

LEVEL 5 ASSESSMENT SPECIFICATION

Student name:	Tom Wolsey	Student ID number:	
Programme:	HND/HNC Electrical/Electronic Engineering, HNC Instrumentation Engineering & HNC Power System Engineering		
Module:	Electrical Principles, Methods and Simulation		
Module code:	PSDE5009	Contribution to Overall Module Assessment (%):	50%
Lecturer:	Jason Pointer	Internal Verifier:	Steve Roberts
Assignment Title:	Analogue Systems	Word count (or equivalent):	2000
Submission deadline:	07/02/19	Return date of provisional marks & written feedback:	
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 40%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		

Module Learning Outcomes (from module syllabus)

1. Analyse and **evaluate electrical circuits, electronic systems** and control systems.
2. Simulate standard **electrical circuits, electronic systems** and control systems.

STUDENT FEEDBACK FORM

This section details the *extent* to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill 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.

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills	0	0
2. Knowledge and Understanding Skills	20	15.2
Achieved 80% for Task 1. Achieved 65% for Task 2. Achieved 80% for Task 3. Achieved 85% for Task 4. Achieved 70% for Task 5. Excellent, detailed knowledge and showed an excellent understanding of the well-established concepts and principles of the covered by this assignment.		
3. Cognitive and Intellectual Skills	20	10.3
Achieved 60% for Task 1. Achieved 55% for Task 3. Achieved 40% for Task 5. For the tasks that asked for comments there is some critical evaluation and analysis of concepts and principles, though descriptive in parts.		
4. Practical Application Skills	50	39.5
Achieved 85% for Task 1. Achieved 65% for Task 2. Achieved 84% for Task 3. Achieved 85% for Task 4. Achieved 70% for Task 5. Achieved 85% for Task 6. Excellent application of established methods in the use of Matlab, Multisim and practical work. Required minimum support throughout the assessment.		
5. Transferable Skills for Life and Professional Practice	10	7
Work is coherent, very fluent and is presented professionally.		

Assessment 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 1 week late (40% Max)

Over 1 week late (0%)

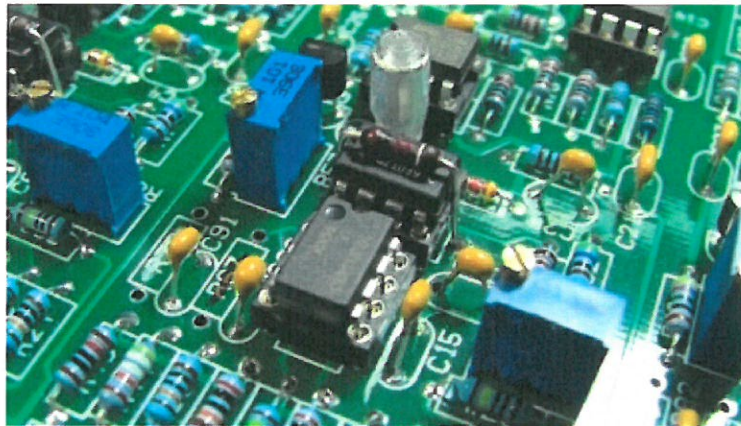
72%

Tom Wolsey 126039

PSDE 5009 – Electrical Principles, Methods and Simulation

Assignment 1 – Analogue Systems

Jason Pointer

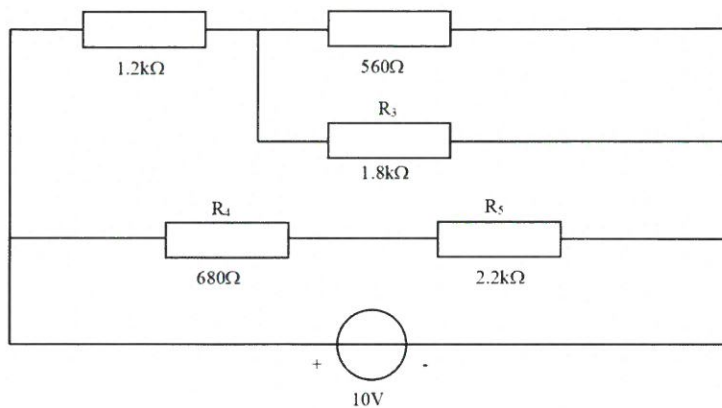


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Task 1 Combinational Circuit

For the first part of this report the circuit which can be seen below was constructed on breadboard and the voltage across each of the resistors where measured using a multimeter. These can be seen in the table below "Task 1 Combinational Circuit".



Task 1 Combinational Circuit				
Resistor	Value	Calculated Voltage (V)	Simulated Voltage (V)	Measured Voltage (V)
R1	1200	7.37	7.375	7.41
R2	560	2.63	2.625	2.72
R3	1800	2.63	2.625	2.72
R4	680	2.36	2.361	2.37
R5	2200	7.638	7.639	7.75

As can be seen in the table above the values that where calculated where almost the same as the simulated and the measured values where slightly different, there are a number of reason why these could be different. For example each of the resistor has a tolerance and the ones used in the partial where $\pm 5\%$. The multimeter that were used for taking the measurement also had an internal resistance which is very high in the mega ohm range but this could add a small loading effect on the circuit. The input voltage would also affect the results that were obtained and the power supply could have a small range from the 10V that was meant to be put into the circuit.

The values that were used in the piratical test where then used to calculate values that could then be compared, an example of the calculations can be seen below.

Calculated Value

$$I1 = \frac{V}{(R4 + R5)} = \frac{10}{(680 + 2200)} = 3.472mA$$

$$V4 = I1 \times R4 = 3.472mA \times 680 = 2.36V$$

$$V5 = I1 \times R5 = 3.472mA \times 2200 = 7.638V$$

$$R23 = \frac{R2 \times R3}{R2 + R3} = \frac{560 \times 1800}{560 + 1800} = 427.119ohm$$

$$R123 = R1 + R23 = 1200 + 427.119 = 1627.119 \Omega$$

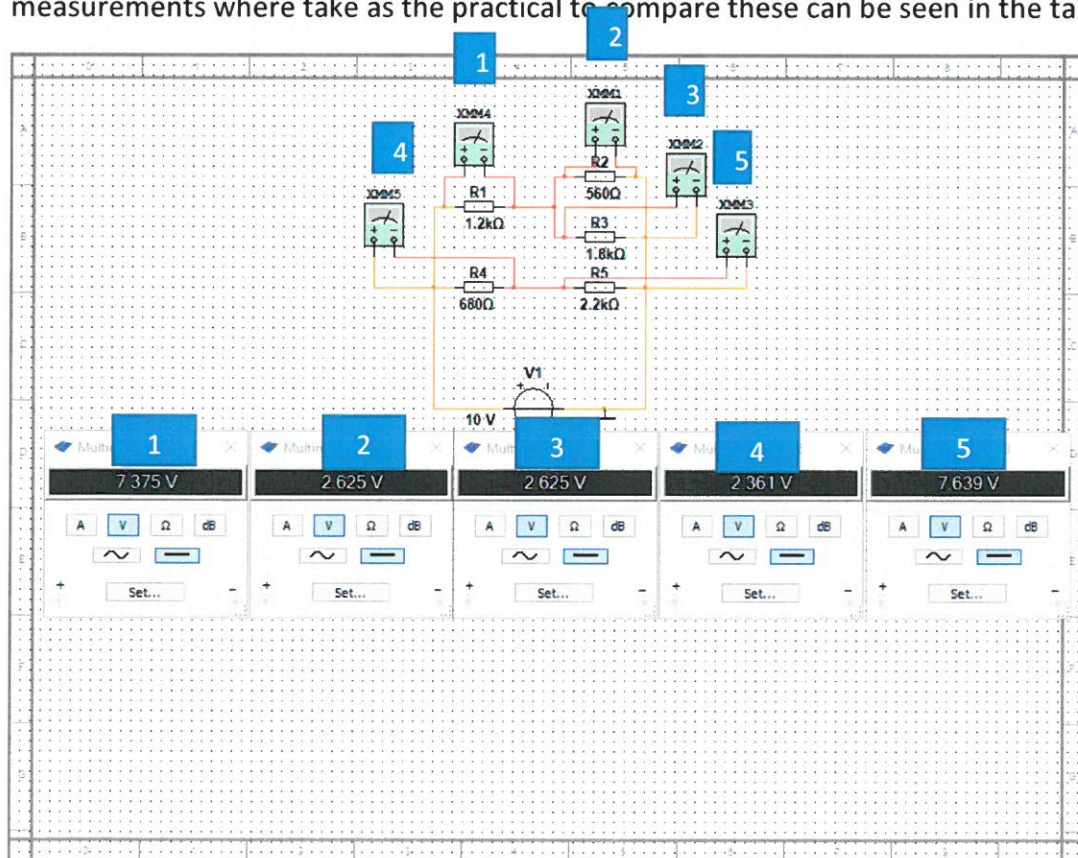
$$I2 = \frac{V}{R123} = \frac{10}{1627.119} = 6.15mA$$

$$V1 = I2 \times R1 = 6.15mA \times 1200 = 7.37V$$

$$V2 = V - V1 = 2.63V$$

$$V3 = V2 = 2.63V$$

After the results were also calculated the circuit was then construed using a simulation package called multisim. Below can be seen the constructed circuit. The same measurements where take as the practical to compare these can be seen in the table above.



A MATLAB program was then designed that would be able to perform all the calculations required with only inputting the resistor value and the voltage. Below can be seen the program and the output result in the screen capture. There can also be seen another screen shot of multisim with different values to compare to the MATLAB program to check it's fully operational.

```

1. %File Name - Assignment_1_task_1_MATLAB.m
2. %Task 1 - DC Circuits
3. %Author - Tom Wolsey
4. %Date 11/10/18
5. V=input('Enter the input voltage: '); %Program waits for user to input value
6. R1=input('Enter the value for R1: '); %Program waits for user to input value
7. R2=input('Enter the value for R2: '); %Program waits for user to input value
8. R3=input('Enter the value for R3: '); %Program waits for user to input value
9. R4=input('Enter the value for R4: '); %Program waits for user to input value
10. R5=input('Enter the value for R5: '); %Program waits for user to input value
11.
12. %Calculations
13. I1 = V/(R4+R5); %Calculates Current 1
14. V4 = I1*R4; %Calculates Voltage 4
15. V5 = I1*R5; %Calculates Voltage 5
16. R23 =(R2*R3)/(R2+R3); %Calculates R23
17. R123 = R1+R23; %Calculates R123
18. I2 = V/R123; %Calculates I2
19. V1 = I2*R1; %Calculates V1
20. V2 = V-V1; %Calculates V2
21. V3=V2; %Makes V3 equal to V2
22.
23. %Displayig Values
24. disp('V1:') %Displays Text V1
25. disp(V1) %Displays Value V1
26. disp('V2:') %Displays Text V2
27. disp(V2) %Displays Value V2
28. disp('V3:') %Displays Text V3
29. disp(V3) %Displays Value V3
30. disp('V4:') %Displays Text V4
31. disp(V4) %Displays Value V4
32. disp('V5:') %Displays Text V5
33. disp(V5) %Displays Value V5

```

Very good layout and presentation.

Original resistor values

```

Enter the input voltage: 10
Enter the value for R1: 1200
Enter the value for R2: 560
Enter the value for R3: 1800
Enter the value for R4: 680
Enter the value for R5: 2200
V1:
    7.3750

V2:
    2.6250

V3:
    2.6250

V4:
    2.3611

V5:
    7.6389

```

f_x >> |

New resistor values

```

Enter the input voltage: 10
Enter the value for R1: 680
Enter the value for R2: 10000
Enter the value for R3: 2200
Enter the value for R4: 580
Enter the value for R5: 220
V1:
    2.7383

V2:
    7.2617

V3:
    7.2617

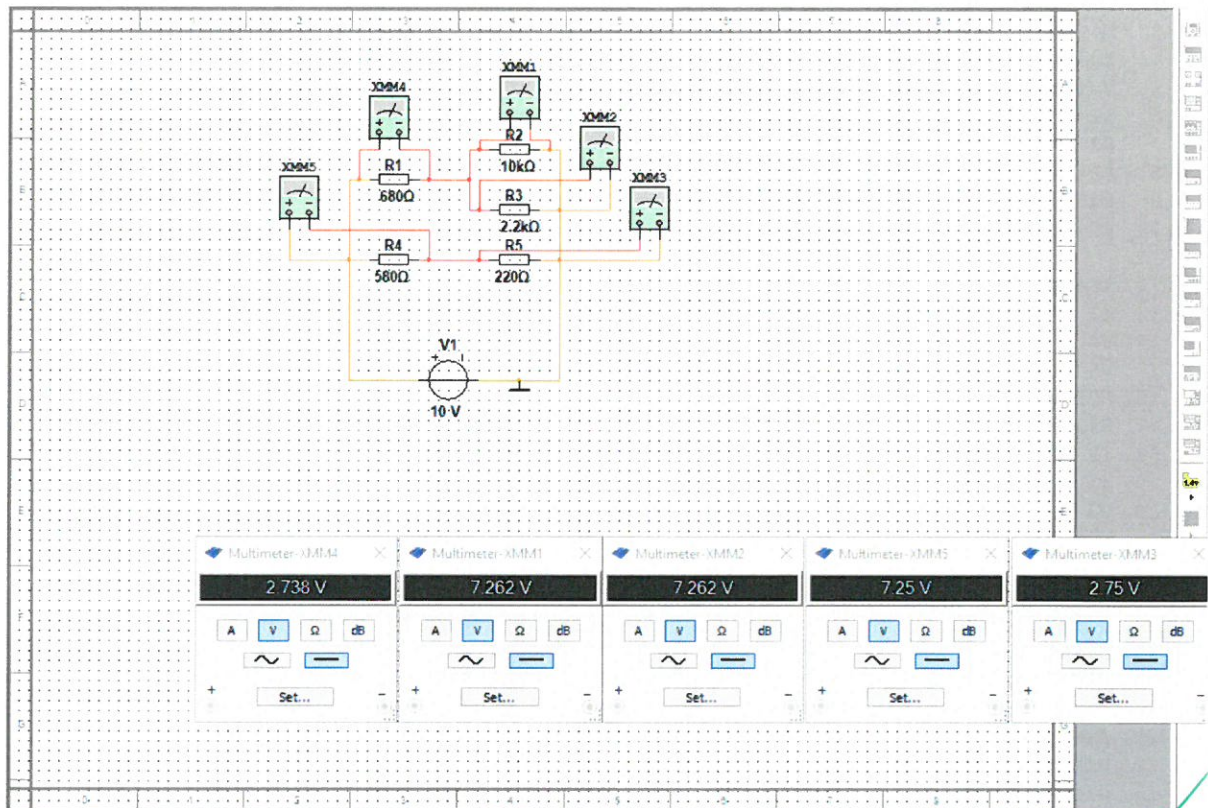
V4:
    7.2500

V5:
    2.7500

```

f_x >>

After the Matlab program was designed and coded, the program was then tested with a different set of results just to confirm that the program was functioning properly. Above can be seen the second set of number entered into the Matlab program and the output, below is a screen capture of the simulation with the new resistor values. Below is also a table showing the difference between the Matlab and simulation results.

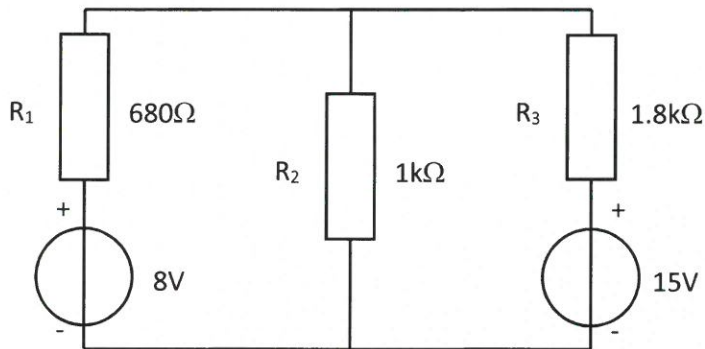


Task 1 New Resistor Values			
Resistor	Value	MATLAB Voltage (V)	Simulated Voltage (V)
R1	680	2.738	2.7383
R2	10000	7.262	7.2617
R3	2200	7.262	7.2617
R4	580	7.25	7.25
R5	220	2.75	2.75

As can be seen from both the table above and the one alongside is there are only very small differences between the Matlab and the Multisim results, this is most likely down to the tolerances that is programmed into Multisim to make the results as realistic as possible to real world components which all have tolerances, some bigger than others.

Task 2 – Circuit Theorem

As part of this section of the document the current flowing through resistor R2 in a circuit which can be seen below, needs to be determined this was done with Norton's.



Below can be seen the calculation used to obtain the current flowing through R2 in the circuit above.

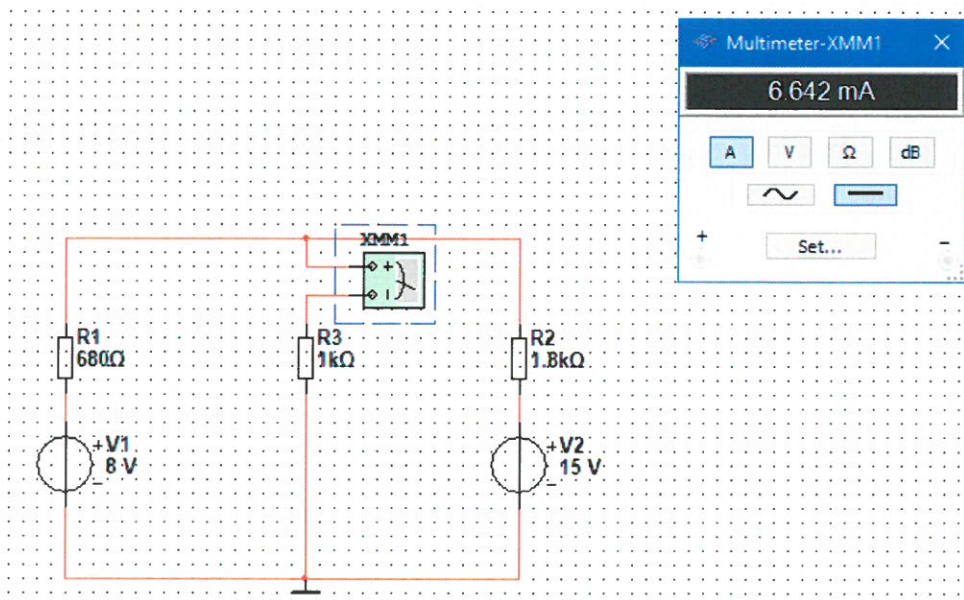
$$I_{SC} = \left(\frac{8}{680} \right) + \left(\frac{15}{1800} \right)$$

$$R = \left(\frac{(680 * 1800)}{(680 + 1800)} \right)$$

$$I = \frac{493.55}{493.55 + 1000} \times 0.020$$

$$I = 6.6 \times 10^{-3} \text{ A}$$

Below in the screen capture can be seen the simulation made in the simulation software Multisim, as can be seen the value that was calculated is very close to the value that was measured when using the simulation package.



After the calculation and the simulation have been completed and it could be seen that the results were similar a Matlab program was then made to perform both Norton's and Thevenin's methods on the one set of values. The program can be seen below.

```

1. %File Name - Assignment_1_task_2_part_b_Both.m
2. %Task 2 - B
3. %Author - Tom Wolsey
4. %Date 08/11/18
5.
6. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
7. % Reads input values %
8. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
9.
10.
11. V1=input('Enter the value for V1: '); %Program waits for user to input value
12. V2=input('Enter the value for V2: '); %Program waits for user to input value
13. R1=input('Enter the value for R1: '); %Program waits for user to input value
14. R2=input('Enter the value for R2: '); %Program waits for user to input value
15. R3=input('Enter the value for R3: '); %Program waits for user to input value
16.
17. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
18. % Calculates values using Norton %
19. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
20.
21. Isc = (V1/R1) + (V2/R3); %Calculates Current in Isc
22. rN = ((R1 * R3) / (R1 + R3)); %Calculates r
23. IN = (r / (r + R2)) * Isc; %Calculates I
24.
25. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
26. % Calculates values using Thevenin's %
27. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
28.
29. I1 = (V1-V2)/(R1+R3); %Calculates Current in I1
30. V = V1 - (I1*R1); %Calculates Voltage
31. rT = ((R1 * R3) / (R1 + R3)); %Calculates r
32. IT = V / (R2 + r); %Calculates I
33.
34. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
35. % Display The Values on Screen %
36. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
37. disp('Norton's I:') %Displays Text Norton's I
38. disp(IN) %Displays Value Norton's I
39. disp('Thevenin's I:') %Displays Text Thevenin's I
40. disp(IT) %Displays Value Thevenin's I

```

The output from the program can be seen in the screen capture below, this shows almost the same results as from multisim this just shows that the Matlab program is working correctly.

```

Command Window
>> Assignment_1_task_2_part_b_Both

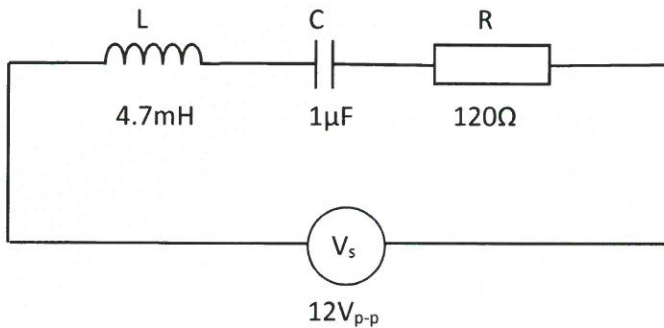
Enter the value for V1: 8
Enter the value for V2: 15
Enter the value for R1: 680
Enter the value for R2: 1000
Enter the value for R3: 1800
Norton's I:
0.0066415
Thevenin's I:
0.0066415
>> |

```

Have not found the current in the other resistor

Task 3 – Series AC Circuit

As part of task3 the phase angel at 1kHz and the resonant frequency was calculated for the circuit that can be seen below.



Below can be seen the calculations

RLC Circuit

Reactance

$$X_L = 2\pi f l \text{ inductor}$$

$$X_C = \frac{1}{2\pi f c} \text{ capacitor}$$

Impedance

$$Z = \sqrt{R^2 + (x_l - x_c)^2}$$

Phase angle

$$\phi = \tan^{-1} \left(\frac{X_L - X_C}{R} \right)$$

$$L = 4.7mH$$

$$C = 1\mu F$$

$$R = 120$$

At 1kHz

$$X_C = \frac{1}{2\pi \times 1000 \times 1 \times 10^{-6}} = 159.15\Omega$$

$$X_L = 2 \times \pi \times 1000 \times 4.7 \times 10^{-3} = 29.53\Omega$$

$$\phi = \tan^{-1} \left(\frac{29.53 - 159.12}{120} \right) = -47.20^\circ$$

Resonant Frequency

At a certain frequency $X_L = X_C$ so the circuit will purely resistive, i.e. at max current

$$\text{Resonant frequency, } F_o = \frac{1}{2\pi\sqrt{LC}}$$

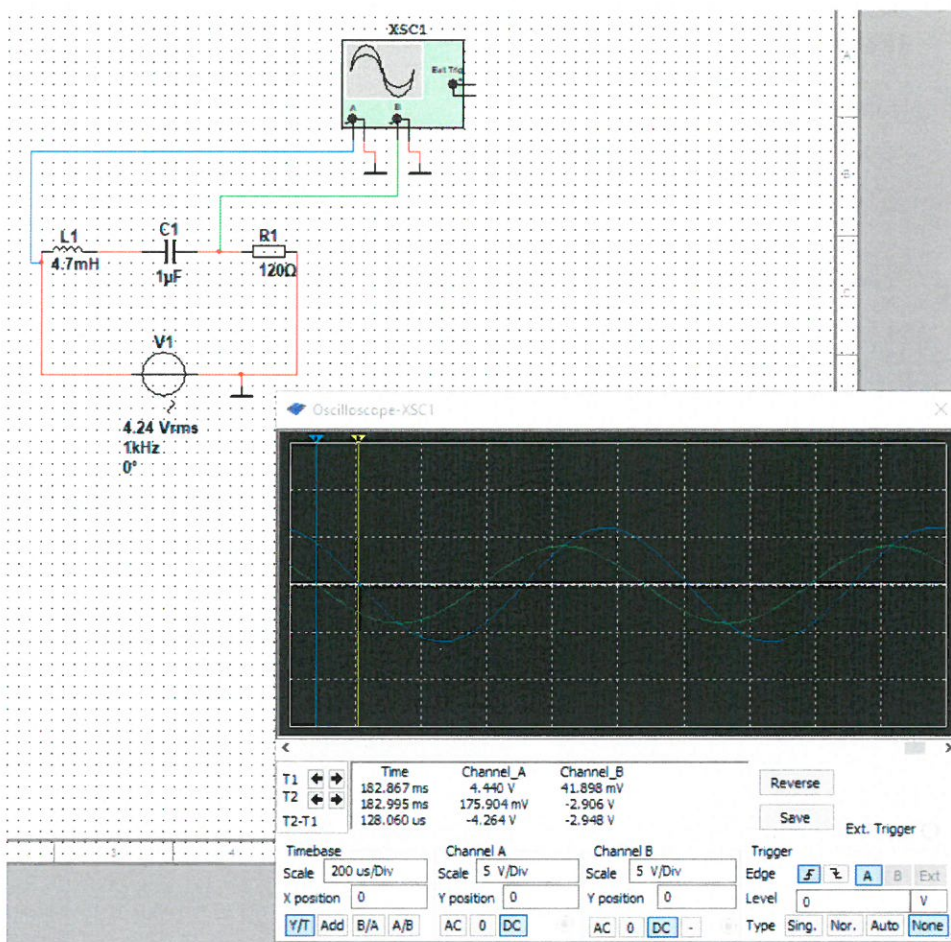
$$F_o = \frac{1}{2\pi\sqrt{4.7 \times 10^{-3} \times 1 \times 10^{-6}}} = 2321.51Hz$$

$$\text{RMS to peak to peak RMS} = \frac{V_p}{\sqrt{2}}$$

$$t = 120.52 \mu\text{s}$$

$$\phi = f * t * 360^\circ = 1000 * 120.52 * 10^{-6} * 360 = 43.3872^\circ$$

After the calculation had been done the circuit was then simulated on a simulation package called multisim. The screen capture below can see the circuit and the output from the oscilloscope. The phase angle and the resonant frequency that were obtained from the simulation can be seen below the screen capture.



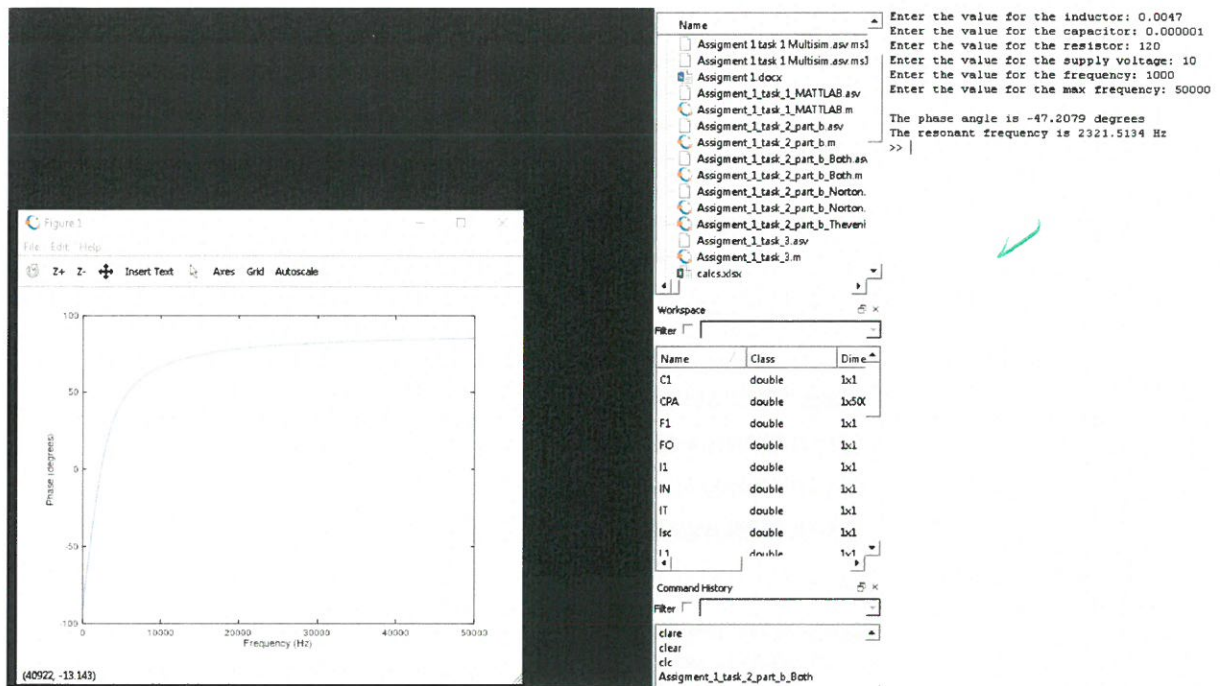
$$128.06 * 10^{-6} * 1000 * 360 = 46.1016 \text{ deg}$$

A Matlab program was then made which would be able to perform all the calculations to get the phase angle and the resonant frequency for the circuit. Below can be seen the code that was used to obtain the results. After the code was working for these two calculations the program was then changed to plot a graph to show the two waveforms, also showing the phase difference. A screen capture of the output can be seen below the code.

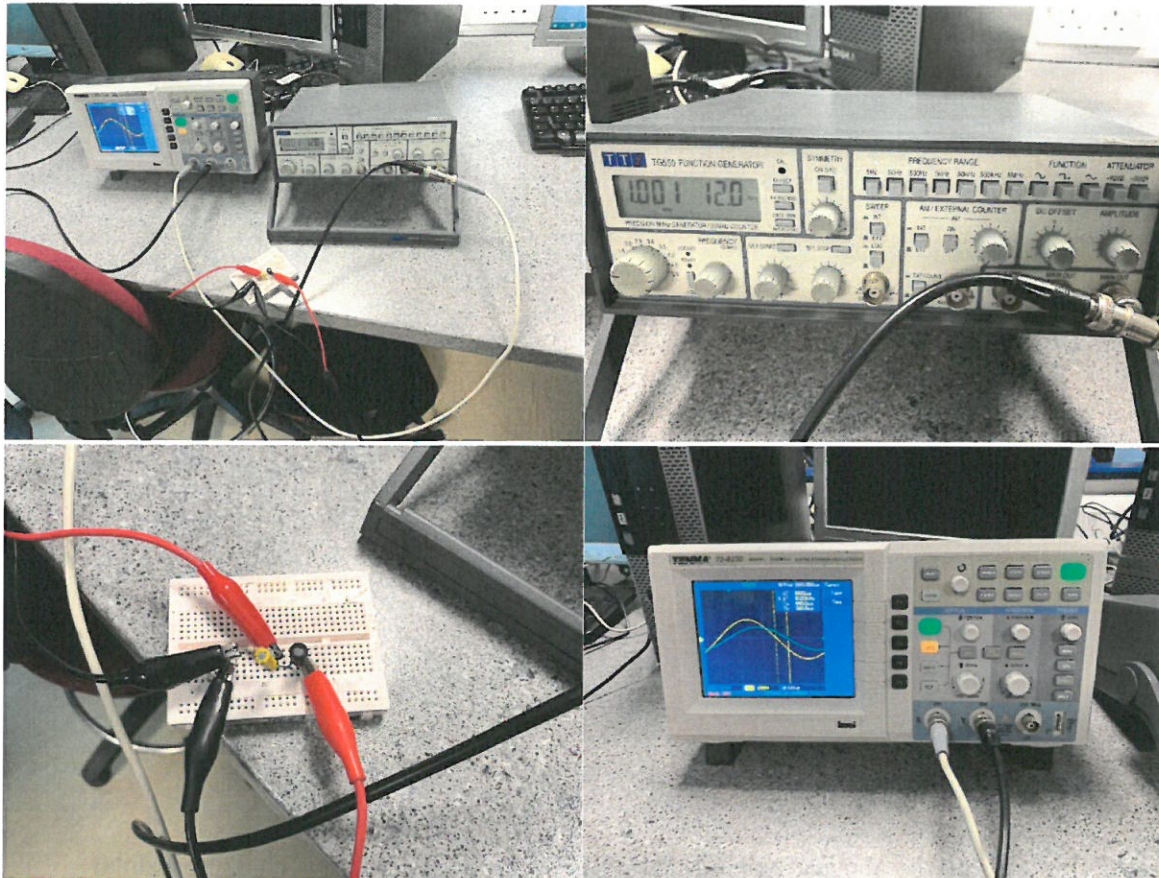
```

1. %File Name - Assignment_1_task_3.m
2. %Task 3
3. %Author - Tom Wolsey
4. %Date 29/11/18
5.
6. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
7. %Inputs
8. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
9.
10. L1 = input('Enter the value for the inductor: '); %Program waits for user to input value
11. C1 = input('Enter the value for the capacitor: '); %Program waits for user to input value
12. R1 = input('Enter the value for the resistor: '); %Program waits for user to input value
13. V1 = input('Enter the value for the supply voltage: '); %Program waits for user to input value
14. F1 = input('Enter the value for the frequency: '); %Program waits for user to input value
15. MAXFREQ = input('Enter the value for the max frequency: '); %Program waits for user to input value
16. fprintf("\n"); %Prints a blank line to the console
17.
18.
19. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
20. % Reactance
21. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
22.
23.
24. XL = 2*pi*F1*L1; %Program calculates the XL Value
25. XC = 1/(2*pi*F1*C1); %Program calculates the XC Value
26.
27. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
28. % Phase Angles
29. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
30.
31. PA = atan((XL-XC)/R1)*(180/pi); %Program calculates the PA Value
32.
33. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
34. % Resonant Frequency
35. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
36.
37. FO = 1/(2*pi*sqrt(L1*C1)); %Program calculates the FO Value
38.
39. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
40. % Plot For phase angle loop
41. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
42.
43. for PAL = 1:MAXFREQ
44.     freq(PAL) = PAL; %Variable frequency
45.     XL = 2*pi*freq(PAL)*L1; %Program calculates the XL Value
46.     XC = 1/(2*pi*freq(PAL)*C1); %Program calculates the XC Value
47.     CPA (PAL) = atan((XL-XC)/R1)*(180/pi); %Program calculates the PA Value
48. end;
49.
50. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
51. % Display Values on Console
52. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
53.
54. X1 = ['The phase angle is ',num2str(PA),' degrees'];
55.     disp(X1)
56.
57. X2 = ['The resonant frequency is ',num2str(FO),' Hz'];
58.     disp(X2)
59.
60. plot(freq,CPA,'b-');
61. xlabel('Frequency (Hz)');
62. ylabel('Phase (degrees)');

```



After the calculation, simulation and matlab section had be completed the circuit was then built on breadboard and a function generator was connected to the input and an oscilloscope to the output. Below are some images of the practical taking place.



Frequency Response
Frequency Vout

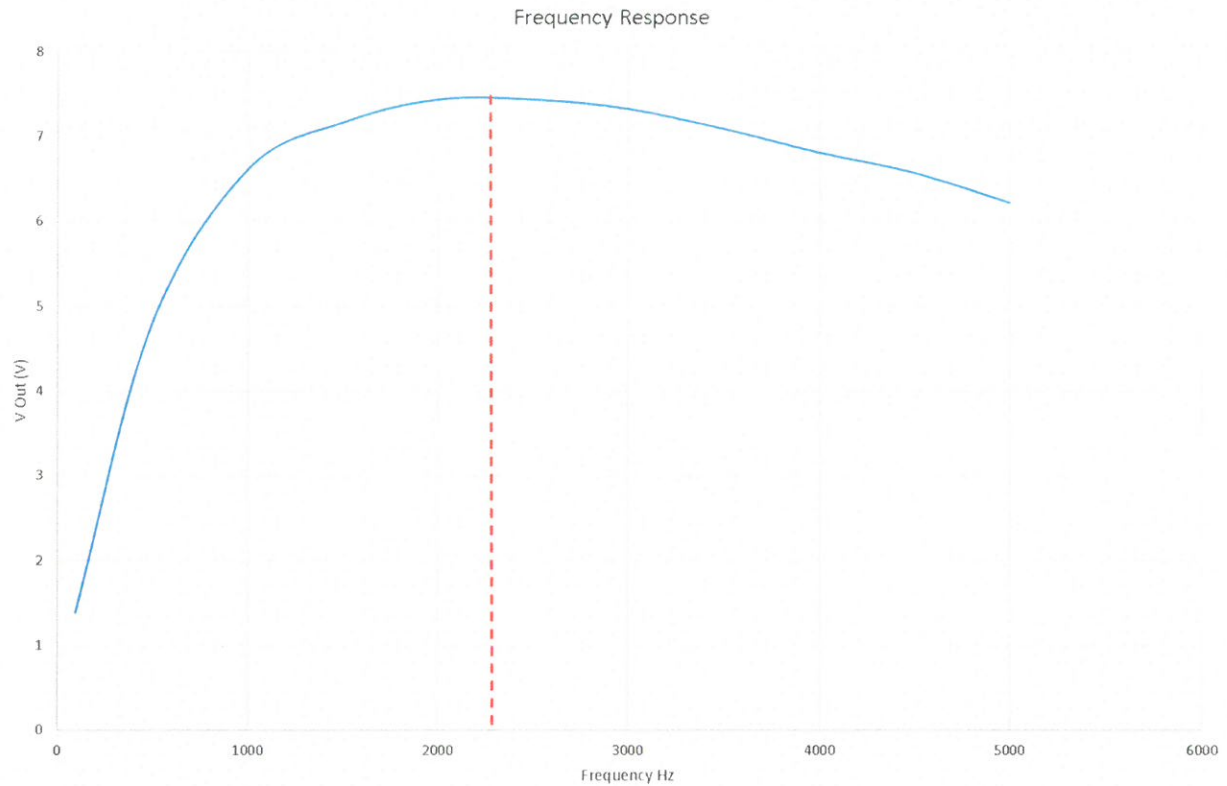
100	1.39
500	4.79
1000	6.61
1500	7.17
2000	7.44
2500	7.44
3000	7.33
3500	7.09
4000	6.81
4500	6.57
5000	6.22

From the results obtained from the practical

it has been calculated as can be seen below that the phase angel is 36° , this is somewhat near the calculated value, but there are a number of reason why it could be out for example the output of the function generator might be out or the reading from the oscilloscope might be slightly off as they were measured using the cursors which is not 100% accurate and finally all components have a tolerance and this could be a fairly large factor in this sort of experiment

$$\phi^t = f * T * 360^\circ = 1000 * 1 * 10^{-6} * 360 = 36.00^\circ$$

A number of different frequency's where injected into the circuit and the output voltage was recorded and the following graph of Vout against frequency was generated.



The red dotted line on the above graph indicated the resonant frequency which is approximal 2300Hz. This is a similar frequency to the one produced from the Matlab program and also the calculated with the Matlab being 2321.51Hz.

Task 4 - Complex AC Circuits

The current was calculated in the circuit below across the capacitor, Mesh current analyses was used and the calculations can be seen below.

$$X_L = 2\pi f L = 2 \times \pi \times 1000 \times 1.2 \times 10^{-3} = j7.5398\Omega$$

$$X_C = \frac{1}{2\pi f C} = \frac{1}{2 \times \pi \times 1000 \times 33 \times 10^{-6}} = -j 4.82\Omega$$

Kirchoffs Law's

Loop 1

$$V = R_1 I_1 + X_C (I_1 - I_2)$$

$$10 = 22 \times I_1 + (-j4.82) \times (I_1 - I_2)$$

$$10 = (22 - j4.82)I_1 + j4.82 \times I_2$$

Loop 2

$$0 = R_2 I_2 + X_C (I_1 - I_2)$$

$$0 = 39 \times I_2 + j7.539 \times I_2 + (-j4.82)(I_2 - I_1)$$

$$0 = j4.82 \times I_1 + (39 + j2.7198) \times I_2$$

Rearrange Eq (2)

$$j4.82 \times I_1 = -(39 + j1.46) \times I_2$$

$$I_1 = \frac{-(39 + j2.7198) \times I_2}{j 4.82}$$

Substituting the value of I1 into Eq(1)

$$10 = j0.207 (22 - j4.82)(39 + j2.7198) \times I_2 + j4.82 \times I_2$$

$$10 = j0.207(8.71 - j128) \times I_2 + j4.82 \times I_2$$

$$10 = (26.52 + j180.32) \times I_2 + j4.82 \times I_2$$

$$I_2 = \frac{10}{26.52 + j185.14} = 0.0076 - j0.0529$$

Substituting the value of I2 into (Eq3)

$$I_1 = \frac{-(39 + j2.7198) (0.0076 - j0.0529)}{j4.82}$$

$$I_1 = 0.4237 + j0.0913$$

$$I = I_1 - I_2 = 0.4237 + j0.0913 - 0.0076 + j0.0529$$

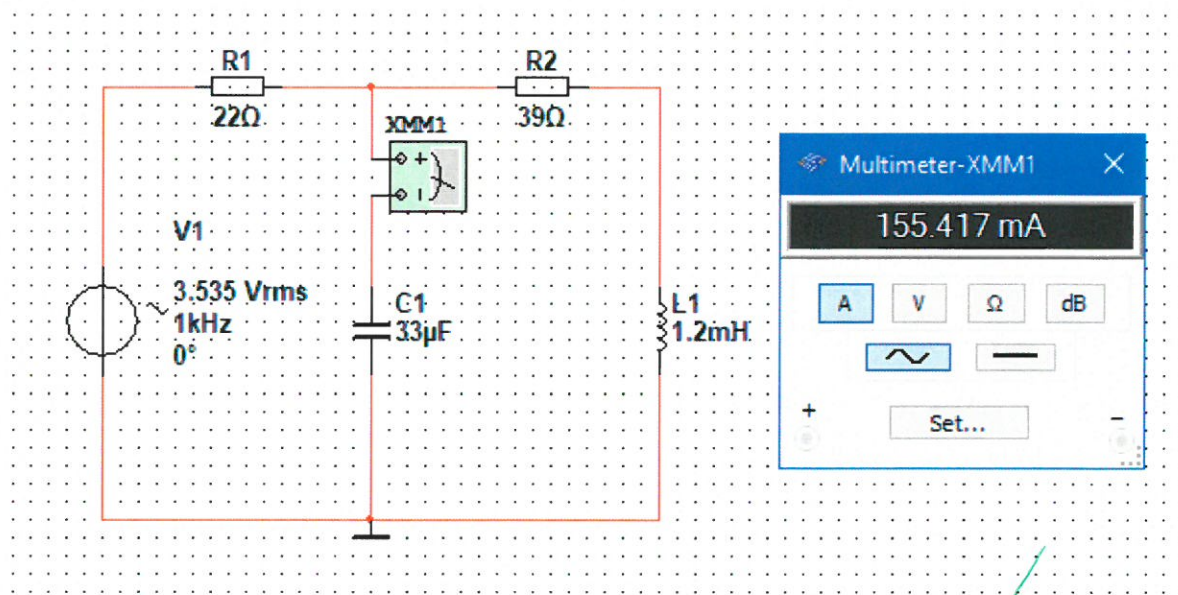
$$I = 0.4161 + j0.1442$$

$0.44037 \angle 19.1138$ Peak to peak value

$$V_{rms} = \frac{0.44037}{2\sqrt{2}} = 0.1557 \angle 19.1138 \text{ A} = 155.7 \text{ mA}$$

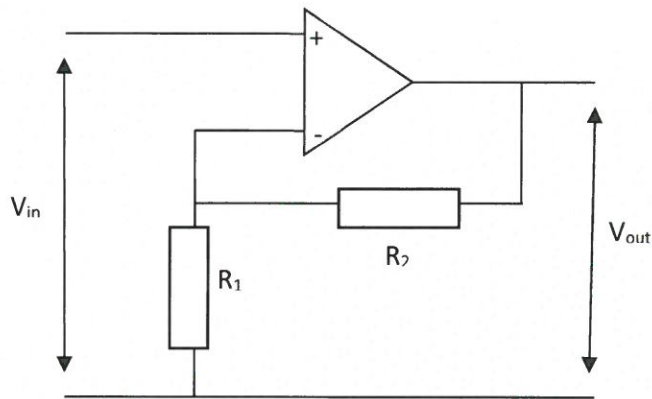
After the calculations had been done the circuit was then simulated in multisim to check and compare the results.

Below can be seen a screen capture from multisim.



Task 5 – Non-Inverting Amplifier Circuits

For the following circuit the values of R_1 or R_{in} and R_2 or R_f had to be determined, below the circuit can be seen the calculations used to determine the values.



$$A_v = 150$$

$$A_v = 1 + \frac{R_f}{R_{in}}$$

$$\frac{R_f}{R_{in}} = A_v - 1$$

$$R_f = (A_v - 1) \times R_{in}$$

$$R_f = (200 - 1) \times R_{in} = 199 \times R_{in}$$

$$\text{Let } R_{in} = 3.3k\Omega$$

$$\text{So } R_f = 199 \times 3300 = 656700 = 656.7k\Omega$$

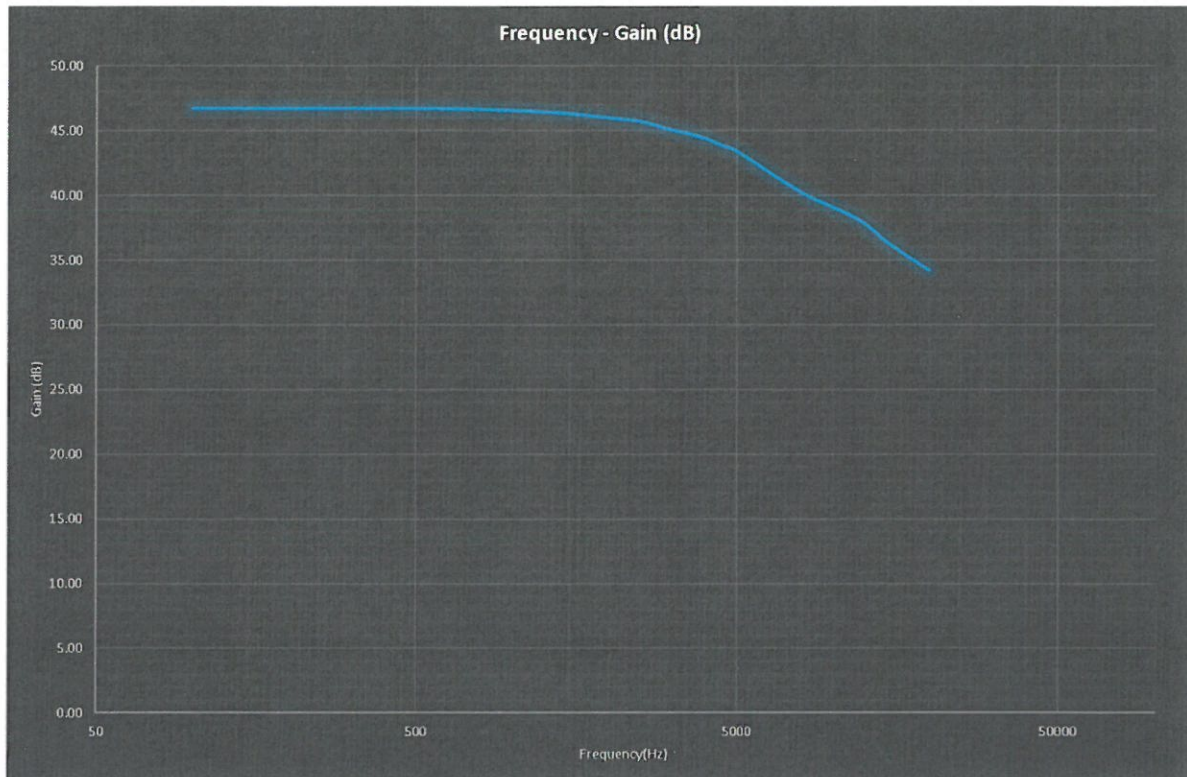
$$\text{Let } R_f = 680k\Omega$$

After the two values had been determined a non-inverting amplifier circuit was then constructed using a 741 op amp, the circuit was made on breadboard. The gain and the bandwidth of the circuit was then determined using a function generator and a oscilicscope. Below in the table can be seen the values of the frequency that where injected into the circuit.

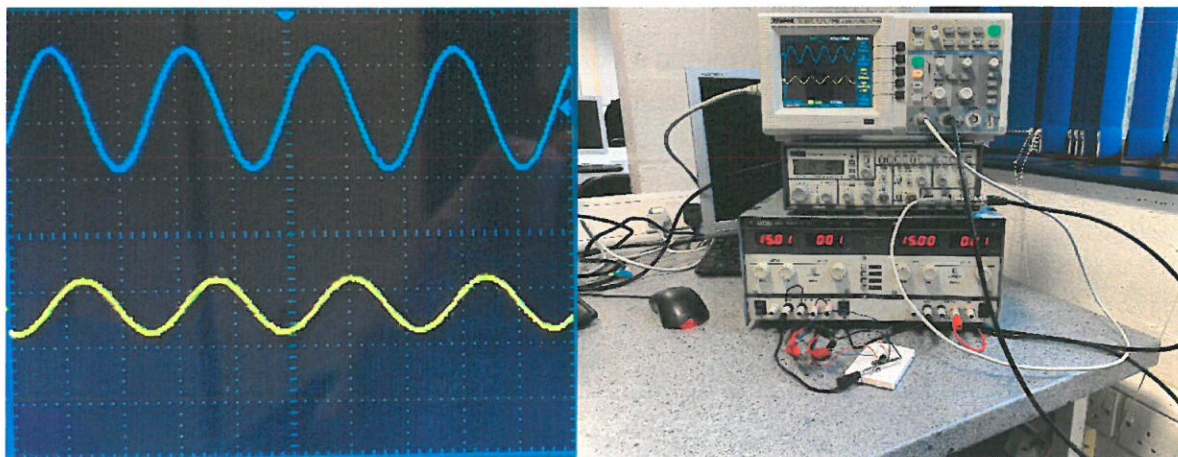
Frequenc	Vout (V)	Gain	Gain (dB)
100	21.78	217.8	46.76
500	21.78	217.8	46.76
1000	21.38	213.8	46.60
1500	20.79	207.9	46.36
2000	20	200	46.02
2500	19.4	194	45.76
3000	18.22	182.2	45.21
3500	17.42	174.2	44.82
4000	16.63	166.3	44.42
4500	15.64	156.4	43.88
5000	14.85	148.5	43.43
8000	10.3	103	40.26
12000	8.12	81.2	38.19
15000	6.53	65.3	36.30
20000	5.15	51.5	34.24

The following graph was generated from the results what can be seen in the table above.

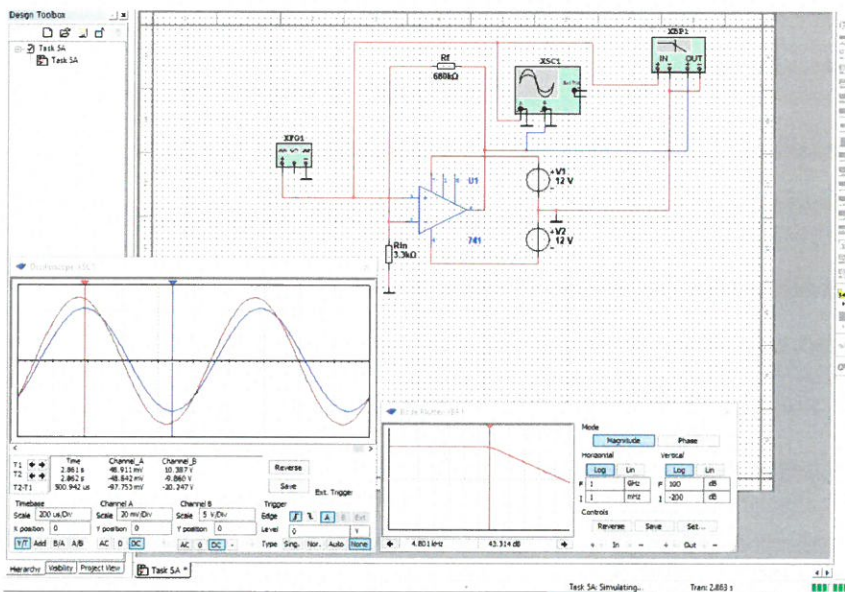
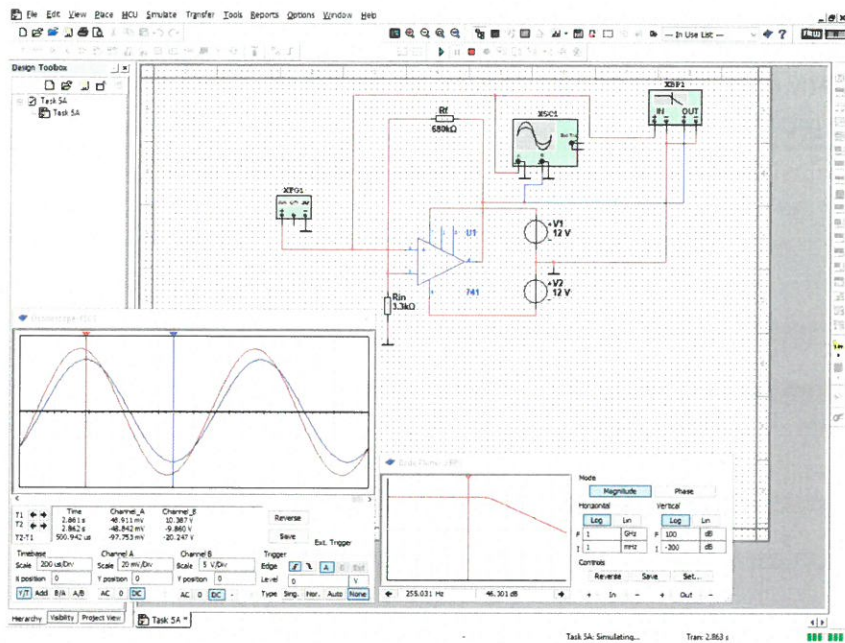
From the graph we can see that the bandwidth of the circuit was approximately 4000Hz. This was determined by reading from the 3dB less from the starting value then reading down to the frequency.



Below can be seen an image of the output from the oscilloscope and an image of the circuit.



After the practical tests had been performed the circuit was then simulated in multisim to check the practical results. Below can be seen the screen captures of the multisim. As can be seen in the screen capture below the resonant frequency is 4801Hz which is similar to the one obtained from the practical exercise which was around 4000Hz. There are a number of reason why these number so quite as different, mainly due to being able to read the frequency accurately.



What about gain.

Task 6 – Integrator Circuits

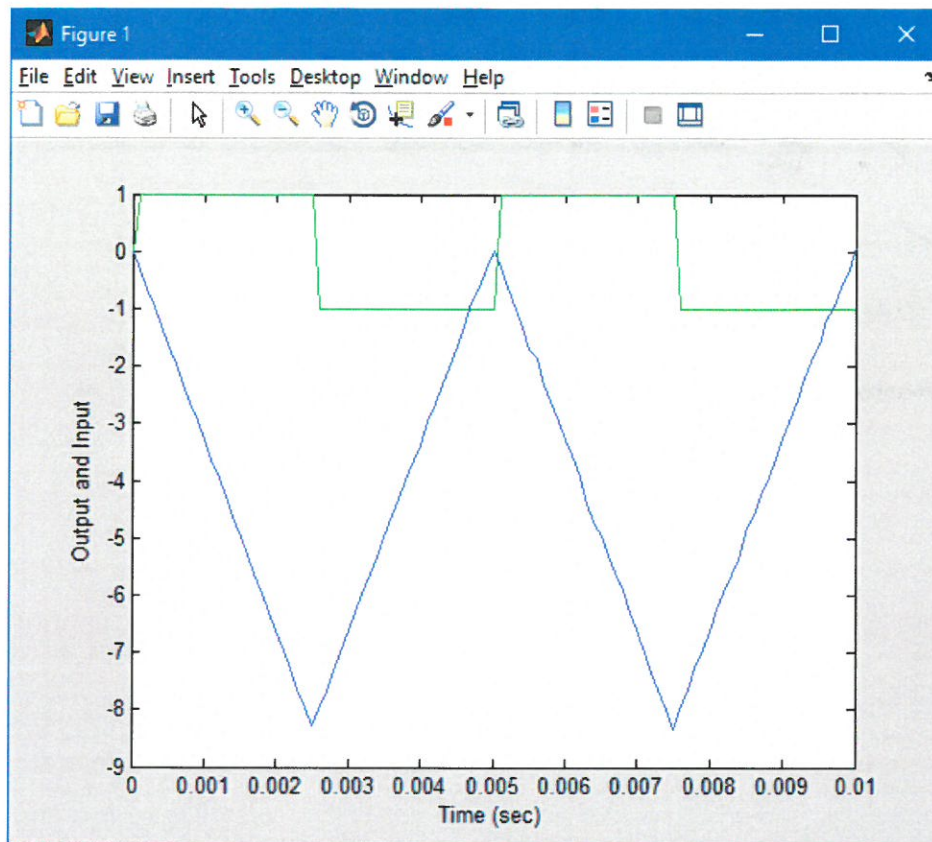
A matlab program was made that would show the output waveform when a square waveform was injected. Below can be seen the program

```
1. %File Name - Task_6.m
2. %Task 6
3. %Author - Tom Wolsey
4. %Date 17/01/19
5.
6. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
7. % Parameters %
8. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
9. R1 = 200; C = 0.0000015; F = 200;
10.
11. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
12. % Time vector %
13. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
14. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
15. t = 0:0.0001:0.01;
16.
17. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
18. % Output %
19. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
20. for k = 1:length(t)
21. Vo(k) = -1/(R1*C)*quad('Vin',0,t(k));
22. end;
23.
24. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
25. % Input Wave %
26. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
27. Vi = 1*sign(sin(2*pi*F*t));
28.
29. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
30. % Display results %
31. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
32. plot(t,Vi,'g-',t, Vo,'b-');
33. xlabel('Time (sec)'); ylabel('Output and Input');
```

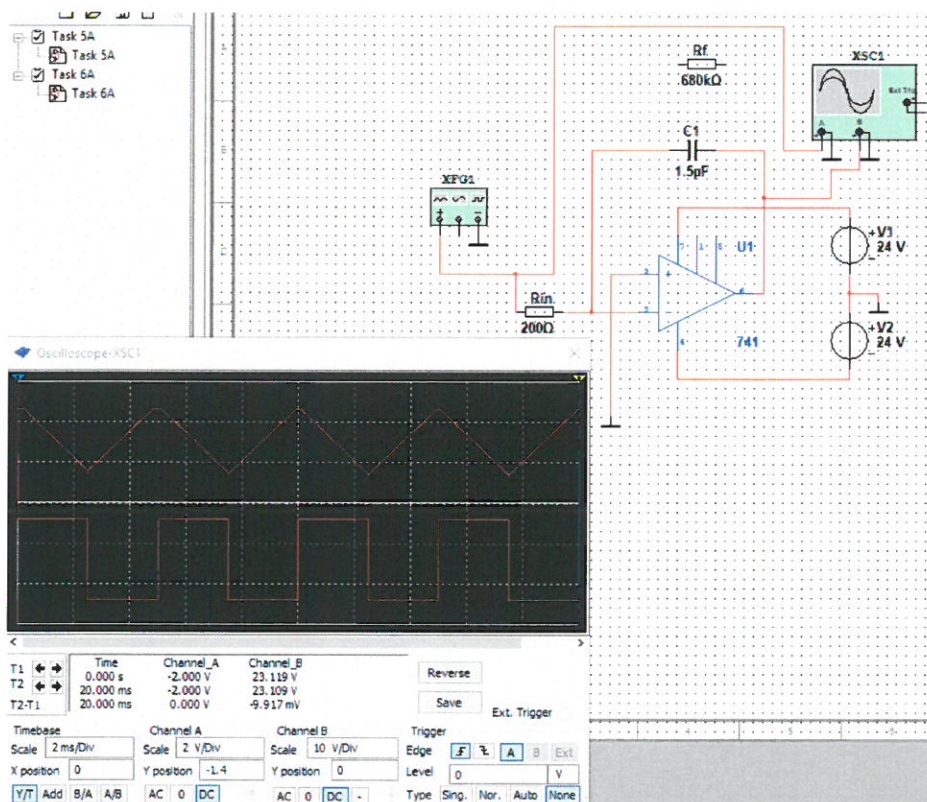
Another sub program was also used called Vin which can be seen below

```
1. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
2. %Calculate a function value at point x %
3. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
4.
5. function[V] = Vin(x)
6. F = 200;
7. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
8. %The function expression %
9. %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
10. %The function expression
11. V = 1*sign(sin(2*pi*F*x));
```

When the program was run the output can be seen below.



After the program was designed a simulation was made of the circuit to compare the results and outcomes, below can be seen a screen capture of the simulation using multisim.



As can be seen the two different output seem similar which suggests that they are both working correctly.

A very good assignment that shows good understanding of most of requirements of the assessment. ~~As~~ There were some parts that were not completed which meant marks were missed.

Your overall presentation of the work was excellent.