Al Mustaqbal University College

STUDENT NAME:		
TUTOR NAME:	**Dr. Ameer Al-khaykan**	
PROGRAMME:	**Electrical Circuit**	
SUBJECT:	**Electrical and Electronics**	
COURSEWORK TITLE:	**The Transistor & Base Biasing**	

Issue Date:	**Due Date:**	**Feedback Date:**	**Extension Date:**

PERFORMANCE

TARGETED LEARNING OUTCOMES

4. Solve problems involving basic analogue and digital electronic circuits using numerical skills appropriate to an engineer.

5. Identify and safely use standard laboratory equipment to extract data, then apply in the solution of an electronic or electrical engineering problem;

6. Adopt a logical approach to the solution of engineering problems.

Important Information – Please Read Before Completing Your Work

All students should submit their work by the date specified using the procedures specified in the Student Handbook. An assessment that has been handed in after this deadline will be marked initially as if it had been handed in on time, but the Board of Examiners will normally apply a lateness penalty.
Your attention is drawn to the Section on Academic Misconduct in the Student's Handbook.

All work will be considered as individual unless collaboration is specifically requested, in which case this should be explicitly acknowledged by the student within their submitted material.

Any queries that you may have on the requirements of this assessment should be e-mailed to
ameer.alkhaykan@mustaqbal-college.edu.iq
No queries will be answered after respective submission dates.
You must ensure you retain a copy of your completed work prior to submission.

MARKING CRITERIA

COURSEWORK WILL BE MARKED ACCORDING TO THE FOLLOWING UNIVERSITY CRITERIA.

90-100%: a range of marks consistent with a first where the work is exceptional in all areas;

80-89%: a range of marks consistent with a first where the work is exceptional in most areas.

70-79%: a range of marks consistent with a first. Work which shows excellent content, organisation and presentation, reasoning and originality; evidence of independent reading and thinking and a clear and authoritative grasp of theoretical positions; ability to sustain an argument, to think analytically and/or critically and to synthesise material effectively.

60-69%: a range of marks consistent with an upper second. Well-organised and lucid coverage of the main points in an answer; intelligent interpretation and confident use of evidence, examples and references; clear evidence of critical judgement in selecting, ordering and analysing content; demonstrates some ability to synthesise material and to construct responses, which reveal insight and may offer some originality.

50-59%: a range of marks consistent with lower second; shows a grasp of the main issues and uses relevant materials in a generally business-like approach, restricted evidence of additional reading; possible unevenness in structure of answers and failure to understand the more subtle points: some critical analysis and a modest degree of insight should be present.

40-49%: a range of marks which is consistent with third class; demonstrates limited understanding with no enrichment of the basic course material presented in classes; superficial lines of argument and muddled presentation; little or no attempt to relate issues to a broader framework; lower end of the range equates to a minimum falls short in one or more areas.
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35-39%: achieves many of the learning outcomes required for a mark of 40% but falls short in one or more areas.

30-34%: a fail; may achieve some learning outcomes but falls short in most areas; shows considerable lack of understanding of basic course material and little evidence of research.

0-29%: a fail; basic factual errors of considerable magnitude showing little understanding of basic course material; falls substantially short of the learning outcomes for compensation.

Note:

- While constructing circuits all connects should be made with the power supply in the off position.
- Check power and ground connections (and other connections) **before** switch on the power.
- Make sure that the power and the ground are properly connected to all IC's before switch on the power.
- **DO NOT** strip wire ends longer than 1/4" and jam long bare ends into the breadboard holes. This will cause shorts and ruin the board.
- **DO NOT** short (connect) the power supply outputs together, i.e., do not allow the exposed wires to touch each other. This will cause permanent damage to the power supply.
- **DO NOT** connect the power supply to the breadboard with reverse polarity. This will cause the permanent chip damage.
- **DO NOT** connect an output of any gate to the output of another gate, to a switch, to power (+5V), or to ground. These situations will cause excessive currents and result in the permanent damage to the chip or chips involved.

6.1 Objects

The objective of this experiment is to show the using of the transistor and examine the characteristics of the silicon one, the relationship between Collector, Emitter and Base, and the base biasing as example of the biasing, the way of current flow and compare it with resistor, show that the Transistor is nonlinear device and the voltage drop in resistor.

6.2 Theory:

The transistor is a three layer semiconductor device made of either silicon or germanium and consists of two layers of n-type and one layer of p-type materials or two layers of p-type and one layer of n-type materials. So there are two types' transistors; *NPN transistor* and *PnP transistor*. The transistor layers are; *Emitter (E)* layer, *Base (B)* layer, and *Collector (C)* layer, where the emitter layer heavily doped, the base layer lightly doped, and the collector layer doped less than the emitter layer. We are talking hear about the *Bipolar Junction Transistor*; that the term bipolar reflects the fact that holes and electrons participate in the injection process into the oppositely polarized material.

There are three regions of operation for the transistor: Active region, Saturation region and cutoff region. To bias a BJT transistor for operation in the active region, the emitter _base junction must be forward biased and the collector base junction reverse biased. Thus, in the active region, current will flow through the collector and will be related to the base current by:

$$I_C=\beta\, I_B$$

Where:

I_C: The collector current.

I_B: The base current.

B: The DC current gain.

The active region is the desired region of operation for a linear amplifier. And to bias a BJT for operation in the saturation region, the emitter_base junction must be forward biased and the collector_base junction is forward biased too.

While in cutoff region both the emitter_base junction and collector_base junction are reverse biased.

The transistor base biasing is one of the transistor biasing schemes with the emitter grounded and the base is connected to a Dc voltage supply that exceeds slightly V_{BE}, in order to forward-bias the base-emitter junction. The value of β in the transistor base biased circuit is not stable and the value of I_C is not too, so the Q point is not fixed on the dc load line during operating the circuit. The base biased transistor circuit shown in figure (1). Note that the following relationship must be verified in the base biased transistor circuit:

$$V_{CC} >> V_{BE}$$

$$I_{BQ} = (V_{CC}-V_{BE})/R_B$$

$$I_{CQ} = B\, I_{BQ}$$

$$V_{CEQ} = V_{CC}-I_{CQ}R_C$$

$$V_B=V_{BE}=0.7V$$

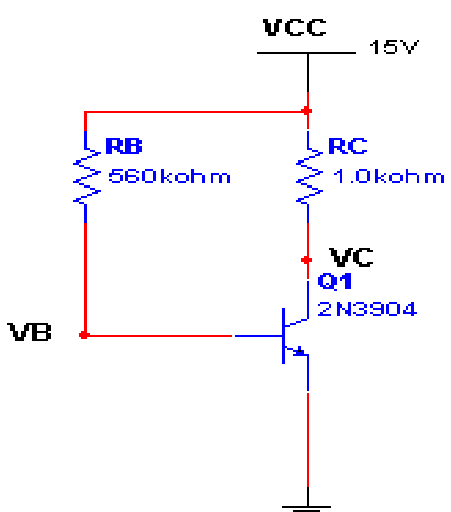

Figure 1: Base biased transistor circuit

3Equipment:

1. 1 kΩ resistor
2. 560 kΩ resistor
3. 2N3904 NPN silicon transistors
4. 0-15 V dc power supply
5. Voltmeter

4 Procedure

1. Connect the circuit shown in figure (1), and then switch the DC power supply on.
2. Using the Voltmeter , measure the voltage across the base and collector resistors, and then using Ohm's law determine the corresponding currents, then record your results in the table No.1 and calculate the value of βdc using the equation:

$$B_{dc}=I_{CQ}/I_{BQ}$$

3. Measure V_B and V_{CEQ} with the Voltmeter and record your results in the table No.1
4. Using the value of βdc calculated in step 2 and the value of V_{BE} =0.7V typically, calculate all the values you measured in step 3, and then record these calculated values in the table No.1 and compare your calculated results to the measured ones.

Table (1) (The transistor parameters)

Parameter	Measured Value	Calculated Value
I_{BQ}		
I_{CQ}		
β_{dc}		
V_{BE}		
V_{CEQ}		

5.Using the equations shown below, calculate V_{CE}(off) & I_C(sat), and record your results in table No.2, then draw the dc load line of the transistor base biased circuit and then plot the Q point you got on the graph, note that the Q point must locates at the dc load line.

V_{CE} (off) =V_{CC}
I_C (sat) = V_{CC}/ R_C

Table No.2 (The saturation and cut off parameters)

Parameter	Calculated value
V_{CE}(off)	
I_C(sat)	

5 Discussion

1. What is meant by the term bipolar in (the bipolar junction transistor)?
2. What are the types of the bipolar junction transistor (BJT)?
3. What are the operations regions of the Transistor?

6.6 Review Questions

1. For the circuit of figure 1, if β=150, then I_B is
(a) 10μA (b) 15μA (c) 20 μA (d) 25μA

2. If β for the transistor in the circuit of figure 1 increases, then
(a) I_B decreases (b) I_C increases (c) V_{CE} decreases (d) all of the above

3. If R_B is made smaller in the circuit of figure 1, then
(a) I_B decreases (b) I_C decreases (c) V_{CE} decreases
(d) all of the above

4. The collector saturation current for the circuit of figure (1) is approximately
(a) 4mA (b) 6mA (c) 10mA (d) 15mA

5. At cutoff, the collector to emitter voltage for the circuit of figure (1) is
(a) 5V (b) 7.5V (c) 10V (d) 15V