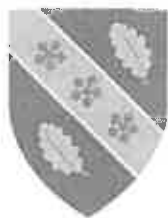


MARKING CRITERIA AND STUDENT FEEDBACK

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.	15	5.5
Poor evidence of reading and/or of reliance on inappropriate sources, and/or indiscriminate use of sources.		
2. Knowledge and Understanding of Subject Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.	15	5.5
Evidence of basic knowledge and understanding of the relevant concepts and underlying principles.		
3. Analysis Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence.	20	6
Some evidence to support findings/ views, but evidence not consistently interpreted.		
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	25
A good and appropriate application of standard methods, materials, tools and/or techniques.		
5. Skills for Professional Practice Attributes in professional practice: individual and collaborative working; deployment of appropriate media; presentation and organisation.	10	4
Can communicate in a suitable format but with some room for improvement.		

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)		46%
	Up to one week late		
	First Attempt?	✓	



School of Applied Computing ASSIGNMENT SPECIFICATION

Student name:	Rhys Armstrong	Student P number:	
Programme:	HND Electrical/Electronic Engineering		
Lecturer:	Jason Pointer	Internal Verifier:	Steve Roberts
Assignment Title:	Transistor & Operational Amplifier Circuits		
Hand Out Date:	02/02/18	Submission deadline:	22/03/18

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:	<i>Hardcopy assignments will not be accepted without a signature here</i>	Date:	

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

Up to one week 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.

Rhys Armstrong

Student name - Rhys Armstrong

Student number – 135522

Assignment module – electronics 1

Module code - PSDE4004

Tutor – Jason pointer

Introduction

Within this assignment there are different sections showing different amplifiers being designed, built and tested. Along with these circuits calculations will be added which will help to find the correct resistor values which will fit the transistor in question, this will ensure that the outputs are correct. Once a transistor has been selected for the amplifier, the individual h_{fe} value will be measured for the transistor. Four similar circuits will be made and measured which will give results to be looked at and calculated.

Class A amplifiers

Common emitter amplifiers are the most commonly used type of amplifier as they have a large voltage gain. They are designed to produce a large output voltage swing from a relatively small input signal voltage of only a few millivolt's and are used mainly as "small signal amplifiers" as we saw in the previous tutorials. Amplifiers are required to drive large resistive loads such as a loudspeaker or to drive a motor in a robot and for these types of applications where high switching currents are needed Power amplifiers are required. They are mainly used as they *not finished*

Class C amplifiers

Class C power amplifier is a type of amplifier where the active element (transistor) conduct for less than one half cycle of the input signal. Less than one half cycle means the conduction angle is less than 180° and its typical value is 80° to 120° . The reduced conduction angle improves the efficiency to a great extend but causes a lot of distortion. Theoretical maximum efficiency of a Class C amplifier is around 90%.

Task 1

The circuit being designed and created requires a transistor value which needs to be between 100-600 h_{fe} . The transistor that has been used within this assignment is a BC549 transistor with an h_{fe} value of 508. This has been determined by using the data sheet and using a multi meter. Before building the circuit, different calculations were required to be done which determine the values of the resistors to be used in the circuit. The calculations are for R_C , R_E , R_2 and R_1 which show what resistor to use.

A)

BC549 HFE 508

$V_{CC} = 12V$

1) $R_C = V_{CC} / 2 \times I_C = 12 / 2 \times I_C = 12 / 2 \times 10^{-3} = 6k\Omega$ nearest value is **5.6k Ω**

2) $R_E = V_E = 10\% \text{ of } V_{CC} = 0.10 \times 12 = 1.2V$

So $R_E = V_E / I_E = 1.2 / 1 \times 10^{-3} = 1.2k\Omega$

3) $R_2 = V_{BE}$ from data sheet = 0.66mA So $V_B = 1.2 + 0.66 = 1.86V$ I_2 is 10 times

greater than I_B . $H_{FE} = I_C / I_B \Rightarrow I_B = I_C / h_{fe} = 1 \times 10^{-3} / 508 = 1.97 \times 10^{-6} = 1.97nA$ *$V_{BE} = 0.66V$* *$= 1.97\mu A$*

So $R_2 = V_B / 10 \times I_B = 1.86 / 10 \times 1.97 \times 10^{-6} = 0.42 \times 10^3$ nearest value is **100k Ω**

94.42

4) $R1 = I1 = I2 + IB = 10IB + IB = 11IB$ and $V1 = VCC - VB$ so $R1 = VCC - VB / 11IB = 12 - 1.86 / 11 \times 1.97 \times 10^{-6} = 467.93 \times 10^3 = \text{nearest value resistor } 470k\Omega$

These results will be put into place and have a series of tests to make sure that the circuit corresponds with DC and AC voltages. Within the calculations "nearest value" which has been put in as to show what resistors are to be used in the circuit as there aren't specific resistors for each value, the resistors will have to be rounded up to the next available size resistor. Rounding resistors up is to allow the circuit values to reach the full amount as the resistor value is larger than required to enable the circuit to work to its full potential.

B)

DC conditions

$V_{RC} = 6.18V$ $V_{BE} = 0.62V$ $V_C = 5.81V$ $V_E = 1.31V$ $V_B = 1.92V$ $I_C = 1.13mA$
 $V_{in} = 40mV$

AC conditions Output Obtain frequency response

Frequency (Hz)	Output (V)
16	2V
25	3V
35	4V
49	5V
68	6V
112	7V
160	7.5V
700	8V
4k	8V
7k	8V
11k	8V
56k	7.5V
105k	7V
167k	6V
233k	5V
325k	4V
470k	3V

Need to include the value of gain in dBs and include the frequency response.

Part 2 tuned amplifier – the circuit below shows a tuned amplifier (Class C)

A tuned amplifier has a frequency response similar to that of a band-pass filter except with gain. In communications, tuned amplifiers are commonly used to separate a desired frequency from a composite waveform. For example, broad tuned radio frequency amplifiers are used to block undesired frequencies such as image frequencies, from entering a radio receiver, and intermediate frequency amplifiers separate and amplify a narrow band of signals for base band detection.

Resonant Frequency = 15915

Rhys Armstrong

Quality factor = 100

Bandwidth = 159.15 Hz

Figure 1

Bandwidth

*Need to state formula
and show workings.*

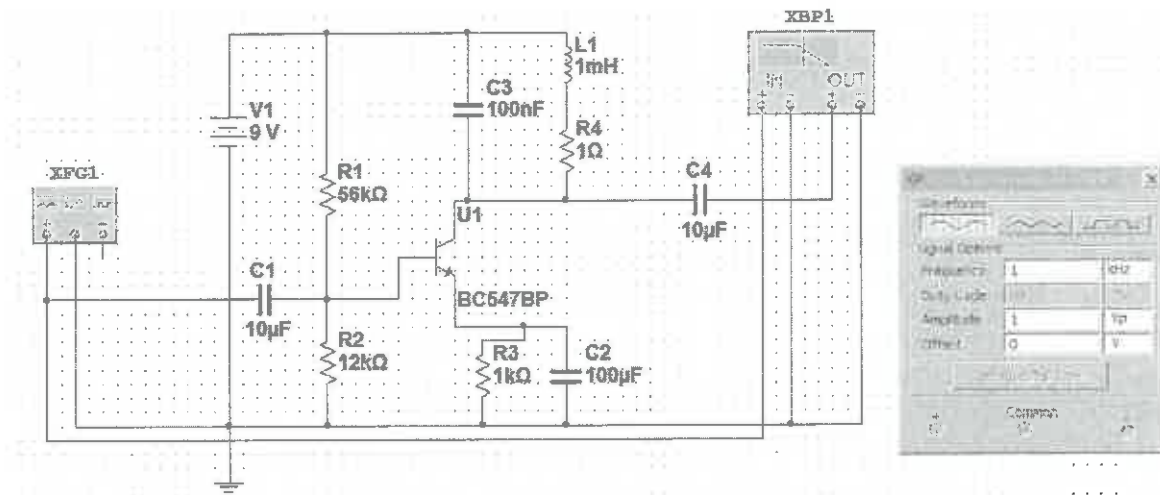
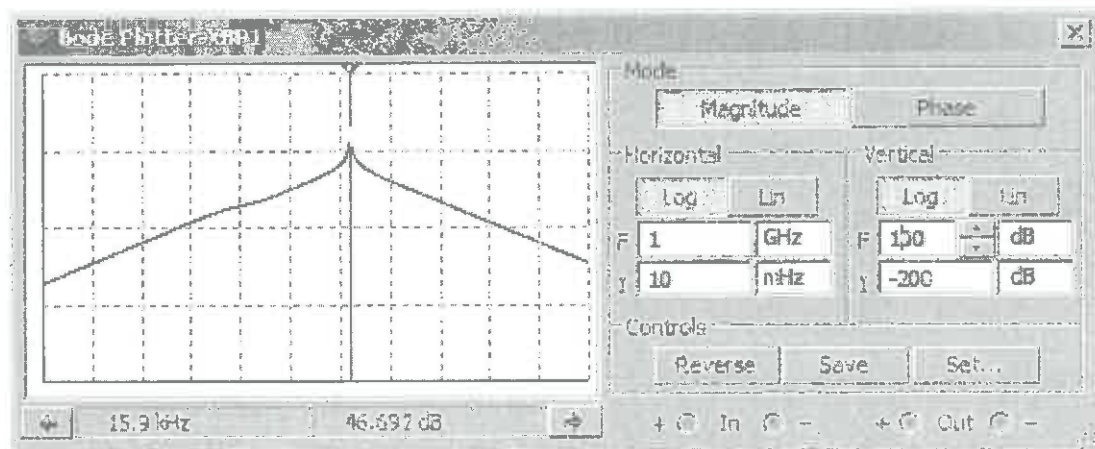
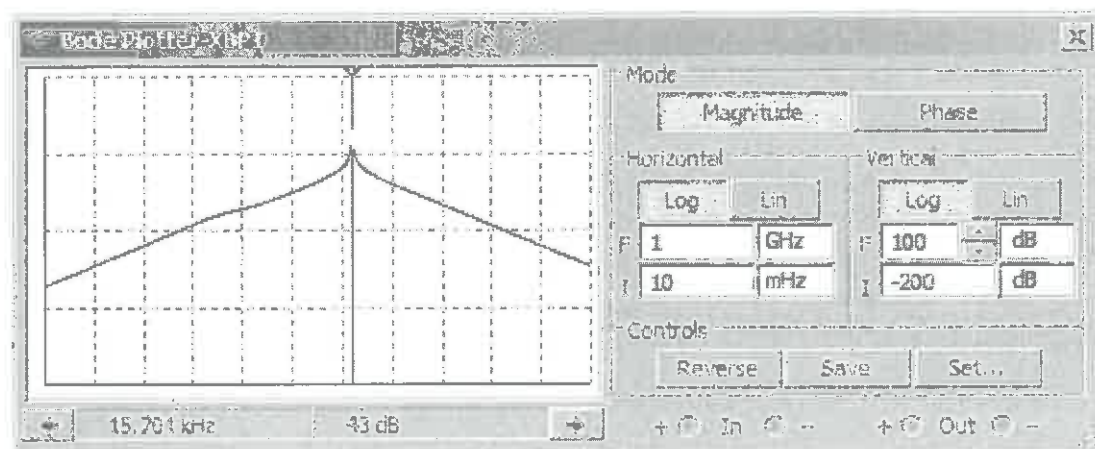


Figure 2



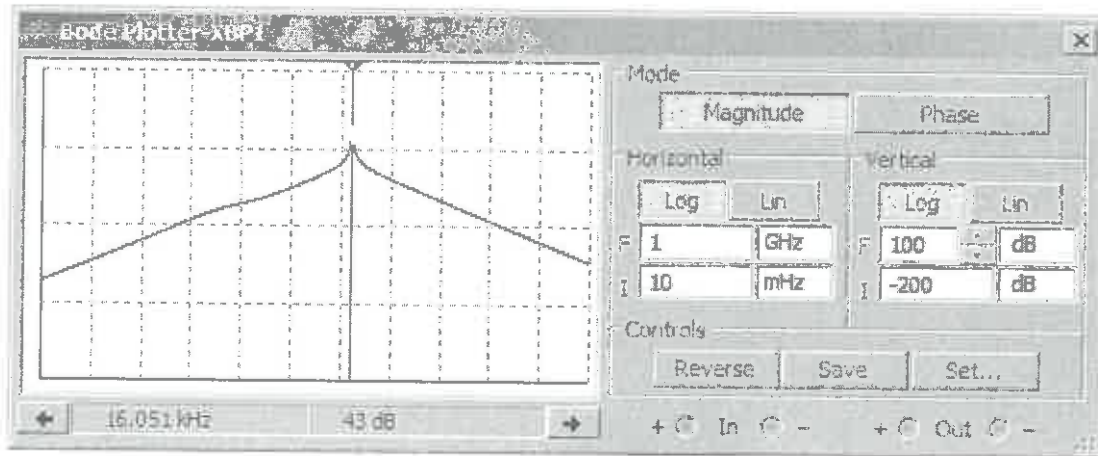
Lower Frequency (f1) = 15.701 kHz

Figure 3



Upper Frequency (f_2) = 16.051 kHz

Figure 4



$$\text{Bandwidth (Hz)} = \text{Upper Frequency (f}_2\text{)} - \text{Lower Frequency (f}_1\text{)} = 16.051 \text{ kHz} - 15.701 \text{ kHz} = 350 \text{ Hz}$$

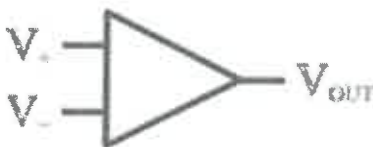
Between the calculations and simulations there is a bit of a difference between in the answers being produced and displayed from the same circuit. The calculations and the circuits have the same values that have been inputted into a formula. However the difference in the results could be caused by multi sim being too accurate and not allowing room for tolerances of components which would make the results vary from each other.

Part 3 - Operational Amplifier Circuits

Operational amplifier

An operational amplifier or an op-amp is an integrated circuit that operates as a voltage amplifier. An op-amp has a differential input. That is has two inputs of opposite polarity. An op-amp has a single output and a very high gain, which means that the output signal is much higher than input signal. An op-amp is often represented in a circuit diagram with the following circuit.

Figure 5



Task 1

need to state what is being done,

Figure 6

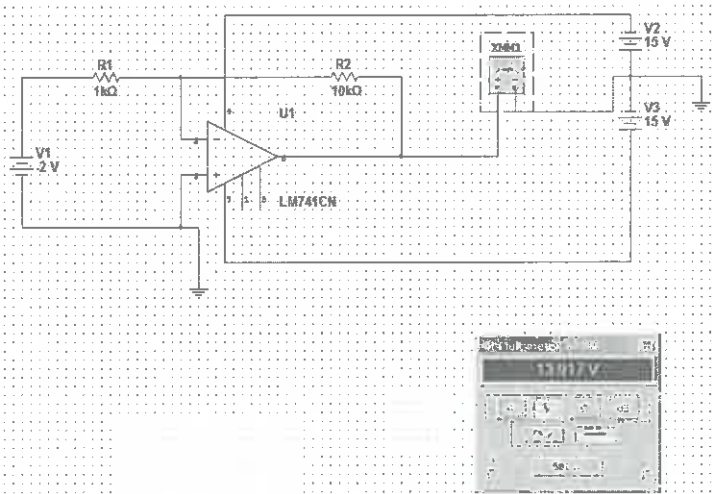


figure 6	Vin	Vout	Simulation
	0.5	-5.05	-4.98
	1	-10.1	-9.98
	1.5	-13.3	-13.92
	2	-13.34	-13.92
	-0.5	5.55	5.01
	-1	11.12	10.01
	-1.5	15.29	13.92
	-2	15.77	13.92

Should have included calculated values.

Figure 6 is a simulation of one of the operational amplifiers circuit which are being produced, the figure 6 table it shows the input values (Vout), output values which have been calculated and the simulation values. As can be seen in the table the simulated values and calculated values are slightly different, this is okay however as different tolerances taking an effect on the results. Also multi sim will be very accurate and causing slight variants within the results.

Figure 7

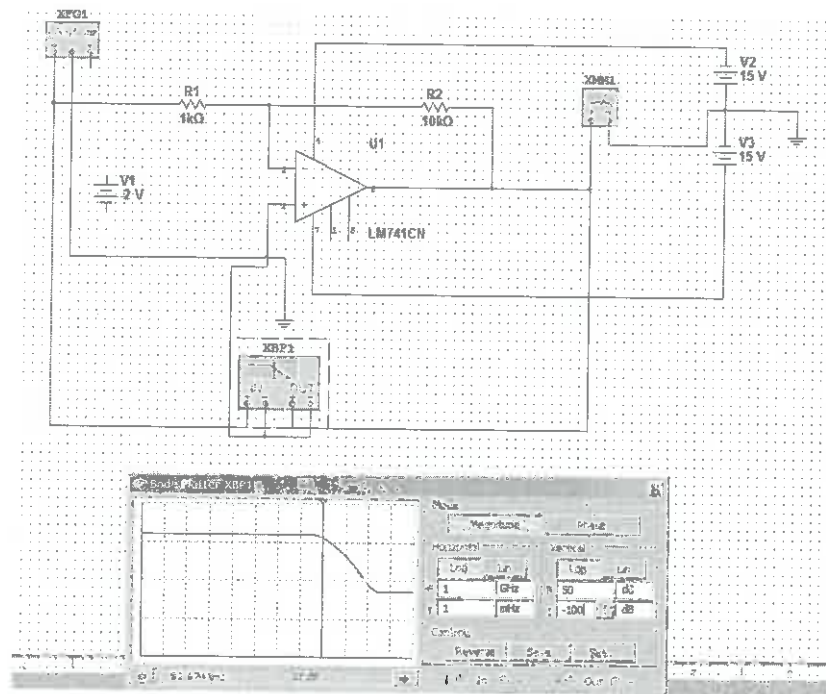


figure 7

Vin1	Vin2	Vout	Simulation
1	2.5	13.18	13.93
1	1.5	5.29	5.01
0.5	1	5.15	5.01
1	1	-0.03	0.01
2	1	-10.33	-9.99
2.5	1	-13.29	-13.91
1	2	10.41	10.01
0	0.5	5.1	5.01
0.5	0	-5.3	-4.99

Figure 8

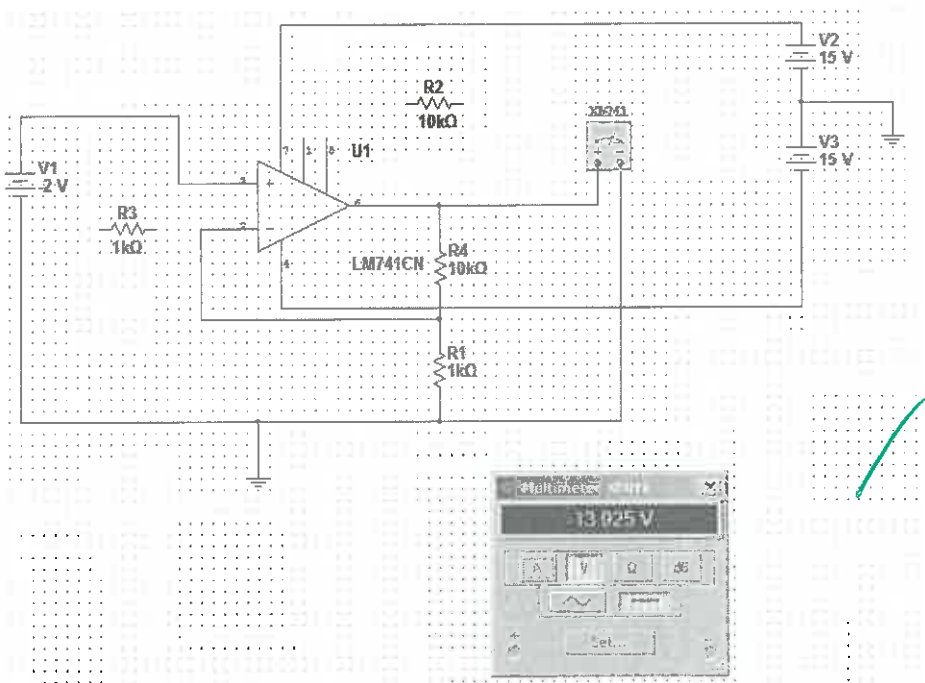


figure 8	Vin	Vout	simulation
	0.5	5.44	5.51
	1	11.02	11.01
	1.5	13.92	13.93
	2	13.92	13.93
	-0.5	-4.96	-5.49
	-1	-9.99	-10.99
	-1.5	-11.87	-13.93
	-2	-11.42	-13.93

Figure 9

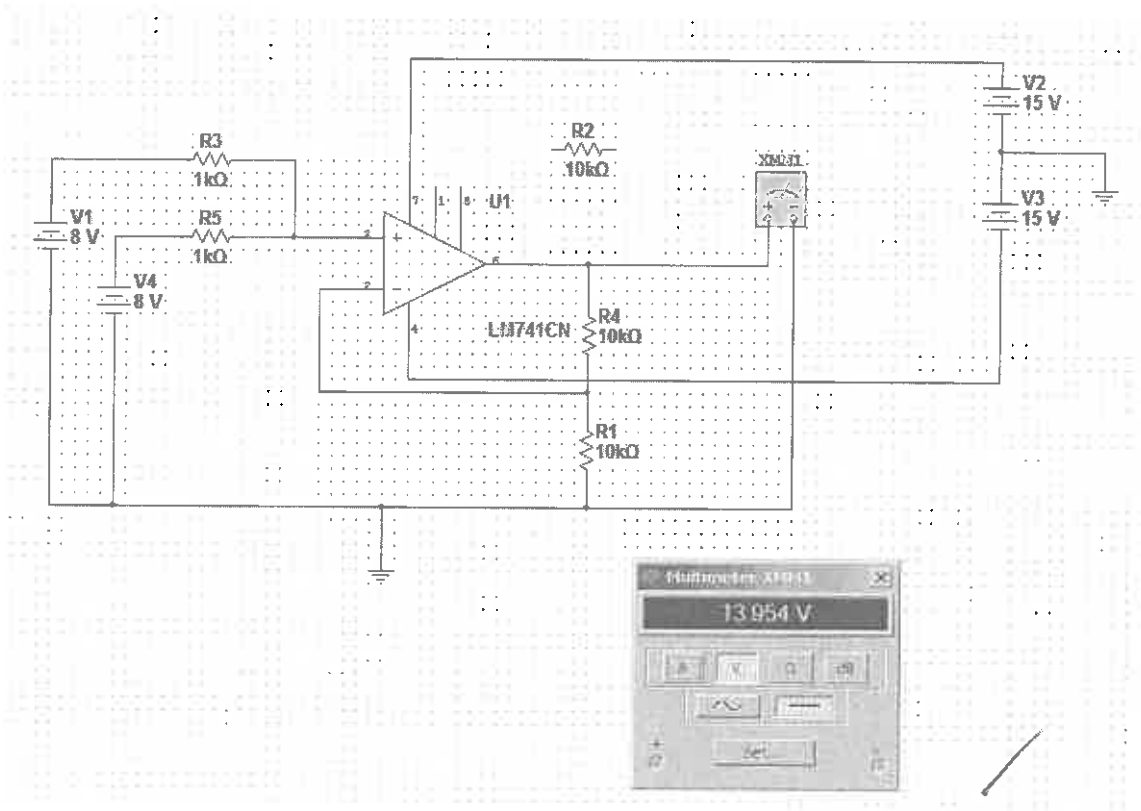
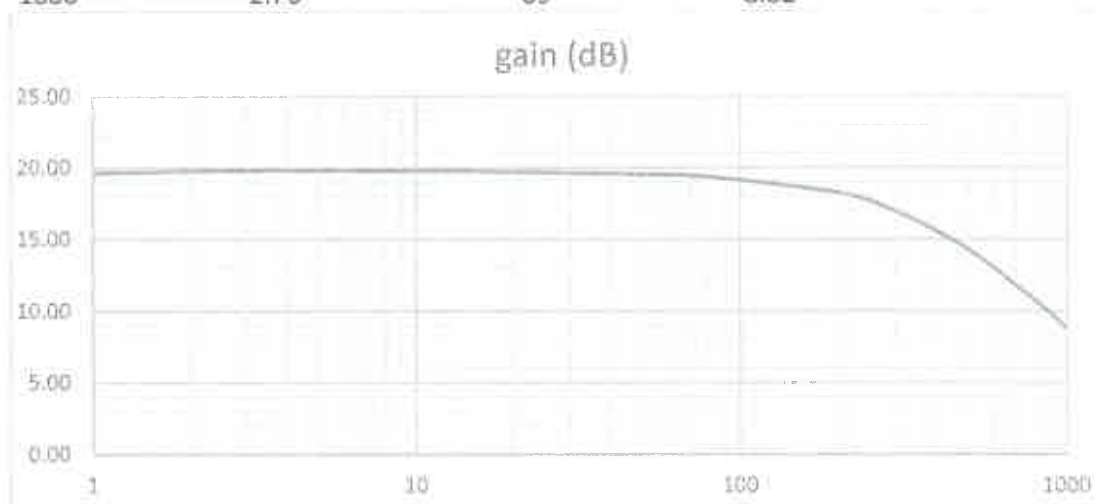


figure 9	Vin1	Vin2	Vout	simulation
	0	1	0.99	1
	1	3	4.01	4
	1	5	6.05	6
	2	3	5.02	5
	2	4	6.04	6
	5	5	10.05	10
	5	7	12.05	12
	7	7	13.97	13.94
	8	8	14.01	13.95

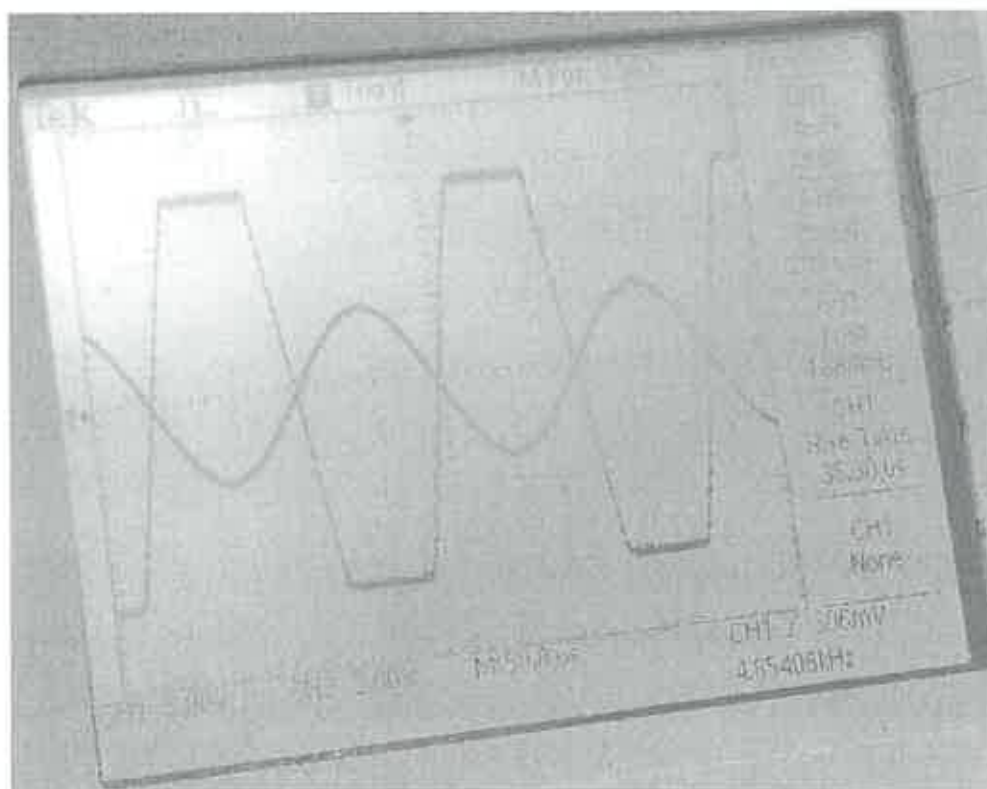
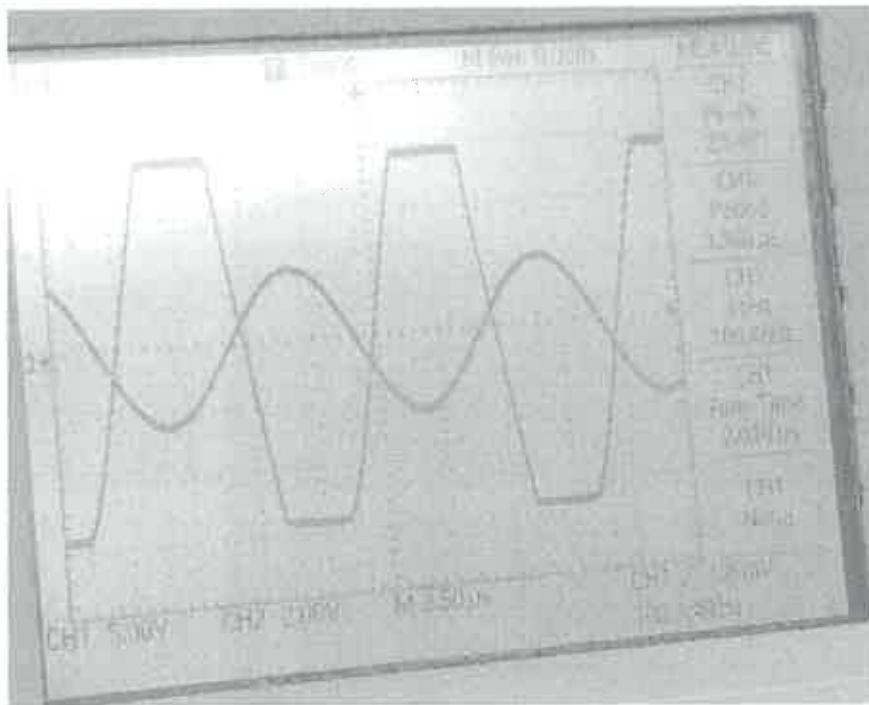
Task 2

Frequency (kHz)	Output Voltage	Phase Relationship	gain (dB)
1	9.6	180	19.65
3	9.8	180	19.82
8	9.76	180	19.79
10	9.72	180	19.75
13	9.74	180	19.77
16	9.7	180	19.74
20	9.68	180	19.72
30	9.6	175	19.65
50	9.48	170	19.54
80	9.28	162	19.35
200	8.16	154	18.23
300	7.04	123	16.95
500	5.2	108	14.32
800	3.44	96	10.73
1000	2.76	89	8.82

 $V_{in} = ?$ 

↑
Labels.





Task 3

What does the shape of the waveform mean?

Task 4 negative feedback

Negative feedback is the most common form of feedback control configuration used in process, micro-computer and amplification systems. Feedback is the process by which a small percentage of the output signal, either voltage or a current, is used as an input. This feedback is opposite in value or phase to the input signal, then the feedback is said to be negative feedback. Negative feedback opposes or subtracts from the input signals giving it many advantages in the design and stabilization of control systems. For example, if the systems output changes for any reason, then negative feedback affects the input in such a way as to counteract the change. There are some advantages of negative feedback amplifier, for example: the negative feedback reduces noise, it has highly stabilized gain, it can control step response of amplifier, it has less amplitude distortion.

$$V_s = V_{in} - V_{\beta}$$

$$V_{out} = A_o \times V_s \Rightarrow V_s = V_{out}/A_o$$

$$V_{\beta} = V_{out} \times \beta$$

$$\text{So } V_{out}/A_o = V_{in} - V_{out} \times \beta$$

$$V_{out} = A_o (V_{in} - V_{out} \times \beta)$$

$$V_{out} = A_o V_{in} - A_o V_{out} \times \beta$$

$$V_{out} + A_o V_{out} \times \beta = A_o V_{in}$$

$$V_{out} (1 + A_o \beta) = A_o V_{in}$$

Should have included block diagram.

$$V_{out}/V_{in} = A_o / (1 + A_o \beta)$$

$$V_{out}/V_{in} = \text{voltage gain} = A_v$$

Conclusion

Within this assignment many different topics have been looked at, transistors have been measured for h_{fe} and have been implemented into different circuits. Within this assignment different calculations have been made to gain different values of use to the assignment. I have covered op amps along with screenshots with calculations to show what is happening. At the end of the assignment negative feedback has been covered with a good explanation about what it is and a formula.

This is not a conclusion should be discussing the results and theory

Resources

Article title: Chegg.com
Website title: Chegg.com
URL: <http://www.chegg.com/homework-help/definitions/operational-amplifier-4>

<https://www.electronics-tutorials.ws/systems/negative-feedback.html>

Limited resources.

