Ryerson University

Department of Electrical, Computer, & Biomedical Engineering
Faculty of Engineering & Architectural Science

Course Title:	Electronic Circuits I
Course Number:	ELE 404
Semester/Year (e.g.F2016)	W2025

Instructor:	Md sadid haque waselul

Assignment/Lab Number:	5
Assignment/Lab Title:	Lab 5: Common-Emitter (CE) Amplifier

Submission Date:	03-16-25
Due Date:	03-16-25

Student LAST Name	Student FIRST Name	Student Number	Section	Signature*
Taing	Ryan	501093407	11	R.T.
Malik	Hamza	501112545	11	H.M.

*By signing above you attest that you have contributed to this written lab report and confirm that all work you have contributed to this lab report is your own work. Any suspicion of copying or plagiarism in this work will result in an investigation of Academic Misconduct and may result in a "0" on the work, an "F" in the course, or possibly more severe penalties, as well as a Disciplinary Notice on your academic record under the Student Code of Academic Conduct, which can be found online at: http://www.ryerson.ca/senate/current/pol60.pdf

Introduction and Objective:

This lab aims to bias a Bipolar-Junction Transistor (BJT) in the active region and to test a Common-Emitter (CE) amplifier. We will learn the skills to record values of the input and output resistances of the amplifier and to analyze the behavior of a CE amplifier. For the lab, we used a 2N3904 NPN BJT to achieve these objectives.

Pre-Lab:

$$V_{cc} = 15V$$
$$\beta = 150$$
$$V_{BE,on} = 0.7V$$
$$V_{CE,sat} = 0.3V$$

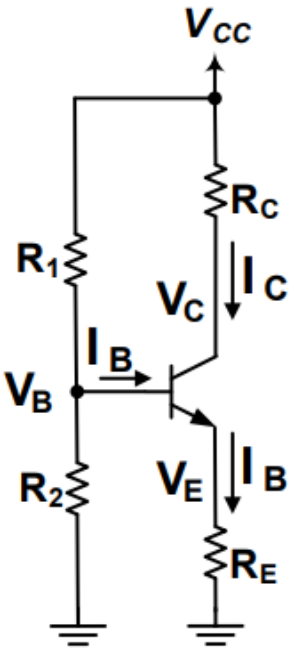


Figure 1.0 Transistor Circuit

Table P1. Quiescent voltages and currents and AC parameters of the transistor circuit of **Figure 1**.

$V_B[V]$	$V_C[V]$	$V_E[V]$	$I_B[mA]$	$I_C[mA]$	$I_E[mA]$	$g_m[mS]$	$r_e[k\Omega]$	$r_\pi[k\Omega]$
5.505	10.23	4.8	2.65×10^{-3}	0.3973	0.4	0.015	0.06475	4.704

$$V_{cc} = 15V$$
$$R_s = 50\Omega$$

$$R_L = 10k\Omega$$

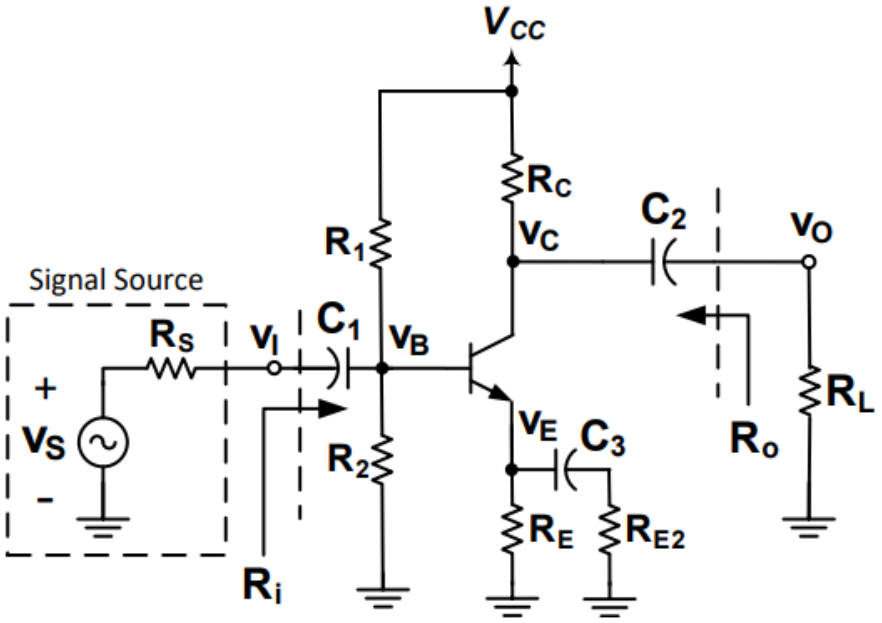


Figure 2.0 Common-Emitter (CE) amplifier based on the circuit of Figure 1.

Table P2. Parameters of the CE amplifier of **Figure 2**.

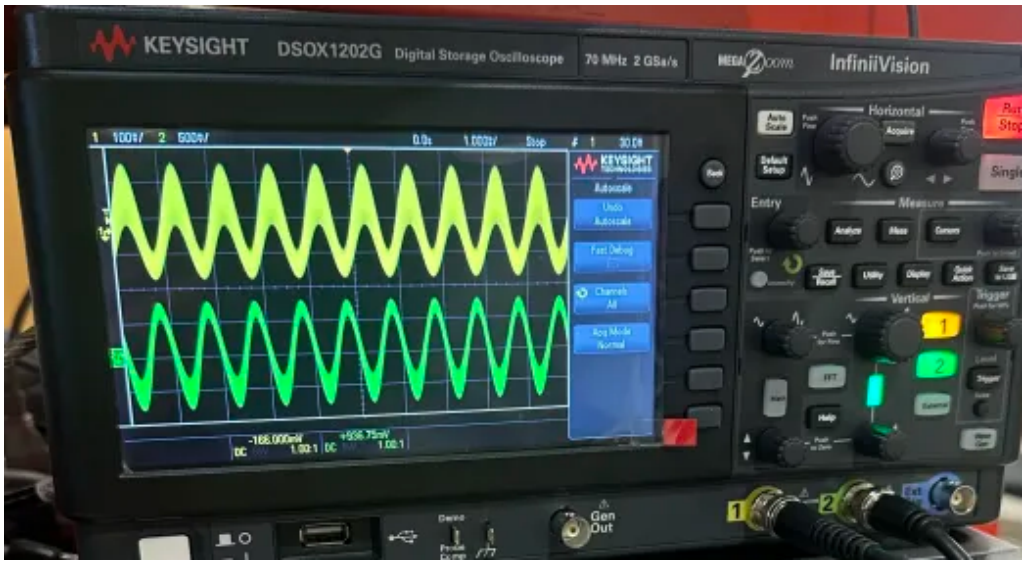
$A_{vo}[V/V]$	$A_v[V/V]$ for $R_L = 10\ k\Omega$	$R_i[k\Omega]$	$R_o[k\Omega]$
-0.693	-0.058	15	12

Experiment and Results:

Table E1. Measured terminal voltages and currents of the BJT in the circuit of **Figure 1**.

$V_B\,[V]$	$V_C[V]$	$V_E[V]$	$I_B[mA]$	$I_C[mA]$	$I_E\,[mA]$
5.479	10.1309	4.8586	0.2634	0.844	0.4041

Table 1.0 Experiment Results 1



Graph E2.

Table E2(a). Input and output ac voltages and gain of the CE amplifier, with $R_L = 10\ k\Omega$.

$V_i\,[Vrms]$	$V_O[Vrms]$	$A_v[V/V]$	$V_I[dB]$	$V_O[dB]$	$A_v\,[dB]$
0.0706	0.387	5.49	30.94	45.729	14.784

Table 2.0a Experiment Results 2a

Table E2(b). Input and output ac voltages and gain of the CE amplifier, with $R_L = \infty$.

$V_i\,[Vrms]$	$V_O[Vrms]$	$A_{vo}[V/V]$	$V_I[dB]$	$V_O[dB]$	$A_{vo}\,[dB]$
0.0759	0.85117	17.1	0.30.494	052.569	24.63

Table 2.0b Experiment Results 2b

Table E3. Parameters of the CE amplifier for determining its input resistance.

$R_{t,in}$ [kΩ]	$V_t[Vrms]$	$V_i[Vrms]$	$R_i[k\Omega]$
15	070.687	038.954	0.139

Table 3.0 Experiment Results 3

Table E4. Parameters of the CE amplifier for determining its output resistance.

$R_{t,out}$ [kΩ] (i.e., the load)	$V_O[Vrms]$ without load (i.e., $A_{vo}v_i$)	$V_o[Vrms]$ with load	$R_o[k\Omega]$
12	1.16	027.924	21.5

Table 4.0 Experiment Results 4

Conclusions:

C1.

Table C1. Calculated and measured (DC) voltages in the transistor circuit of **Figure 1**.

	$V_B[V]$	$V_C[V]$	$V_E[V]$
Calculated values (from Table P1)	5.505	10.23	4.8
Measured values (from Table E1)	5.479	10.1309	4.858
Percent error, *e*%	0.472 %	0.978 %	1.208 %

C2.

Table C2. Calculated and measured ac parameters for the CE amplifier of **Figure 2**.

	$A_v[V/V]$	$A_{vo}[V/V]$	$R_i[k\Omega]$	$R_o[k\Omega]$
Calculated Values (from Table P2)	-0.58	-0.693	0.989	5.46
Measured Values (from Tables E2, E3, and E4)	5.481	12.06	8.265	20.87
Percent Error, *e*%	1045%	1841%	736%	282%

A reason for these extremely large discrepancies may be human error in regard to the configuration of the circuit, seen as a common-emitter BJT amplifier configuration should result in a negative gain, as evident by the calculated values in Table P2, ultimately meaning that the required circuit was built/configured incorrectly

C3.

$$i_o = \frac{v_0}{R_{t,out}}$$

$$i_i = \frac{V_t - V_i}{R_{t,in}}$$

Using the values from Table E3 and Table E4:

$$i_o = 2.33\text{A}$$

$$i_i = 2.11\text{A}$$

$$A_i = \frac{i_o}{i_i} = 1.102\text{A}$$

$$A_p = A_v A_i = (5.48)(1.102) = 6.04$$

C4.

Effect of R_{E2} on the CE amplifier on:

- Voltage Gain: R_{E2} and Voltage gain are inversely proportional. When R_{E2} increases, the voltage gain decreases and vice versa.
- Input Resistance: R_{E2} no significant impact on the input resistance
- Output Resistance: R_{E2} no significant impact on the output resistance since the output resistance is determined by R_C
- Maximum Magnitude of v_i before the output voltage exhibits distortion: R_{E2} and maximum magnitude of v_i are inversely proportional. When R_{E2} increases, the maximum magnitude of v_i decreases and vice versa.