

MARKING CRITERIA AND STUDENT FEEDBACK

This section details the assessment criteria. The *extent* to which these are demonstrated by you determines your mark. The marks available for each criterion are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Common Assessment Criteria Applied	Marks available	Marks awarded
1. Research-Informed Literature Extent of research and/or own reading; selection of credible sources; application of appropriate referencing conventions.	10	3
Poor evidence of reading and indiscriminate use of sources.		
2. Knowledge and Understanding of Subject Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.	10	4
Evidence of basic knowledge and understanding of the relevant diodes and transistors. Need to include all calculation work i.e. voltage regulator design.		
3. Analysis Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence.	30	7
Some evidence of analysis for some of the assignment elements, but for the most part descriptive. There was no overall conclusion and need to make links to relative theory.		
4. Practical Application and Deployment Deployment of methods, materials, tools and techniques; application of concepts; formulation of innovative and creative solutions to solve problems.	40	26
Very good practical work, required some guidance. All relative calculations were obtained and showed a clear understanding of the procedures.		
5. Skills for Professional Practice Attributes in professional practice: individual and collaborative working; deployment of appropriate media; presentation and organisation.	10	4
Work lacks coherence in places and could be better structured.		

Assignment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)

Late Submission Penalties (tick if appropriate)

Up to four weeks late

First Attempt?

✓

44%



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

RESULT

44%

School of Applied Computing ASSIGNMENT SPECIFICATION

Student name:	Keegan Summers	Student P number:	
Programme:	HND Electrical/Electronic Engineering		
Lecturer:	Jason Pointer	Internal Verifier:	Steve Roberts
Assignment Title:	Diode and Transistor Characteristics		
Hand Out Date:	10/11/17	Submission deadline:	15/12/17

Referencing:	In the main body of your submission you must give credit to authors on whose research your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have read or quoted in order to complete this assignment (e.g. for books: surname of author and initials, year of publication, <u>title of book</u> , edition, publisher: place of publication).		
Disclosure:	I declare that this assignment is all my own work and that I have acknowledged all materials used from the published or unpublished works of other people. All references have been duly cited.		
Student's Signature:	Hardcopy assignments will not be accepted without a signature here	Date:	

Late submission will result in a late penalty mark, as follows:

Up to four weeks late, maximum mark of 40% for first attempts and 0% for resubmissions.
(Academic Quality Handbook 2015/16 7.5 (5))

Learning Outcomes tested (from module syllabus)

1. Demonstrate an understanding of semi-conductor components and characteristics and their application in **analogue** and digital electronic circuits.
2. To design, simulate, build, test and evaluate **analogue** and digital electronic circuits using information gained from datasheets.

Electrical and Electronic Engineering HND

Programmable Logic Controllers / Module code: PSDE4004

Student name: Keegan Summers

Lecturer name: Jason Pointer

22/12/2017

Summary

This assignment will be made up of two main parts, the first part will contain information and evidence of results gained from practical activities testing the characteristics of diodes, there will also be some background theory to go with the results. The second part of the assignment will be all on bipolar transistors, there will be results shown in forms of graphs, tables and calculations to be done. All of the work done electronically will be constructed using Multisim as it is the most appropriate, all of the information gathered from other sources will be referenced.

Task 1

Part A – Characteristics of diodes

This section of the assignment will investigate the characteristics of diodes and some of the circuit applications of diodes.

Simulation Requirements: Multisim.

Experimental equipment: DVM ($\times 3$), $1\text{k}\Omega$ resistor, germanium diode, silicon diode, power supply.

Silicon and germanium diodes are very similar in terms of the fact that they're *they are* manufactured in a very similar manner, both contain anode and cathode (positive and negative) sides and they both control the current flow direction, but apart from that they do have their differences.

The most commonly used diode from the two is the silicon diode, a silicon diode has a forward-bias voltage of 0.7V . The main reason that a silicon diode is the more common is because it's inexpensive to obtain and process, they're also used in many basic circuits that don't require specific requirements as they contain the basic needs of many circuits of today.

Germanium diodes are rare to find, but they're more efficient in circuits than silicon diodes, they have a forward-bias of 0.3V resulting in lower power losses across the circuit. They're appropriate to use over silicon in circuits that need to meet certain requirements but overall silicon diodes are the more obvious choice.

Below are the tables of results gathered from the forward and reverse bias for each diode.

Silicon forward

need to state method

Volts	Current(mA)
0	0
0.1	0.00003
0.2	0.00026
0.3	0.00204
0.4	0.0161
0.5	0.117
0.6	1.054
0.7	5.97
0.8	33

Germanium forward

Voltage	Current(mA)
0	0
0.1	0.017
0.2	0.218
0.3	0.862
0.4	1.84
0.5	2.76
0.6	4
0.7	5.37
0.8	6.8
0.9	8.35
1	10.04

Silicon reverse

V1 (V)	V2 (mV)	VD (V)	Current (mA)
0	0	0	0
-1.5	45.6	-1.5456	-4.56
-3	53.7	-3.0537	-5.37
-4.5	58.1	-4.5581	-5.81
-6	63.8	-6.0638	-6.38
-7.5	65.2	-7.5652	-6.52
-9	69.4	-9.0694	-6.94
-10.5	70.7	10.5707	-7.07
-12	72.6	12.0726	-7.26
-13.5	74.3	13.5743	-7.43
-15	76.7	15.0767	-7.67

Germanium reverse

V1 (V)	V2 (mV)	VD (V)	Current (μA)
0	0	0	0
-1.5	34	-1.534	-3.4
-3	59	-3.059	-5.9
-4.5	92	-4.592	-9.2
-6	137	-6.137	-13.7
-7.5	199	-7.699	-19.9
-9	283	-9.283	-28.3
-10.5	375	-10.875	-37.5
-12	481	-12.481	-48.1
-13.5	601	-14.101	-60.1
-15	749	-15.749	-74.9

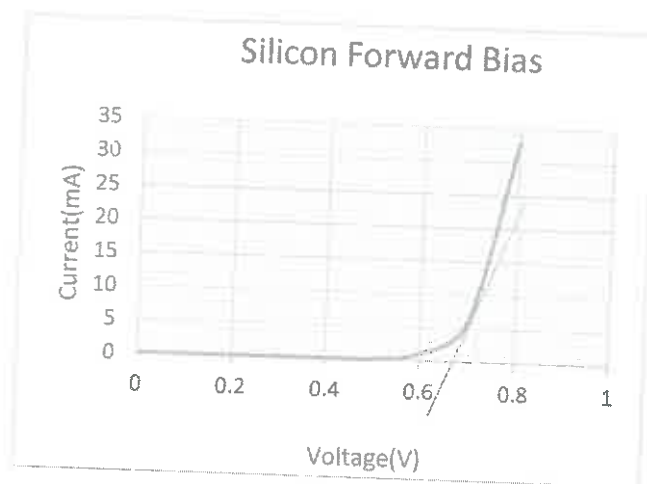
Silicon forward bias

Dynamic-

$$\Delta R = \frac{\text{Change in } V}{\text{Change in Current}} = \frac{0.7 - 0.66}{20 \times 10^{-3}} = 2\Omega$$

Static-

$$R_s = \frac{V}{I} = \frac{0.7}{5.97 \times 10^{-3}} = 117.25\Omega$$



Silicon reverse bias

Dynamic-

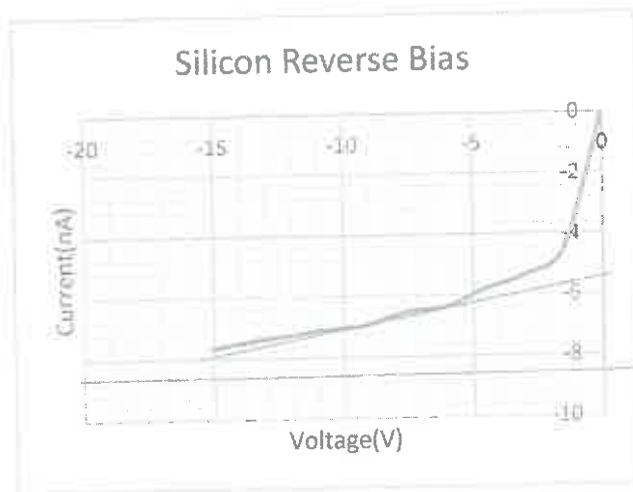
$$\Delta R = \frac{\text{Change in } V}{\text{Change in Current}} = \frac{15}{1.8 \times 10^{-9}}$$

$$= 8.33 \times 10^9 \Omega = 8.33 \text{ G}\Omega$$

Static-

$$R_s = \frac{V}{I} = \frac{-9}{-6.94 \times 10^{-9}}$$

$$= 1.297 \times 10^9 \Omega = 1.297 \text{ G}\Omega$$



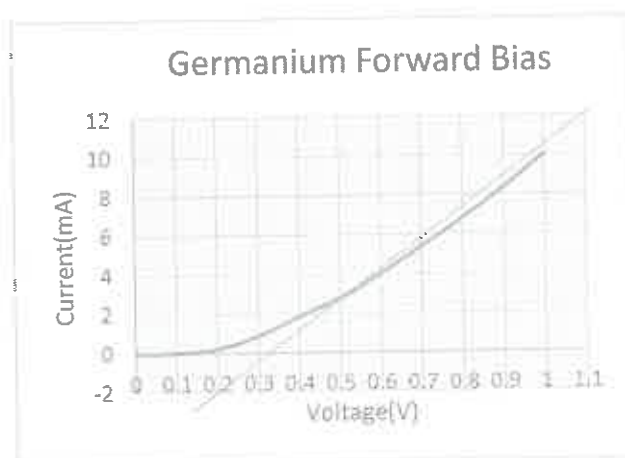
Germanium forward bias

Dynamic-

$$\Delta R = \frac{\text{Change in } V}{\text{Change in Current}} = \frac{0.7 - 0.34}{9.9 \times 10^{-3}} = 36.36 \Omega$$

Static-

$$R_s = \frac{V}{I} = \frac{0.7}{5.37 \times 10^{-3}} = 130.35 \Omega$$



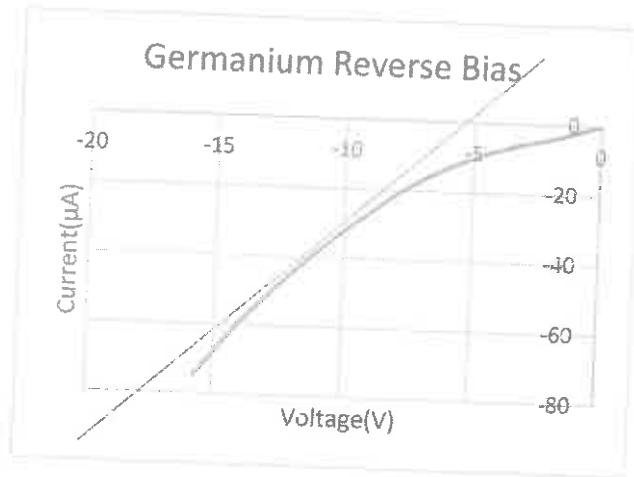
Germanium reverse bias

Dynamic-

$$\Delta R = \frac{\text{Change in } V}{\text{Change in Current}} = \frac{11.6}{67 \times 10^{-6}} = 173.13 \text{ k}\Omega$$

Static -

$$R_s = \frac{V}{I} = \frac{-9}{-28.3 \times 10^{-6}} = 318.021 \text{ k}\Omega$$

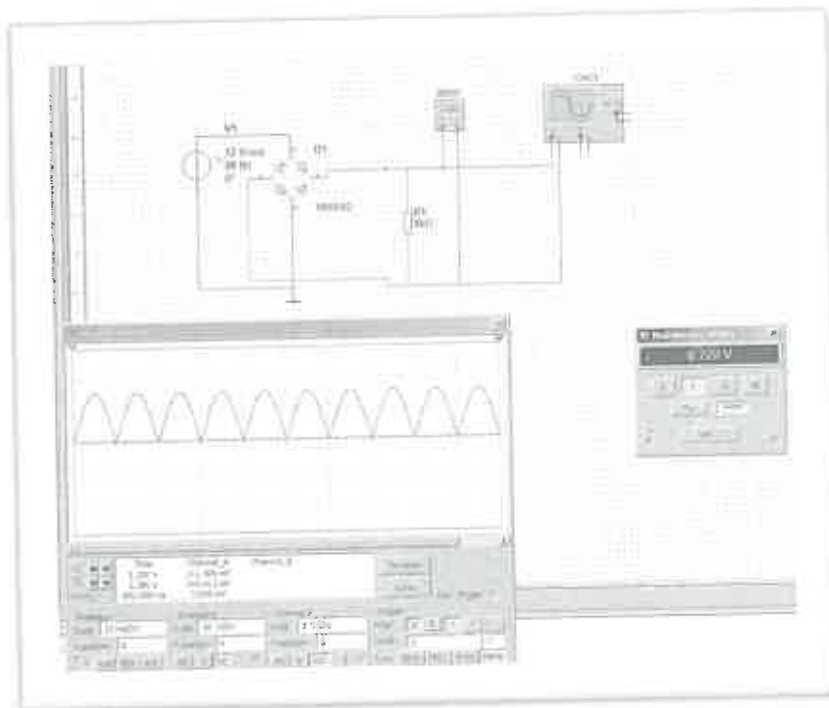


Part B – Diode circuits

Datasheet for BZX84c5V -

http://www.farnell.com/datasheets/2284128.pdf?_ga=2.67931091.396909131.1513943379-706466034.1513943379 ✓

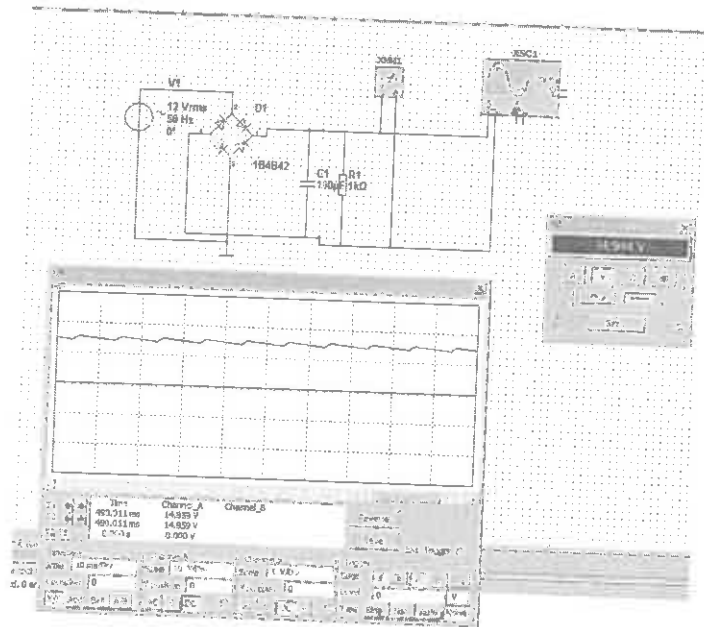
Regular junction diodes are designed to only work in a forward direction, other diodes such as zener diodes are designed differently so that they can work efficiently in the reverse direction without getting damaged.



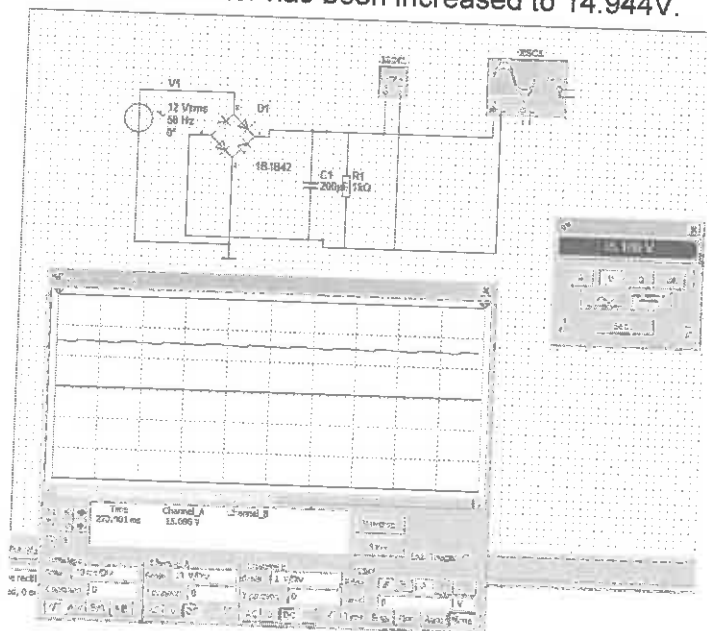
The screenshot above shows a basic full wave rectifier circuit, the circuit is constructed upon using a 1B4B2 rectifier, a 1k resistor and a 12V supply. The multimeter recorded a peak voltage of 15.62V and an output voltage of 9.729V. ✓

To gain a 'ripple effect' in the voltage a capacitor was added – a 100 μ F capacitor.

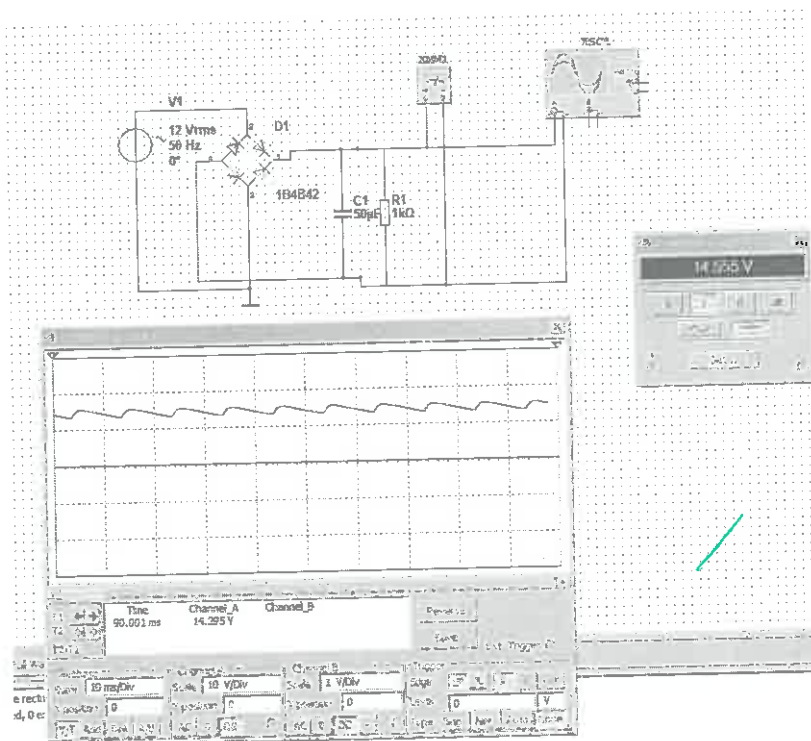
Have not explained operation



The screenshot above shows that the capacitor has been added to the circuit, because it's been added it not only demonstrates a ripple on the oscilloscope but the output voltage from the multimeter has been increased to 14.944V.



The screenshot above shows that the capacitor value has been increased to 200µF and this has had an effect on the output voltage edging it closer to the peak voltage, meaning the line shown on the oscilloscope is almost a flat line or a 'perfect DC voltage'.



The screenshot above shows that the capacitor value has been decreased to $50\mu\text{F}$, other than the output voltage decreasing the biggest change visible is the ripple effect that it has on the oscilloscope reading. It had this effect as the capacitor is charging up and discharging slowly which doesn't allow the voltage to go below 0V .

What about the voltage regulator circuit.

Task 2 - Static Characteristics of BJTs

This section of the assignment will investigate the characteristics of a bipolar transistor.

Equipment: DVM ($\times 3$) BFY 51
decade boxes $1\text{M}\Omega$ and $10\text{k}\Omega$ Power supply

Objective: To construct the input, output and transfer static characteristics of a transistor configured in the common emitter mode.

Table 1

$V_{CE} = 3\text{V}$			$V_{CE} = 5\text{V}$		
V_{BE}	V_{RB}	$I_B = V_{RB}/R_B$	V_{BE}	V_{RB}	$I_B = V_{RB}/R_B$
0.63V	0.018	0.000018	0.63V	0.0247	0.0000247
0.64V	0.0289	0.0000289	0.64V	0.034	0.000034
0.65V	0.046	0.000046	0.65V	0.0469	0.0000469

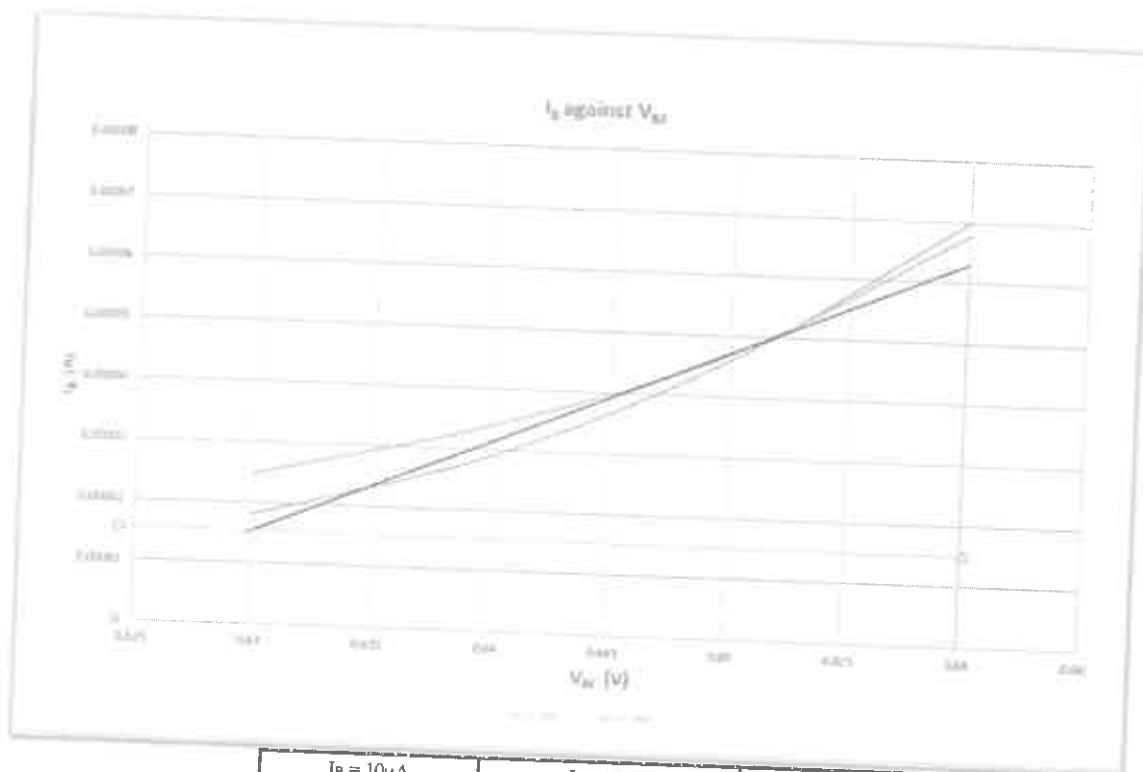
0.66V	0.0701	0.0000701	0.66V	0.0677	0.0000677
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The change in $I_B = 0.00055A$

The change in $V_{BE} = 0.03V$

$$h_{ie} = V_{BE}/I_B = 0.03/0.00055 = 54.54\Omega$$

Below is a graph showing the results from I_B against V_{BE} .



It could have been better in colour.

V_{CE}	$I_B = 10\mu A$		$I_B = 20\mu A$		$I_B = 30\mu A$		$I_B = 40\mu A$		$I_B = 50\mu A$	
	V_{RC}	$I_C = V_{RC}/R_C$	V_{RC}	$I_C = V_{RC}/R_C$	V_{RC}	$I_C = V_{RC}/R_C$	V_{RC}	$I_C = V_{RC}/R_C$	V_{RC}	$I_C = V_{RC}/R_C$
0	0	0	0	0	0	0	0	0	0	0
0.2	0.0976	0.000976	0.2009	0.002009	0.3126	0.003126	0.4257	0.004257	0.5372	0.005372
0.4	0.0985	0.000985	0.2042	0.002042	0.3166	0.003166	0.4313	0.004313	0.5433	0.005433
0.8	0.0985	0.000985	0.2051	0.002051	0.3173	0.003173	0.4322	0.004322	0.5443	0.005443
1	0.0986	0.000986	0.2053	0.002053	0.3175	0.003175	0.4323	0.004323	0.5449	0.005449
3	0.0992	0.000992	0.2072	0.002072	0.3211	0.003211	0.4376	0.004376	0.5502	0.005502
5	0.0997	0.000997	0.2087	0.002087	0.3245	0.003245	0.4397	0.004397	0.5572	0.005572

Output admittance, h_{oe}

4.375 μS

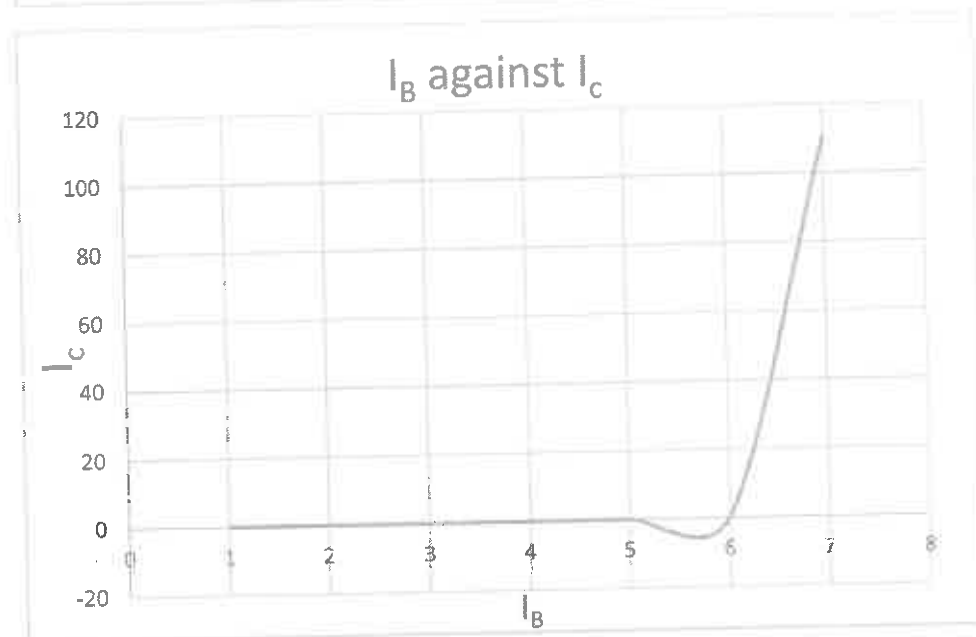
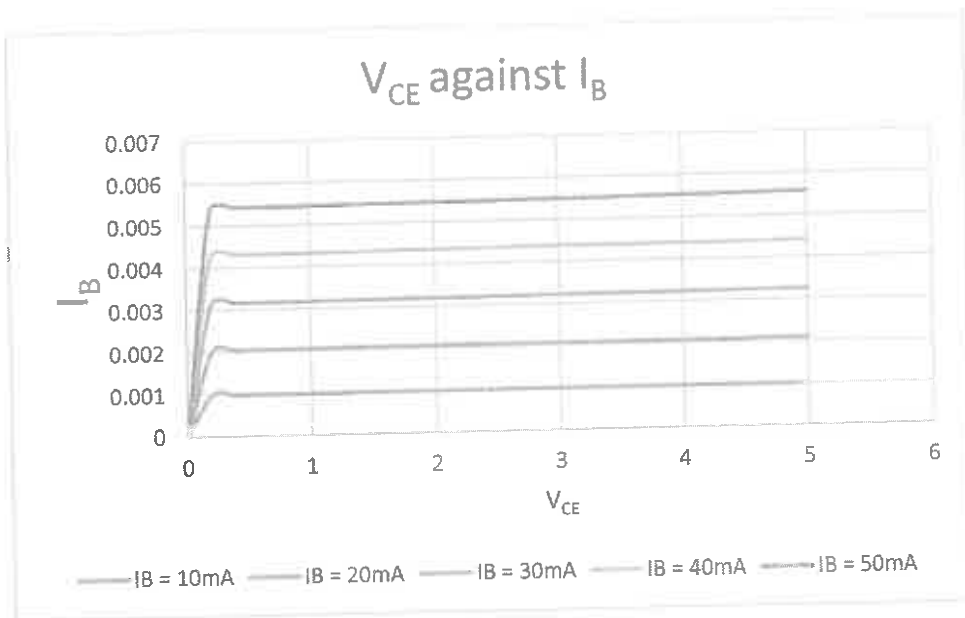
16.25 μS

24.79167 μS

29.16667 μS

41.66667 μS

The output admittance was calculated using the formula - $\Delta I_C / \Delta V_{CE}$, which gave the values for each of the different I_B values.



The graphs above show the results of V_{ce} against I_b and I_b against I_c .

Below is a table of results showing the current gain for $V_{ce} = 3V$

$I_B(\mu A)$	$I_C(A)$
0	0
10	0.000992
20	0.002072
30	0.003211
40	0.004376
50	0.005502
h_{fe}	110.04

Current gain (h_{fe}) = $\Delta I_C / \Delta I_B = 0.005502 / 0.000050 = \underline{110.04/A}$

No conclusion

Bibliography

Sciencing. (2017). *Characteristics of Silicon & Germanium Diodes*. [online] Available at: <https://sciencing.com/characteristics-silicon-germanium-diodes-6823105.html> [Accessed 22 Dec. 2017].

Farnell.com. (2017). *Cite a Website - Cite This For Me*. [online] Available at: http://www.farnell.com/datasheets/2284128.pdf?_ga=2.67931091.396909131.1513943379-706466034.1513943379 [Accessed 22 Dec. 2017].

Power Electronics A to Z. (2017). *Zener Diode Basics, Operation, Characteristics*. [online] Available at: <http://www.completepowerelectronics.com/zener-diode-basics-operation-characteristics/> [Accessed 22 Dec. 2017].



