Faculty of Engineering & Technology Electrical & Computer Engineering Department
ENEE2103
CIRCUITS AND ELECTRONICS LABORATORY

Report II :Experiment 7
BJT Transistor as An Amplifier, CE, CC, CB Connection

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Abstract

The goal of this experiment is to provide an introduction to Bipolar Junction Transistors (BJT), explain how to use them as amplifying devices, and help the user become familiar with their operating theory. The experiment demonstrates how transistors react to sinusoidal signals when applied to circuits, explore the characteristics of transistor amplifiers in common emitter, common collector, and common base connections.Additionally, we will learn how to operate various tools and components such as oscilloscopes, digital multimeters, resistors, capacitors, transistors, potentiometers, breadboards, and AC generators.

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Theory

1. BJT Construction and Operation

BJT is a semiconductor device made of three parts called Base, Collector, and Emitter. These parts are separated by two special regions called p-n Junctions. Bipolar transistors come in two types, PNP and NPN, and they are often used to increase the flow of electricity. They can be used as switches or amplifiers in many electronic devices, such as mobile phones, TVs, radios, and industrial control systems.

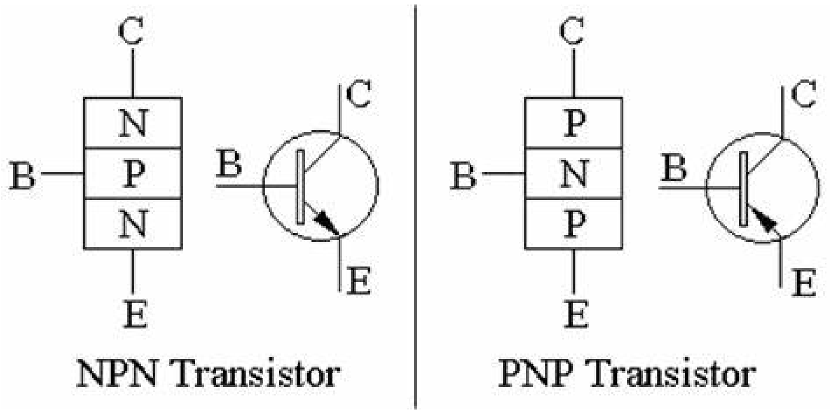


Figure 1.NPN and PNP

2. Transistor Biasing

Bipolar transistors operate in four different regions, which are called BJT junction biases. Table 1 displays these regions. In order for a transistor to work as an Amplifier, also known as an Active device, the BE junction must be forward biased and the BC junction must be reverse biased.

Junction Type	Applied voltages	BE Junction	BC Junction	Mode
NPN	E < B < C	Forward	Reverse	Forward-active
	E < B > C	Forward	Forward	Saturation
	E > B < C	Reverse	Reverse	Cut-off
	E > B > C	Reverse	Forward	Reverse-active
PNP	E < B < C	Reverse	Forward	Reverse-active
	E < B > C	Reverse	Reverse	Cut-off
	E > B < C	Forward	Forward	Saturation
	E > B > C	Forward	Reverse	Forward-active

Table 1. Regions of Operation

Bipolar transistors can function in three different regions depending on the polarity of the external bias voltage used:

- Saturation Region: the transistor acts like a fully-on switch and IC=ISaturation.
- Active Region: the transistor acts as an amplifier, and the approximate relationships are shown in Figure 2.
- Cut-Off Region: the transistor acts like a fully-off switch and IC=0.
- Reverse Region: this is similar to the active region, but the roles of the emitter and collector regions are switched.

$$I_C \cong \alpha I_E \cong I_E \qquad \beta = \frac{\alpha}{1-\alpha}$$

$$I_C \cong \beta I_B$$

$$I_E \cong (\beta+1) I_B$$

Figure 2. Approximate Relationships

3. BJT Configurations

In circuit connections, we require four terminals, with two terminals for input and two terminals for output. To address this issue, we use one terminal as a common terminal for both input and output actions. There are typically three distinct configurations of transistors, namely the Common Base (CB) Configuration, Common Collector (CC) Configuration, and Common Emitter (CE) Configuration, as depicted in Figure 6.

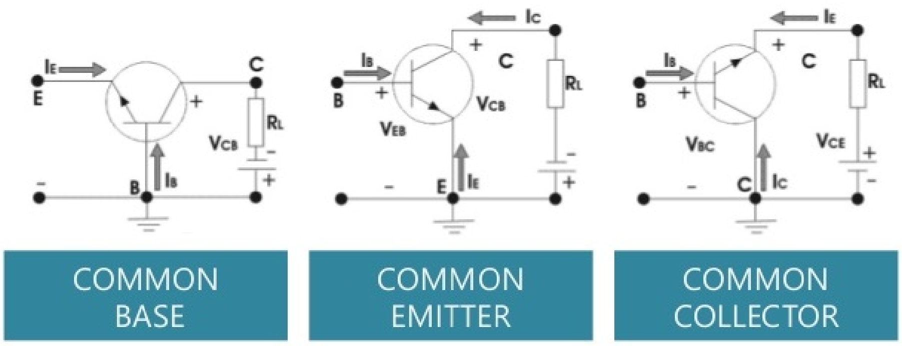


Figure 3. Types of different BJT Configurations

A. Common Base (CB) Configuration

The Common Base Configuration has the emitter as the input terminal, the collector as the output terminal, and the base terminal is connected as a common terminal for both input and output. Therefore, the emitter terminal and common base terminal are considered input terminals, while the collector terminal and common base terminal are considered output terminals.Since the base terminal is grounded in the Common Base Configuration, it is also known as the Grounded Base Configuration. The Common Base Configuration is sometimes referred to as the Common Base Amplifier, CB Amplifier, or CB Configuration.

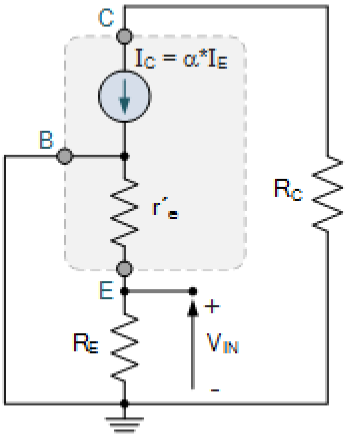


Figure 4. Common Base Configuration

As shown in Table 2 the common base configuration's transistor is :

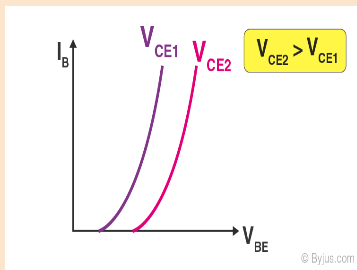
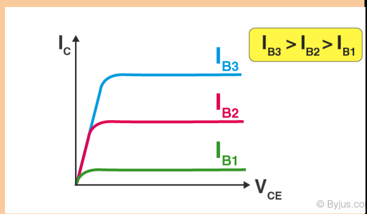
Transistor Characteristics	Definition	Formula	
Input Characteristics	When the transistor becomes forward biased, it exhibits characteristics similar to those of a p-n diode in forward bias. Specifically, the current flowing through the emitter (IE) increases for a constant voltage between the base and emitter (VEB) as the voltage between the collector and base (VCB) increases.	Rin = VEB / IE	
Output Characteristics	While keeping the emitter current (IE) constant, the collector current (IC) varies with changes in the collector-base voltage (VCB).	Rout = VCB / IC	

Table 2. :Common Base Characteristic

B. Common Collector (CC) Configuration

The Common Collector Configuration uses the base terminal of the transistor as the input, the emitter terminal as the output, and the collector terminal as the common terminal for both input and output. This is why it is also referred to as the Common Collector Configuration. The input is applied between the base and collector, while the output is taken from the emitter and collector.Since the collector terminal is grounded in the Common Collector Configuration, it is also known as the Grounded Collector Configuration.

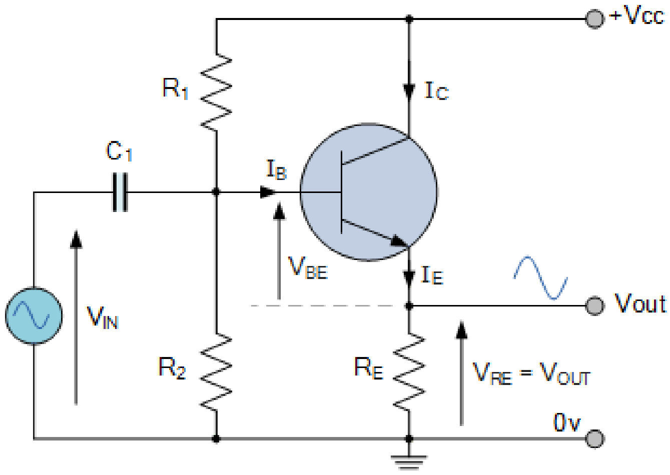


Figure 5. Common Collector Configuration

As shown in Table 3 the common collector configuration's transistor is :

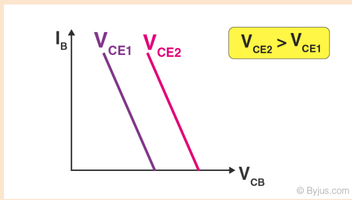
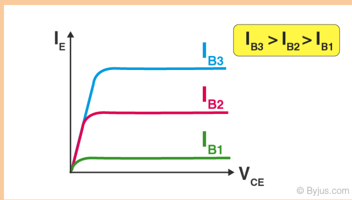
Transistor Characteristics	Definition	
Input Characteristics	The change in the emitter current (IB) concerning the collector-base voltage (VCB) while maintaining a constant voltage between the emitter and collector (VEC).	
Output Characteristics	The base current (IB) remains unchanged while the emitter current (IE) fluctuates concerning the collector-emitter voltage (VCE).	

Table 3. Common Collector Characteristic

C. Common Emitter (CE) Configuration

The Common Emitter Configuration has the base as the input terminal, the collector as the output terminal, and the emitter as the common terminal for both input and output. Therefore, the base terminal and common emitter terminal are considered input terminals, while the collector terminal and common emitter terminal are considered output terminals.
Since the emitter terminal is grounded in the Common Emitter Configuration, it is also known as the Grounded Emitter Configuration. The Common Emitter Configuration is sometimes referred to as the CE Configuration, Common Emitter Amplifier, or CE Amplifier, and it is the most commonly used transistor configuration.

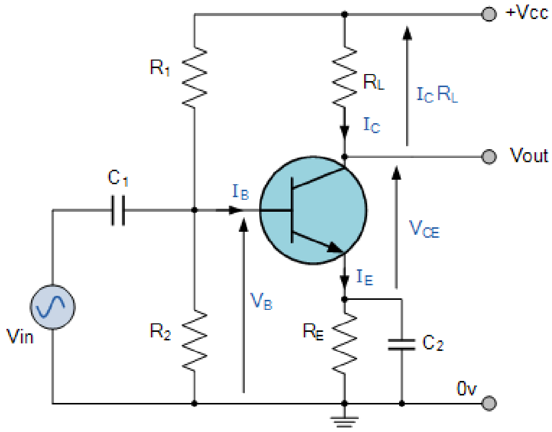


Figure 6. Common Emitter

As shown in Table 4 the common collector configuration's transistor is :

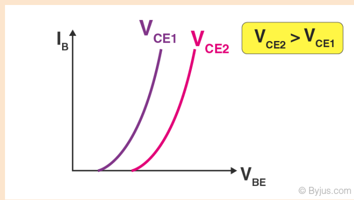
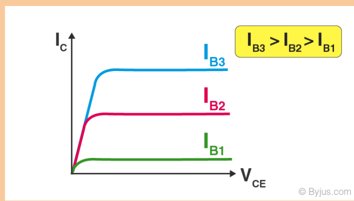
Transistor Characteristics	Definition	Formula	
Input Characteristics	When the Collector-Emitter Voltage (VCE) remains constant, the Emitter Current (IB) fluctuates concerning the Base-Emitter Voltage (VBE).	Rin = VBE/IB	
Output Characteristics	The base current (IB) remains unchanged while the collector current (IC) fluctuates concerning the collector-emitter voltage (VCE).	Rout = VCE/IC	

Table 4. Common Emitter Characteristic

The behavior of the Bipolar Junction Transistor (BJT) in each of the circuit configurations mentioned above is distinct, resulting in different circuit characteristics related to input impedance, output impedance, and gain, whether it be voltage gain or current gain, as presented in Table 5.

Characteristic	Common Base	Common Emitter	Common Collector
Input Impedance	Low	Medium	High
Output Impedance	Very High	High	Low
Voltage Gain	High	Medium	Low
Current Gain	Low	Medium	High

Table 5. Summary of Transistors Configurations

Procedure

In this experiment, the transistor amplifier's characteristics in common collector, common emitter, and common base were examined by connecting three circuits.

1. Common Emitter Transistor Amplifier:

Figure 7 shows how to connect a common emitter transistor amplifier circuit, which includes an NPN BJT transistor, four resistors with values of 10K, 22K, 100K, and 1K, a potentiometer, and two capacitors with values of one microfarad. To operate the circuit, the AC was set to a sinusoidal wave with amplitude zero and a frequency of 1 KHz, while the DC power supply was set at +15V.

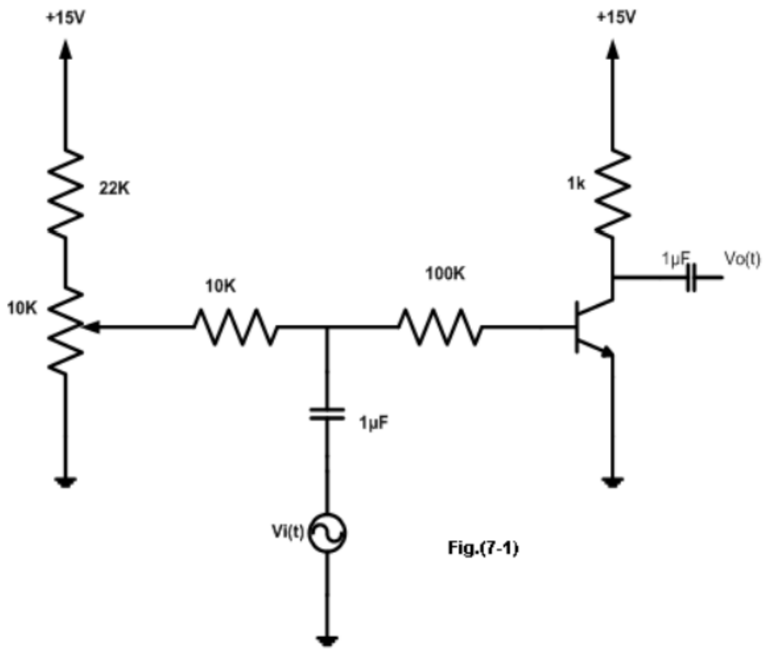


Figure 7. Common emitter transistor amplifier circuit

Figure 8 displays the input and output voltage for the Common Emitter Circuit. The input voltage had a peak-to-peak value of 3.6V, whereas the output voltage was measured to have a peak-to-peak value of 8.08V.

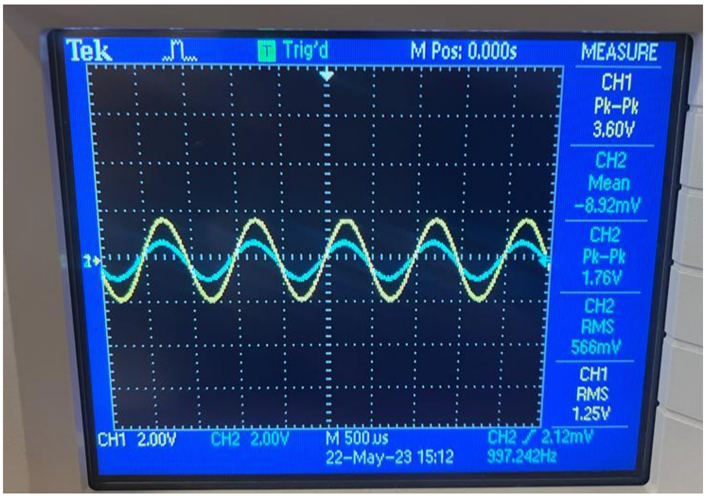


Figure 8. Input and output voltage for the Common Emitter

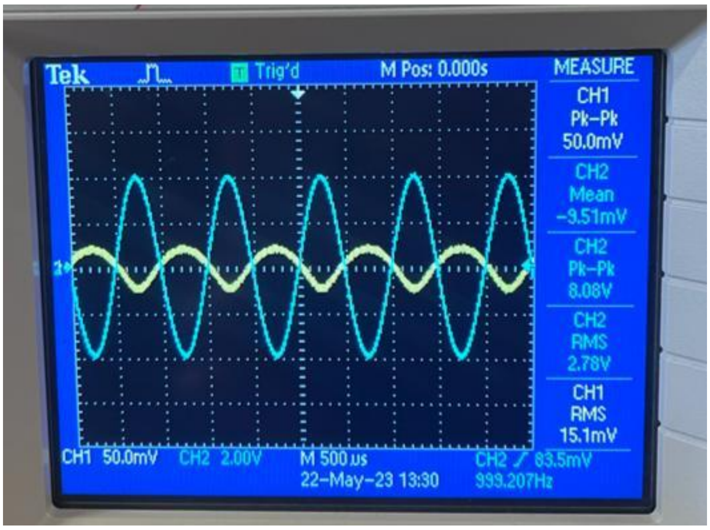


Figure 9. Input and output voltage for the Common Emitter

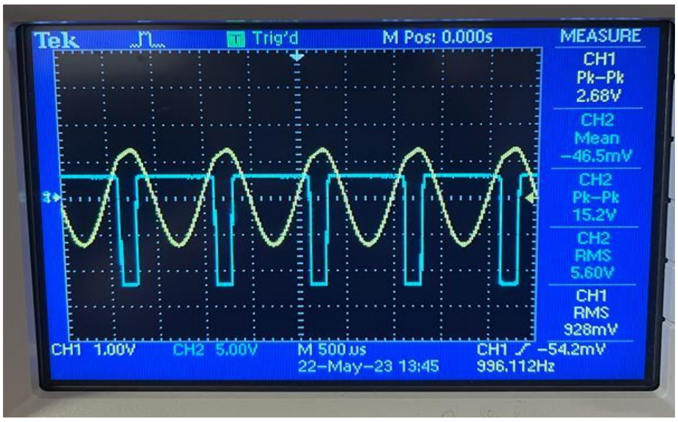


Figure 10. without 100 kohm.

Table 6 lists measurements of IC,IB,VCE,VBE and VBC . These measurements were taken after adjusting the potentiometer to stabilize the collector DC voltage at 8V and adjusting the function generator to obtain an output voltage of approximately 8V peak to peak. The input voltage(Vi), base voltage(Vb), output voltage(Vo), and AC current were measured with an oscilloscope and digital multimeter.

DC Analysis	
IC	6.8mA
IB	21.92µA
VCE	8volt
VBE	0.641volt
VBC	-9.030volt
AC Analysis	
Vi(t)Peak-To-Peak	3.6V
Vo(t)Peak-To-Peak	8.08
VB(t)Peak-To-Peak	50mV
IB	9.20µA
IC	2.712mA

Table 6. Experimentally results for common emitter

Conclude that the NPN transistor is operating in the forward active mode since VBE is positive and VBC is negative. Moreover, the measured values indicate that IB has a low value while IC has a higher value, which is theoretically expected for active mode (as IC=β IB, determined through DC Analysis). To verify the accuracy of our values, we can use the equation VCE= VCB- VBE. Substituting the values, we get VCE= 9.030-0.641 = 8.389 V, which is in close proximity to the values obtained.

- $Voltage\ Gain\ AV = VO(t)/Vi\ (t) = 8.08/3.6 = 2.24$
- $AV1 = VO(t)/VB(t) = 8.08/50\ \mathrm{m} = 161.6$
- DMMs were used to measure RMS AC currents for both the base and the collector of transistor. $Vi = 1.25\ V, II = 75\ \mu A$
- $Current\ Gain\ of\ the\ Amplifier = IO/Ii = IC/IB = 2.712mA/9.20\mu\mathrm{A} = 294.783$
- $Input\ Impedance\ Zi = Vi/Ii = 940\mathrm{m}V/75\ \mu A = 12.53\ k\Omega$
- Vi RMS and Vo RMS were measured after removing the 100 kohm resistor from the circuit.
- $Vi,RMS = 928\mathrm{mV}$, $VO,RMS = 5.60\ V$, $AV = VO/Vi = 5.60\mathrm{v}/928\mathrm{mV} = 6.034$ $(Increased)$

The results we obtained from the experiment are correct , however, there is a slight difference that could be due to the possibility of inaccurate readings.

2. Common Collector Transistor Amplifier:

Figure 11 illustrates the connection of the common collector transistor amplifier circuit, consisting of an NPN BJT transistor, four resistors with values of 47K, 22K, 100K, and 1K, a potentiometer, and two capacitors with values equivalent to one microfarad and 100nF. The AC was initially set to a sinusoidal wave with amplitude zero and frequency of 1 KHz, while the DC power supply was set at +10V.

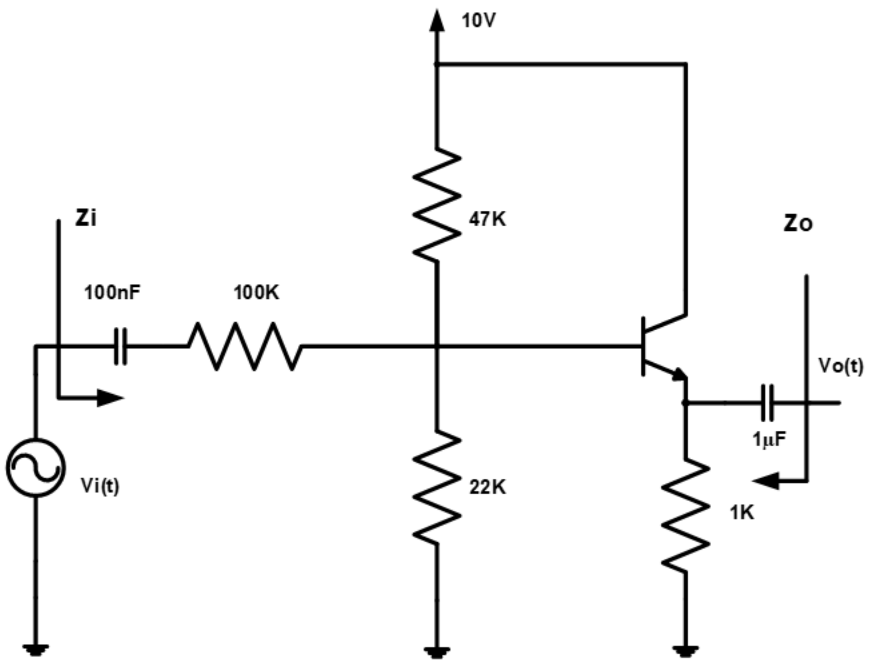


Figure 11. Common collector transistor amplifier circuit

In Figure 12, you can see the input and output voltage for the common collector circuit. The input voltage had a peak-to-peak value of 1.86V, while the output voltage had a peak-to-peak value of 15.0V. The common collector amplifier has a non-inverting effect, which means that there is no phase shift between the input and output voltage (i.e., the phase shift is equal to zero).

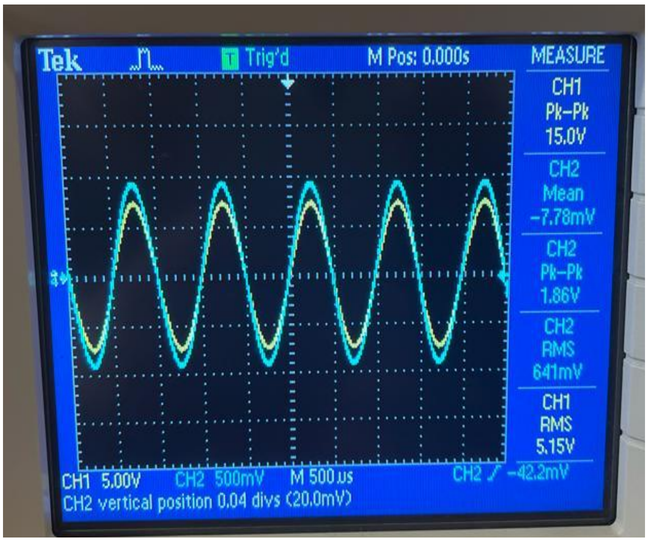


Figure 12. Input and output voltage for the Common Collector

Table 7 shows the measurements of emitter voltage (VE) and base-emitter voltage (VB). In the experiment, the function generator was reconnected to the circuit and adjusted until the output voltage (Vo) reached 2V peak to peak. Then, the input voltage (Vi) was measured using an oscilloscope.

DC Analysis	
VE	2.420V
VB	3.055V
AC Analysis	
Vi	5.15VRMS
VO	0.64VRMS
V100K	4.477VRMS
Iin,RMS	4.477VRMS/100K=44.77μA
Iout,RMS	Vo,RMS/Rl=0.64VRMS/1K=640μA

Table 7. Experimentally results for common collector

<u>Calculations</u>

- Av = $vo(t)$/ vi(t) =0.641 /5.15V = 0.1245

- Ai= Iout,RMS / Iin,RMS =640μA / 44.77μA = 14.3
- Input Impedance: Zi= Vi / Ii = 5.15V/44.77μA = 115.03 kΩ
- output Impedance Zo= VT / IT =1.057/4.44m = 2.3 kΩ

The voltage gain for the Common Collector Circuit is less than 1, resulting in attenuation, whereas in the Common Emitter Circuit, the voltage gain is greater than 1, resulting in amplification. The input impedance of the Common Collector Circuit is very high, while it is moderate in the Common Emitter Circuit. Both the Common Collector Circuit and Common Emitter Circuit have a current gain greater than 1.

Questions:

- How is the output quiescent voltage related to the input ?

The output voltage is phase-shifted by 0° relative to the input voltage.

- How do parameters compare with those of the common emitter stage ?

Common emitter amplifiers do not exhibit any phase shift, but in the emitter stage, a 180° phase shift is present. Although the voltage and current gains are lower than those of common emitter amplifiers, the input impedance is higher.

Characteristic	Common Emitter	Common Collector
Input Impedance	Medium	High
Output Impedance	High	Low
Voltage Gain	Medium	Low
Current Gain	Medium	High

Table 8. Difference between characteristic of common emitter and Common collector

3. Common Base Transistor Amplifier:

Figure 13 shows how to connect a common base transistor amplifier circuit. This circuit includes an NPN BJT transistor, five resistors with values of 4.7K, 22K, 100K, 1K, and 10K, and three capacitors with values of one microfarad and 100nF. To operate the circuit, the AC was set to a sinusoidal wave with amplitude zero and frequency of 1 KHz, while the DC power supply was set at +10V.

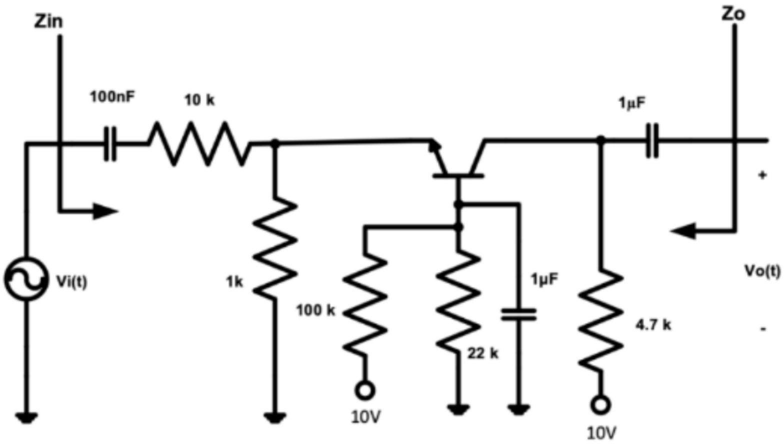


Figure 13. Common base transistor amplifier circuit

Figure 14 displays the input and output voltage for the common base circuit. The input voltage had a peak-to-peak value of 2.08V, whereas the output voltage was measured to have a peak-to-peak value of 4.48V.

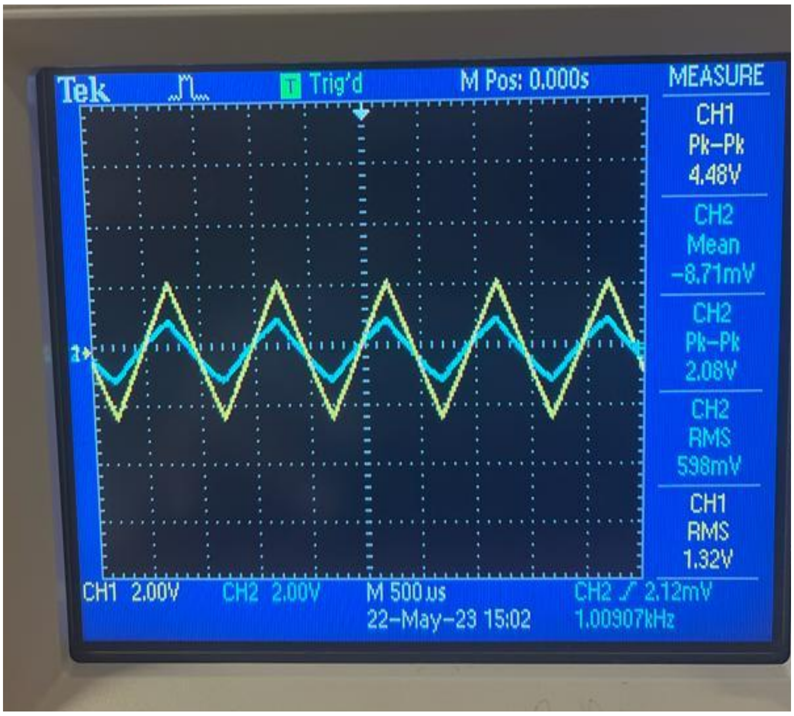


Figure 14. Input and output signal for the Common Base

In the experiment, the function generator was reconnected to the circuit and adjusted to obtain an output voltage of 2V peak to peak. Then, the input voltage was measured using an oscilloscope. The common base amplifier has a non-inverting effect, which means there is no phase shift between the input and output voltage. To calculate the input current, the voltage across the 10-kohm input resistor was measured using a DMM, and the output current of the load resistor was calculated from the output voltage. The input impedance was found using previously measured values. Afterwards, the input voltage was replaced with a short circuit, and a sine wave generator was connected to the output via a capacitor to determine the output impedance using the formula Zo=VT/IT. The results of these measurements are listed in Table 9.

DC Analysis	
IB	79.11μA
IC	1.127mA
VBE	0.633V
VBC	-2.946V
VCE	3.6V
AC Analysis	
Vi	132mRMS
VO	598mRMS
V10K	12.82mV
*Ii ,RM***S**	V10K/10K=12.8v/10K=1.28mA
*IO RM***S**	Vo/RL=598m/1K=598μA
VT	1V
IT	0.235mA

Table 9. Experimentally results for common base

-Table 9 shows that the NPN transistor is in the forward active mode, as VBE is positive and VBC is negative. It was also observed that the base current (IB) has a lower value compared to the collector current (IC), which is as expected in the active mode, as determined through DC Analysis (IC=β IB).

Calculations

- Av = $vo(t)$/ vi(t) =598 /132 = 4.53
- Ai= Iout / Iin =598μA / 1.28mA= 0.467
- Zi= Vi / Ii = 132mV/ 1.28mA = 103Ω
- Zo= VT / IT =1v /0.235mA = 4.255 kΩ

The voltage gain for the Common Base Circuit is greater than 1, resulting in amplification, and it is a more efficient amplifier than the Common Emitter Circuit, which has a voltage gain of 2.24 . The input impedance of the Common Base Circuit is very low, whereas it is moderate in the Common Emitter Circuit (12.53 $k\Omega$). The current gain in the Common Base Circuit is very low, unlike the Common Emitter Circuit, which has a current gain greater than 1.

Questions:

- How is the output quiescent voltage related to the input

The output voltage is phase-shifted by 0° relative to the input voltage.

- How do parameters compare with those of the common emitter stage ?

Common emitter amplifiers do not exhibit any phase shift, but in the emitter stage, a 180° phase shift is present. Although the voltage and current gains are lower than those of common emitter amplifiers, the input impedance is lower.

Characteristic	Common Base	Common Emitter
Input Impedance	Low	Medium
Output Impedance	Very High	High
Voltage Gain	High	Medium
Current Gain	Low	Medium

Table 10. Difference between characteristic of common emitter and Common base

Conclusion

In conclusion, this experiment allowed us to practically implement important configurations of BJT circuits. We gained knowledge on connecting circuit components and measuring DC and AC quantities using oscillators and a Digital Multimeter. We studied the characteristics of each configuration, such as voltage gain, current gain, input impedance, output impedance, and phase shift. Although the experimentally obtained results aligned with the theoretical results, there were some errors due to the limitations of the tools and components used in the experiment. Additionally, we became more familiar with Pspice, which we used for designing circuits and producing signals in the prelab. We also learned how to use Microsoft Word in writing the report. Overall, we gained an understanding of the function of each element in the circuit and its effect on the circuit behavior, including the role of the transistor.

References

[1] https://byjus.com/physics/characteristics-of-a-transistor/
Accessed on 25 May 3:00 pm.

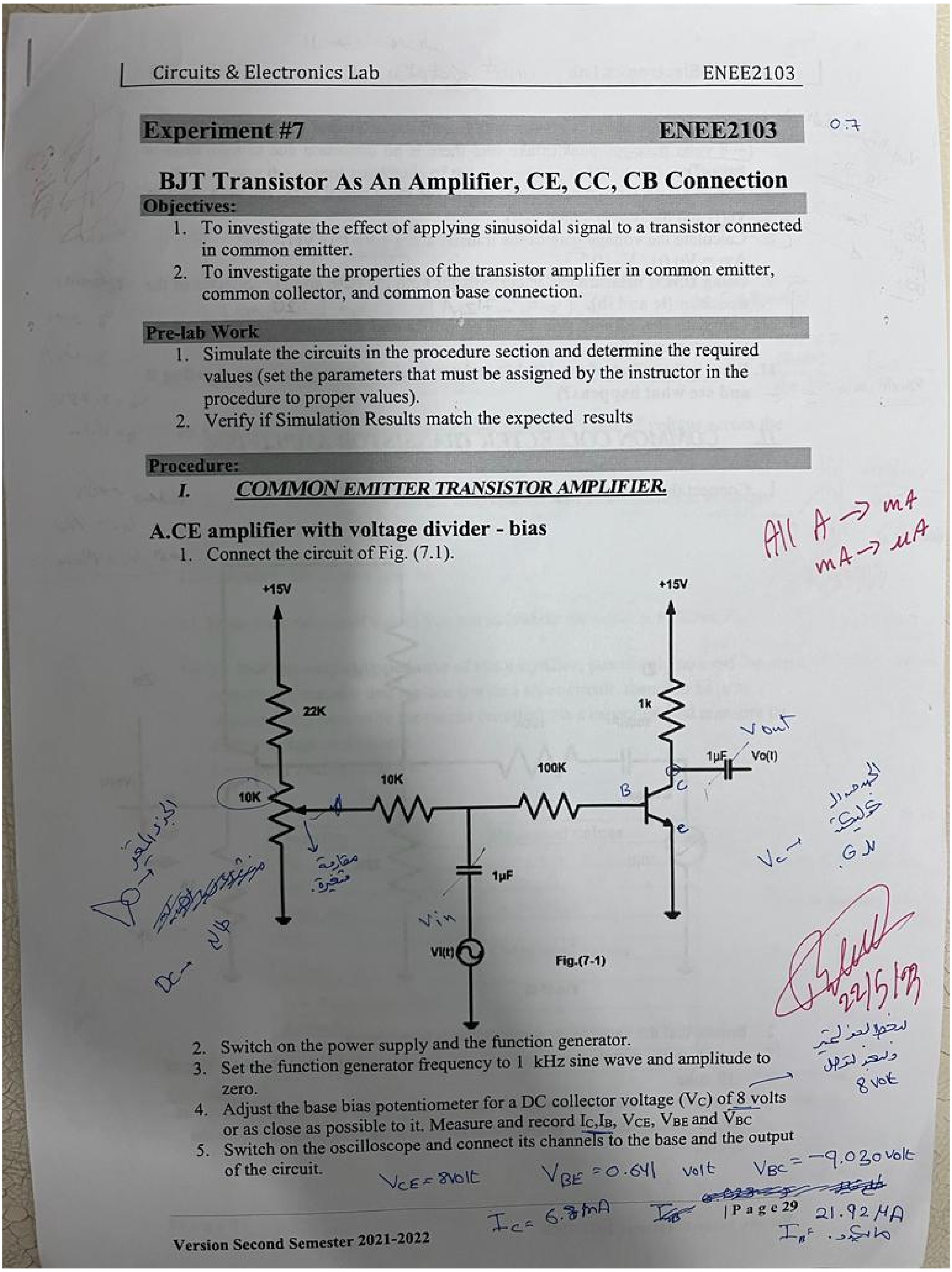
[2]https://www.physics-and-radio-electronics.com/electronic-devices-and-circuits/transistors/bipolarjunctiontransistor/commoncollectorconfiguration.html
Accessed on 25 May 3:30 pm.

[3]https://byjus.com/physics/bipolar-junction-transistor/
Accessed on 25 May 5:00 pm.

[4]https://www.electronics-tutorials.ws/amplifier/amp_2.html
Accessed on 28 May 7:42 pm.

[5]https://www.electronics-tutorials.ws/amplifier/common-collector-amplifier.html
Accessed on 28 May 7:43 pm.
[6]https://www.electronics-tutorials.ws/amplifier/common-base-amplifier.html
Accessed on 28 May 8:02 pm.

Appendix



Experiment #7 **ENEE2103**

0.7

BJT Transistor As An Amplifier, CE, CC, CB Connection

Objectives:

1. To investigate the effect of applying sinusoidal signal to a transistor connected in common emitter.
2. To investigate the properties of the transistor amplifier in common emitter, common collector, and common base connection.

Pre-lab Work

1. Simulate the circuits in the procedure section and determine the required values (set the parameters that must be assigned by the instructor in the procedure to proper values).
2. Verify if Simulation Results match the expected results

Procedure:

I. ***COMMON EMITTER TRANSISTOR AMPLIFIER.***

A.CE amplifier with voltage divider - bias

All A → mA
mA → μA

1. Connect the circuit of Fig. (7.1).

Fig.(7-1)

2. Switch on the power supply and the function generator.
3. Set the function generator frequency to 1 kHz sine wave and amplitude to zero.
4. Adjust the base bias potentiometer for a DC collector voltage (V_C) of 8 volts or as close as possible to it. Measure and record I_C,I_B, V_{CE}, V_{BE} and V_{BC}
5. Switch on the oscilloscope and connect its channels to the base and the output of the circuit.

V_{CE} = 8Volt V_{BE} = 0.641 volt V_{BC} = −9.030 Volt

I_C = 6.8mA 21.92 μA I_B

ال Gain ⇐ طالب
ل ال output < input.

6. Turn up the function generator output until the **ac output of the circuit** $V_o(t)$ is ~ 8 volts peak-to –peak.(make sure there is no distortion due to saturation or cut-off)
7. Use oscilloscope to measure and record the input signal $v_i(t)$, the base voltage $V_B(t)$ and the output signal $V_o(t)$.
8. Calculate the voltage gain of the transistor $Av = Vo(t) / Vi(t)$ and $Av_1 = Vo(t) / V_B(t)$
9. Using **DMM** measure the ac currents for both the base and the collector of the transistor **(ic and ib).** $i_c = 2.712\ A$ $i_b = 9.20\ mA$
10. Calculate the current gain of the amplifier and the input impedance of the transistor amplifier.
11. What is the effect of the 100 kΩ resistor on the voltage gain? **(try shorting it and see what happens?)**

العلاقة بين ال Vout و ال V_B

Ac ← Gain ال

Square wave

V_{RMS}

$V_o = 2.78V$

$V_B = 15.1m$

II. COMMON COLLECTER TRANSISTOR AMPLIFIER.

1. Connect the circuit of Fig. (7.2).

الاصفر قيمة ال

الازرق $V_o = 2.77V$

الاصفر $V_i = 940mV$

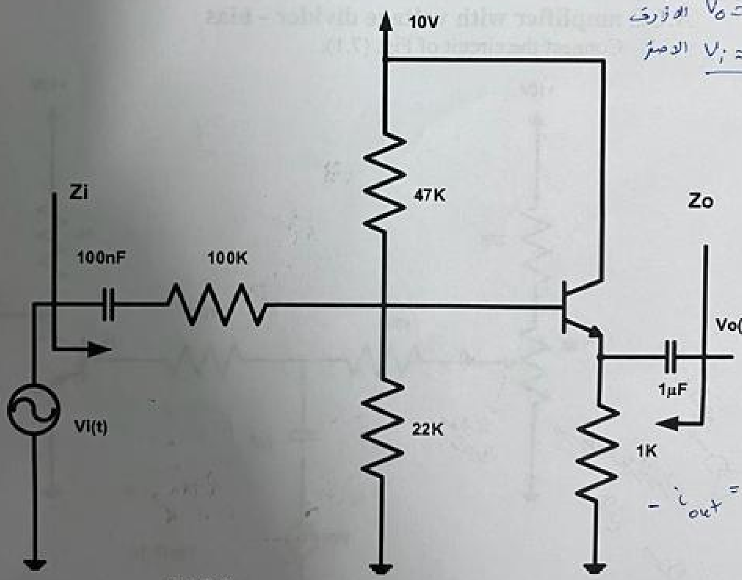


Fig.(7-2)

2. Ensure that the variable dc control knob is at minimum.
3. Switch on the power supply and adjust the variable dc voltage to give a Vcc of +10 volts.
4. Set the sine wave generator to a frequency of 1 kHz ,but either disconnect its output ,or turn its output amplitude to zero, so there is no signal input to the circuit.

0.7 او 0.6 لازم يكون

5. Measure the quiescent bias voltages of the circuit V_E and V_B, **using DVM.** $\boxed{V_E = 2.420}$ $\boxed{V_B = 3.055}$

6. Increase the output amplitude of the sine wave generator until an output amplitude from the amplifier $\mathbf{v_o(t)}$ **is about 2volts peak-to-peak**. (make sure the waveform is undistorted). $V_{BE} =$

$\boxed{V_o = 641\,mV}$

7. **Measure** the ac input voltage $v_i(t)$ needed to achieve this output. $\boxed{V_i = 5.15V}$

8. **Calculate** the voltage gain Av.

9. **Measure** the ac voltage across the 100 kΩ input resistor $\mathbf{V_{100k\_RMS}}$. $V = \frac{4.477}{100\,k} = I_{in} =$

10. **Calculate** the input current using your measured value of voltage across the input resistor.

11. From the output voltage and the load resistor value **calculate** the ac output current. $V_o = 684\,mV$

12. **Calculate** the current gain Ai.

13. From your measured values you can **calculate** the input impedance Z_{in}. ① $V_{in} = 0$ (Short circuit)

14. **To find the output impedance of the amplifier**, you should take off the input sine wave generator and replace it with a short circuit, then you have to connect the generator to the output (emitter) via a capacitor, and measure its output voltage and current. ② Voltage generator V_T to the out → I_T

$$Z_o = \frac{V_T}{I_T} \quad V_{in} = 0$$

15. Enter your results table 7.1.

Table 7.1

Quantity	Measured values
V_{in}	690 mV
V_{out}	86 mV
V_{100k_RMS}	0.603/100k
i_{out}	
	Calculated values
$Av = V_{out}/V_{in}$	
$i_{in} = V_{100k\_RMS}/100k$	
$A_i = i_{out}/i_{in}$	
$Z_{in} = V_{in}/i_{in}$	
$Z_{out} = V_T/i_T$	

$V_T = 0.602\,V$ rms

$I_T = 3\,mA$ rms

$Z_o = \frac{0.6}{3}$ very small

$\boxed{V_T = 1.057}$ $\boxed{I_T = 4.44}$

Questions:

- How is the output quiescent voltage related to the input?
- How do the parameters compare with those of the common emitter stage?

III. COMMON BASE TRANSISTOR AMPLIFIER

1. Connect the circuit of Fig. (7.3).

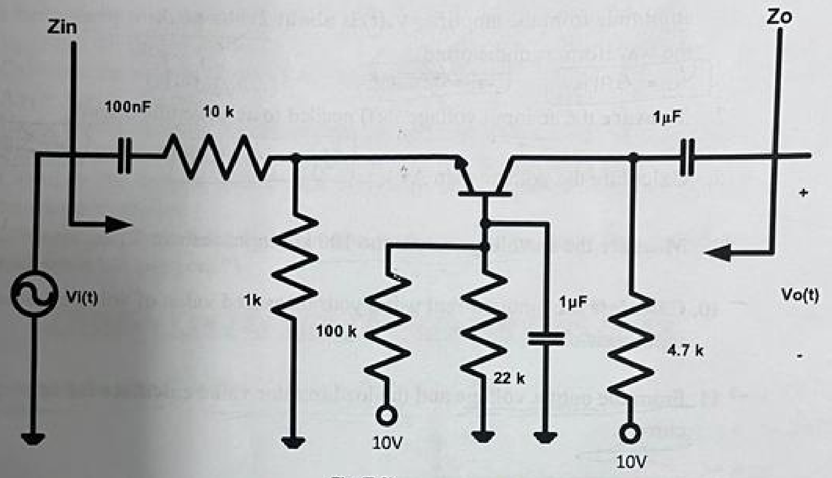


Fig.(7-3)

2. Ensure that the variable dc control is at min. 10V
3. Switch on the power supply and adjust the variable dc voltage to give a Vcc of +10 volts.
4. Set the sine wave generator to a frequency of 1 kHz ,but either disconnect its output ,or turn its output amplitude to zero, so there is no ac signal input to the circuit.
5. Measure and record the quiescent bias voltages and currents I_B, I_C, V_{BE} , V_{BC} and V_{CE}. ,using DVM. ~~I_B~~ , $I_B = 79.11\ \mu A$, $I_C = 1.127\ A$, $V_{BE} = 0.633V$ $V_{BC} = 2.946V$, $V_{CE} = 3.6V$
6. Increase the output amplitude of the sine wave generator until an output amplitude from the amplifier is about 2volts peak-to-peak. $V_{out} = 598mV$ $V_{in} = 1.32V$
7. Measure the ac input voltage needed to achieve this output. What happens if the ac input is increased further?
8. Calculate the voltage gain Av.
9. Measure the ac voltage across the 10 kΩ input resistor. $V_{10k} = 1.282$ $R = 100k$
10. Calculate the input current using your measured value of voltage across the input resistor.

11. From the output voltage and the load resistor value (4.7k) calculate the ac output current io(t). $V_{4.7} = 0.59\ V$

16. Calculate the current gain.

17. From your measured values, you can calculate the input impedance Z_{in}.

18. To find the output impedance of the amplifier, you should take off the input sine wave generator and replace it with a short circuit, then you have to connect the generator to the output (collector) via a capacitor, and measure its output voltage and current.

* $V_T = 1V$
* $I_T = 0.235\ mA$

19. Enter your results in a table 7.2.

* $i_{out} = 0.106\ mA$
* $i_{in} = 0.110\ mA$

Table 7.2

Quantity	Measured values
V_{in}	
V_{out}	
V_{10k_RMS}	
	Calculated values
$A_V = V_{out}/V_{in}$	
$i_{out} = V_{out}/4.7k$	
$i_{in} = V_{10k\_RMS}/10k$	
$A_I = i_{out}/i_{in}$	
$Z_{in} = V_{in}/i_{in}$	
$Z_{out} = V_T/i_T$	

Questions:

- How is the output quiescent voltage related to the input?
- How do the parameters compare with those of the common emitter stage?