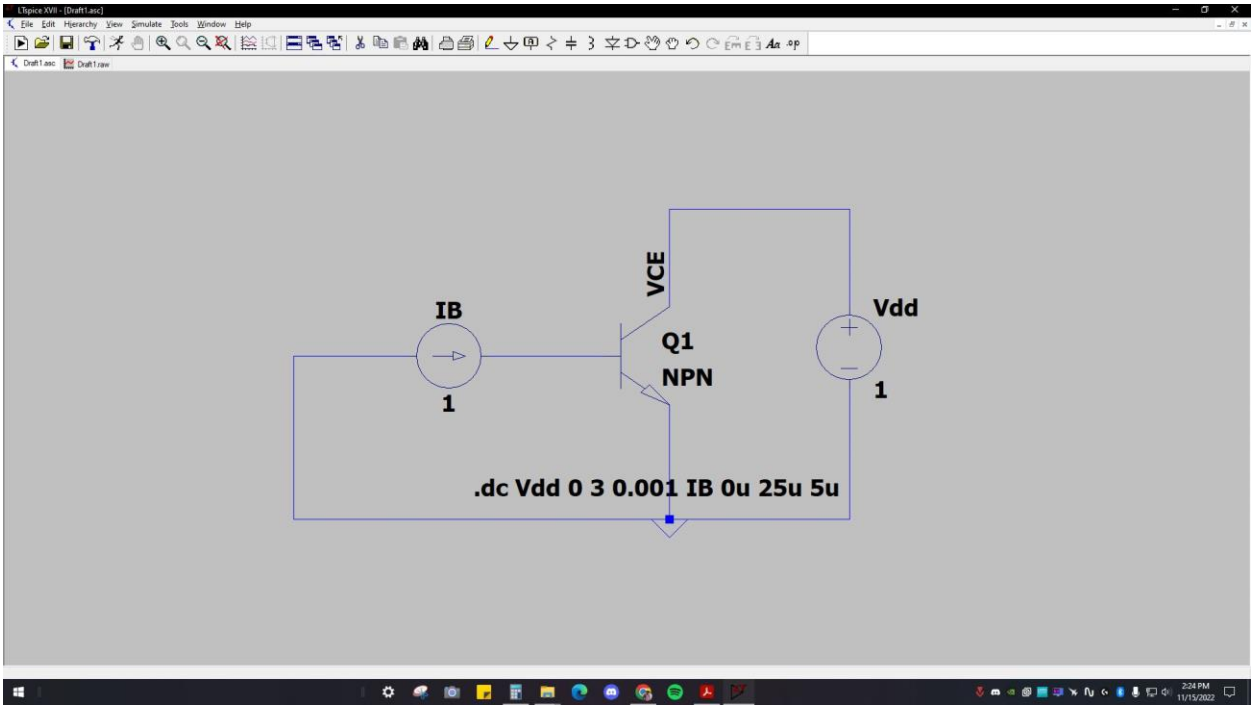
Graph 2: For V_{BB} = 2.5V

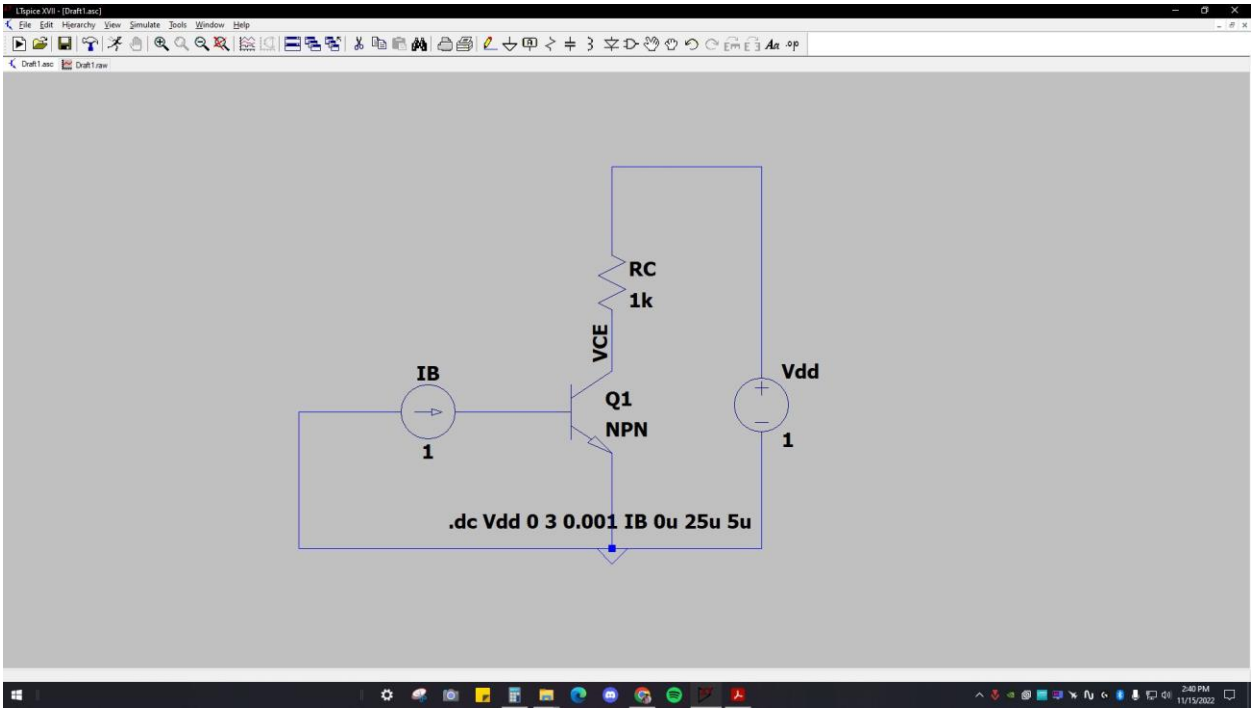


Graph 3: For V_{BB} = 3V

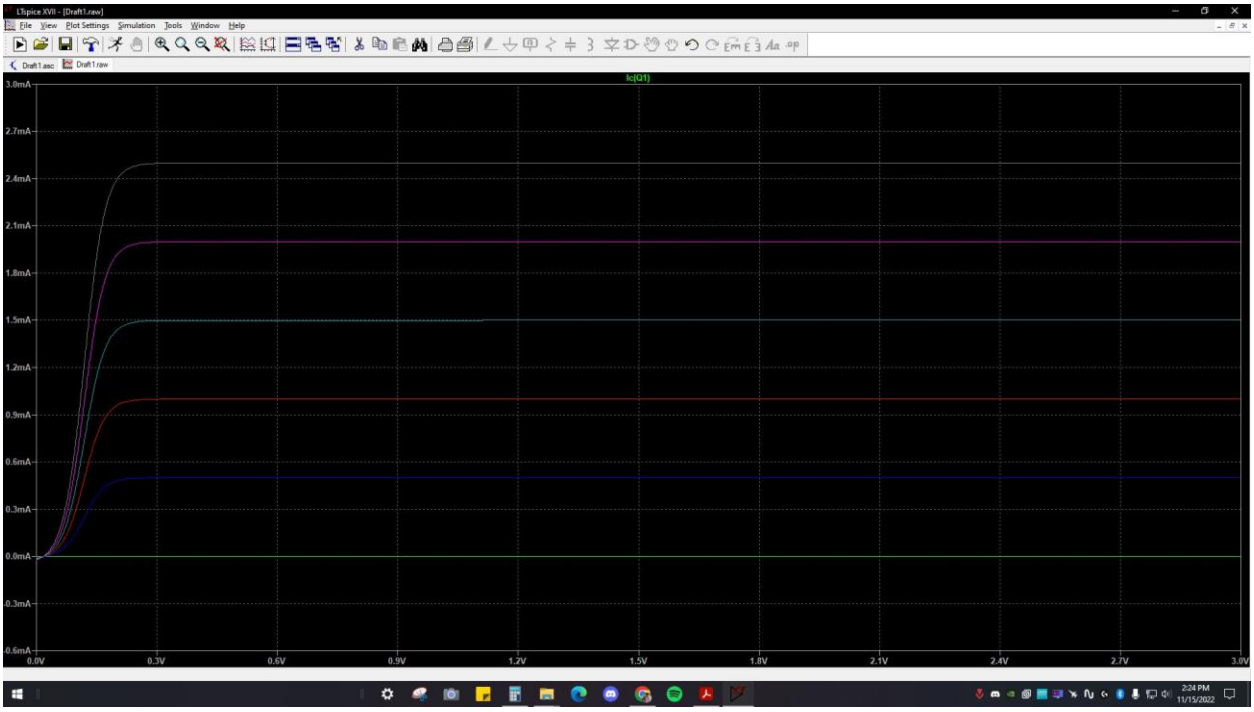


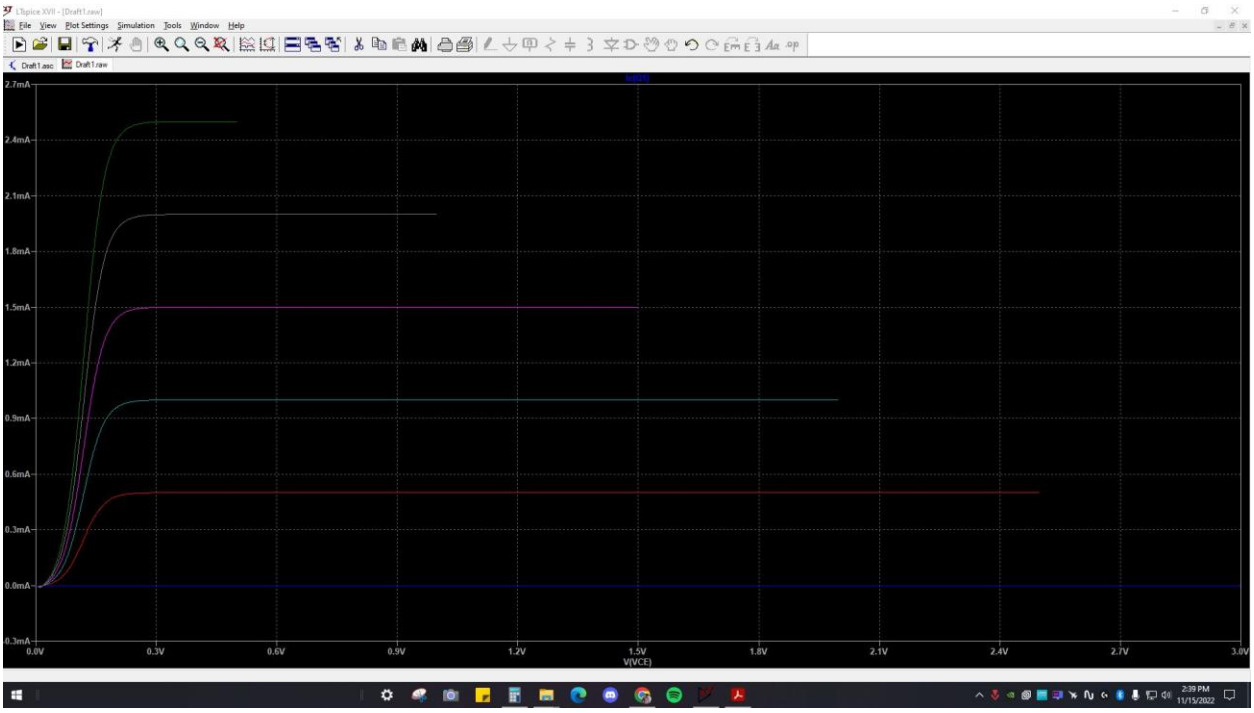
LTspice Circuit diagrams:





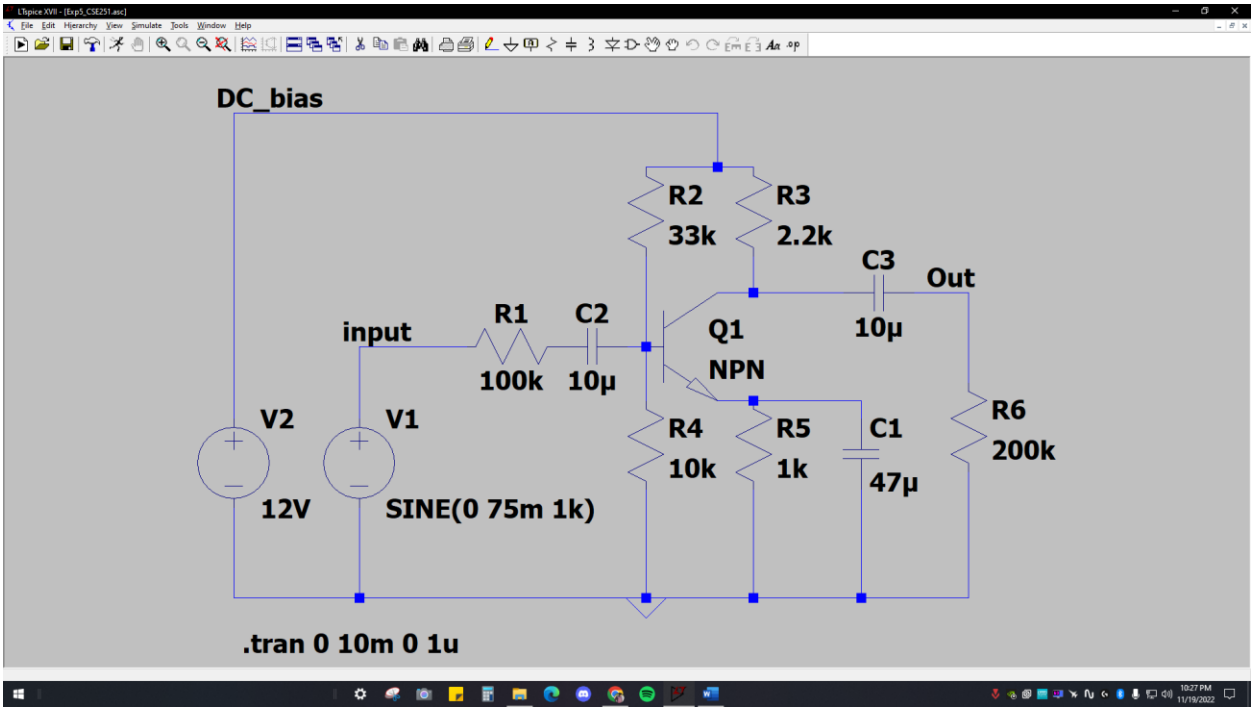
Plots Generated:



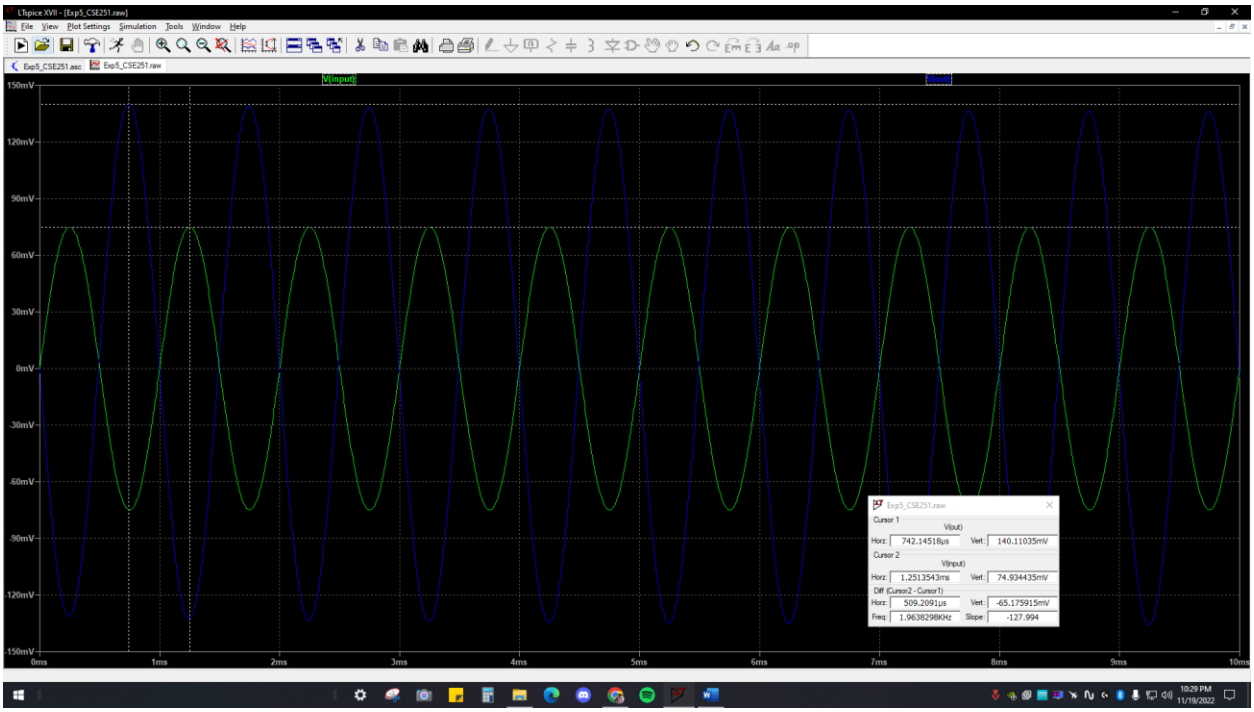


BJT Common Emitter Amplifier:

Circuit:



Graph:



Discussion:

In this lab we were introduced to a three terminal semiconductor named BJT. It is a type of transistor that is used for electrical amplification. We used a npn configured BJT. It is a current controlled device. As a current source is difficult to implement, we used voltage source in series with a resistor to provide current to the BJT. After designing the circuit we measured V_{CE} and V_{RC}, then calculated I_C and plotted in the graph to observe the saturation and active region. Next, in active mode as BJT acts like a amplifier, we implemented a CE amplifier with it. In our lab, the jumper wire were out of order and malfunctioning, thus we couldnot get the desired output. Later, by using LTspice we implemented the circuit to get those values.