DCU School of Electronic Engineering Assignment Submission

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Programme:	B.Eng in Electronic and Computer Engineering
Module Code:	EE401
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I understand that I may be required to discuss with the module lecturer/s the contents of this submission.

I/me/my incorporates we/us/our in the case of group work, which is signed by all of us.

Signed: Michael Lenehan

Assignment

Michael Lenehan

Results

1.1 Part A

The following figure shows the first 200 samples of and $800Hz$ sine wave, with a sampling period of $50\mu s$.

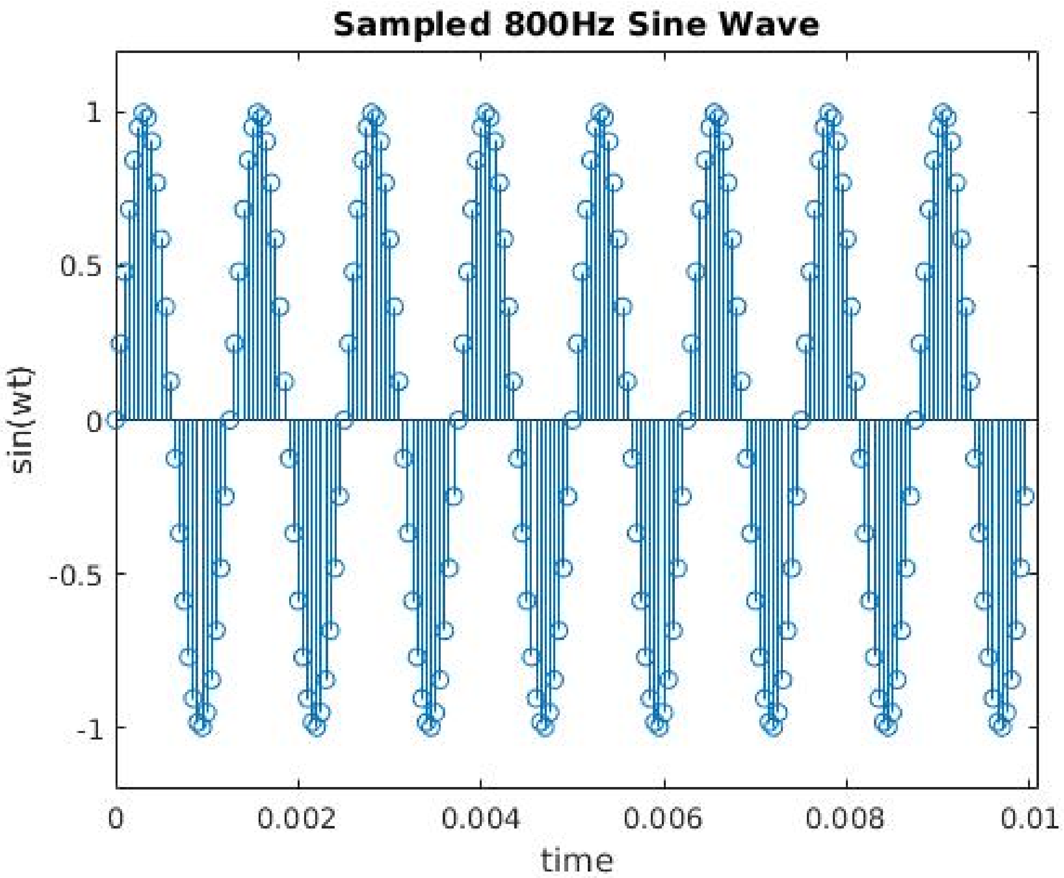

Figure 1: Sampled 800Hz Sine Wave

1.2 Part B

The zero frequency of the DFT is the average of the DFT, which, as output by Part b of the EE401AssignmentCode is 1.0.

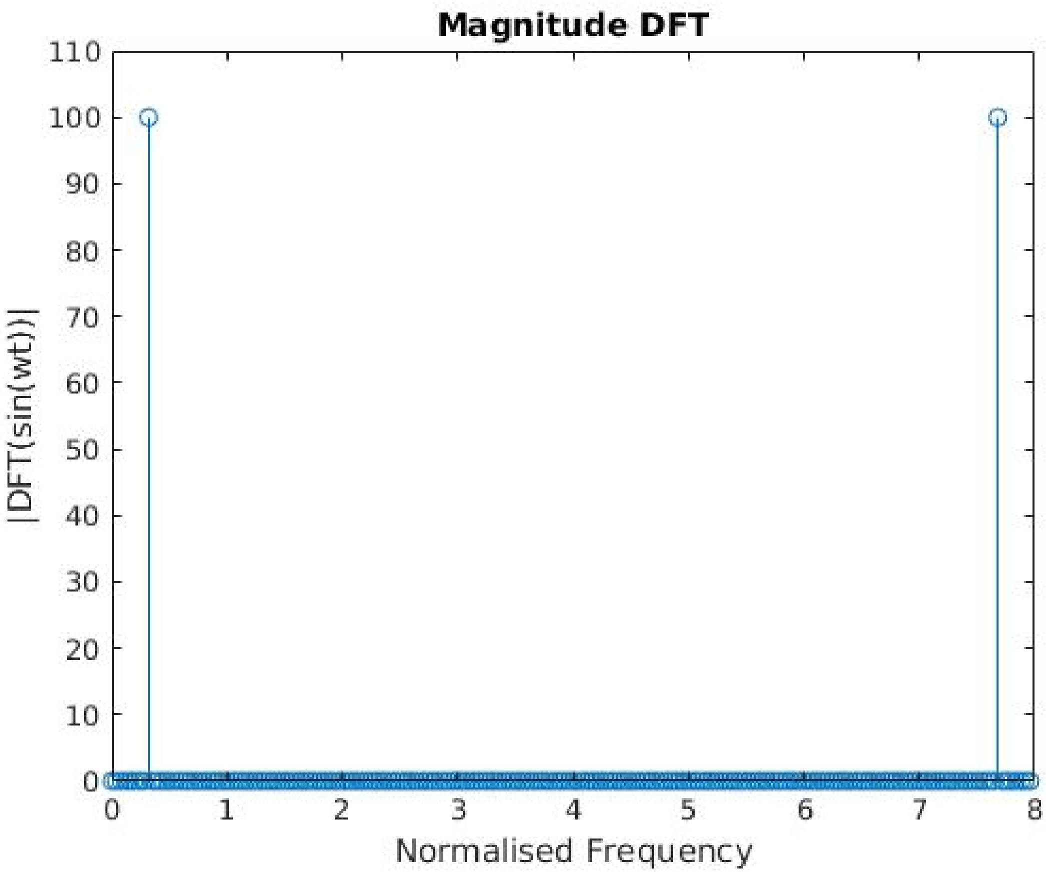

Figure 2: Modulus DFT of 800Hz Sine Wave

1.3 Part C

As shown in the Normalised frequency graph, the peaks occur at $F = 0.32$ and $F = 7.68$.

1.4 Part D

Two peaks are present in the graph as one represents the positive frequency portion, and one represents the negative frequency portion.

1.5 Part E

At a signal of 800Hz, a single peak may be achieved by using half of the original sampling frequency, therefore giving a signal of $sin(2 * pi * 8 * \frac{1/fs}{2})$.

1.6 Part F

The following figure displays the modulus DFT plot of the modified signal from Part E:

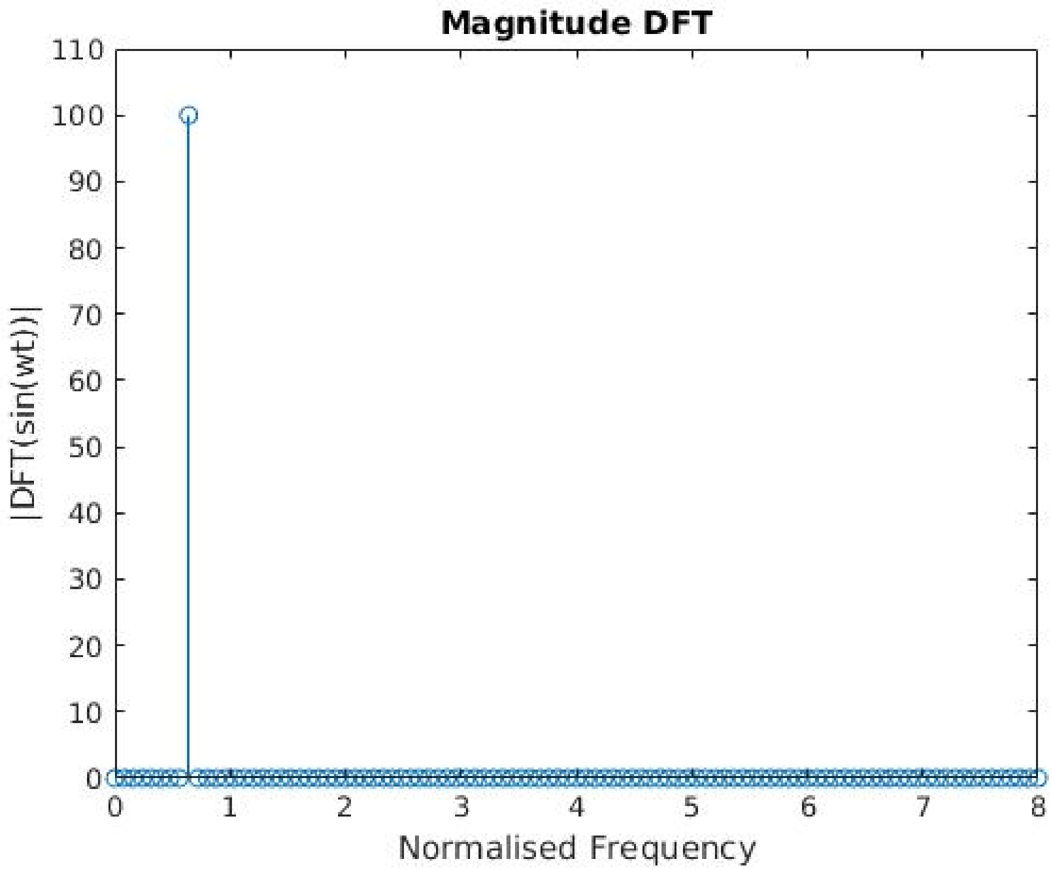

Figure 3: Modulus DFT of modified 800Hz Sine Wave Signal

1.7 Part G

The following figure is of a sampled 771Hz Sine Wave:

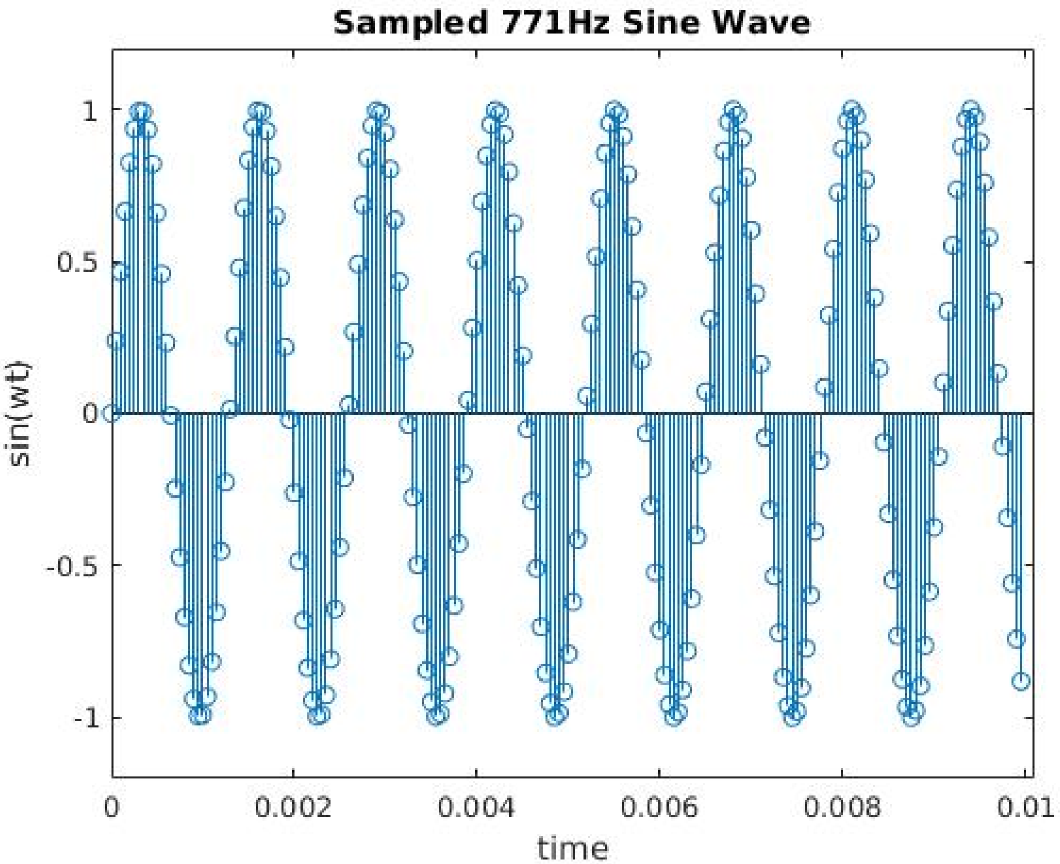

Figure 4: Sampled 771Hz Sine Wave

1.8 Part H

The following figure is of the Modulus DFT of the 771Hz Sine Wave:

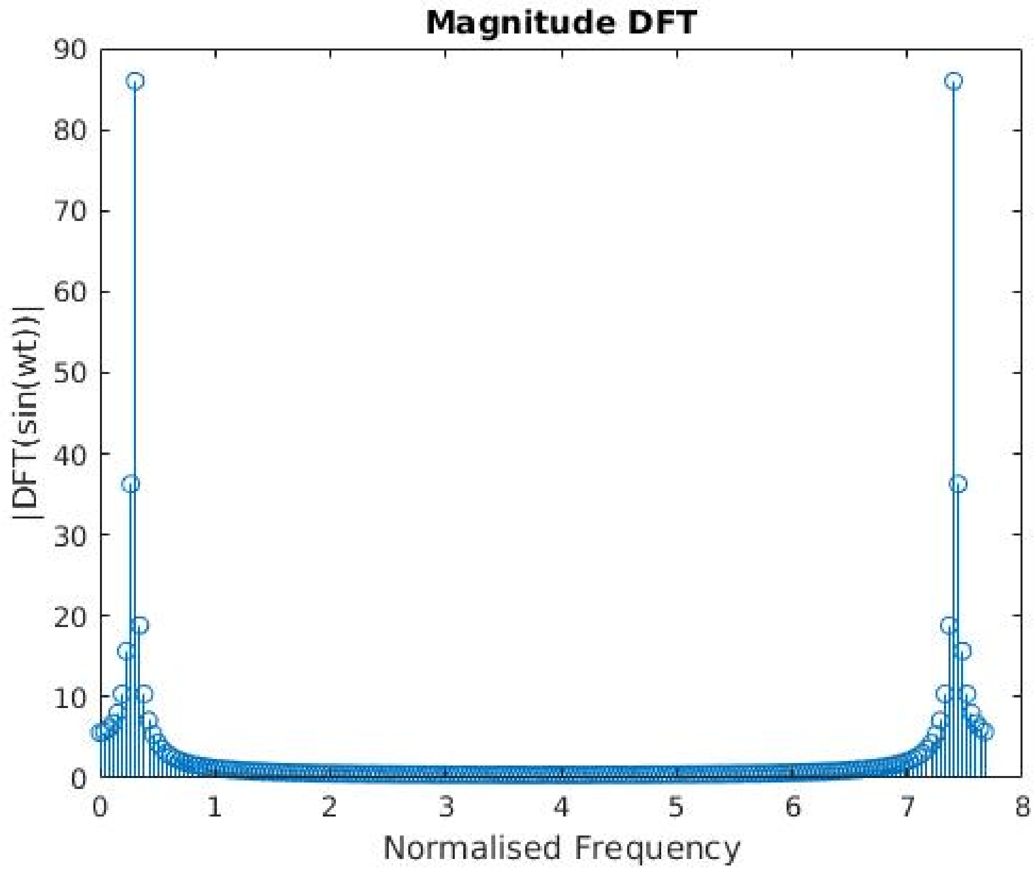

Figure 5: Modulus DFT of 771Hz Sine Wave

The spectral peaks are broader in Figure 5 than in Figure 2 due to spectral leakage occurring. Spectral leakage occurs when there is a non-whole number of cycles in the sample signal. This leads to broadening spectral peaks as frequencies between the bins of the DFT are spread across the spectrum.

1.9 Part I

The following calculations were input to MATLAB in order to implement the required 2-pole, 2-zero filter:

$fs = 20000$

$fstop = 10000$

$fc = 2950$

$fb = 60$

$\Omega_0 = 2\pi(\frac{2950}{20000})$

$\Delta\Omega = 2\pi(\frac{60}{20000})$

$StopBand = 2\pi(\frac{10000}{20000})$

$R = 1 - 0.5\Delta\Omega$

$\therefore Poles \approx 0.991e^{\pm j\Omega_0}$

$\therefore Zeroes = e^{\pm jStopBand}$

The transfer function of the filter is therefore as follows:

$H(z) = \frac{z+e^{\pm jStopBand}}{z-Re^{\pm j\Omega_0}}$

1.10 Part J

The following figure is of the frequency response of the filter designed in Part I.

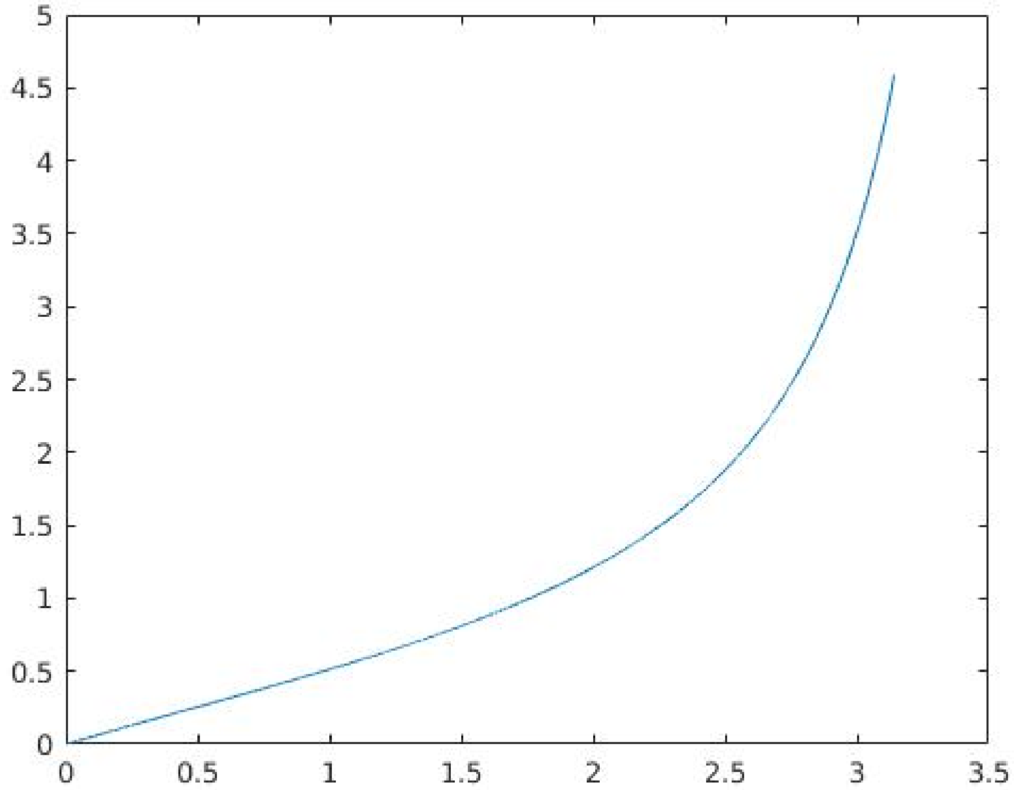

Figure 6: Frequency Response to Filter

1.11 Part K

The following figure displays the sampled combination of the 200Hz and 2975Hz sine waves:

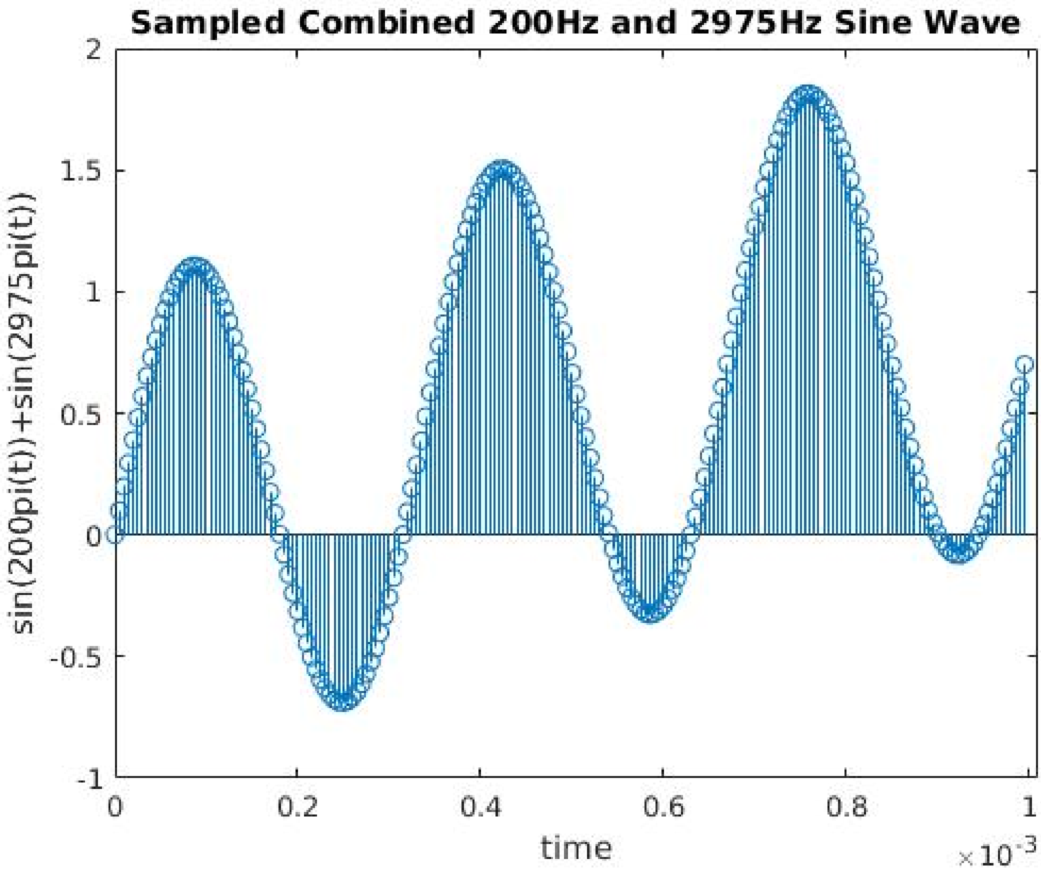

Figure 7: Sampled Output Sine Wave from combination of 200Hz and 2975Hz Sine Waves

1.12 Part L

The following figure is of the modulus DFT of the sampled sine wave:

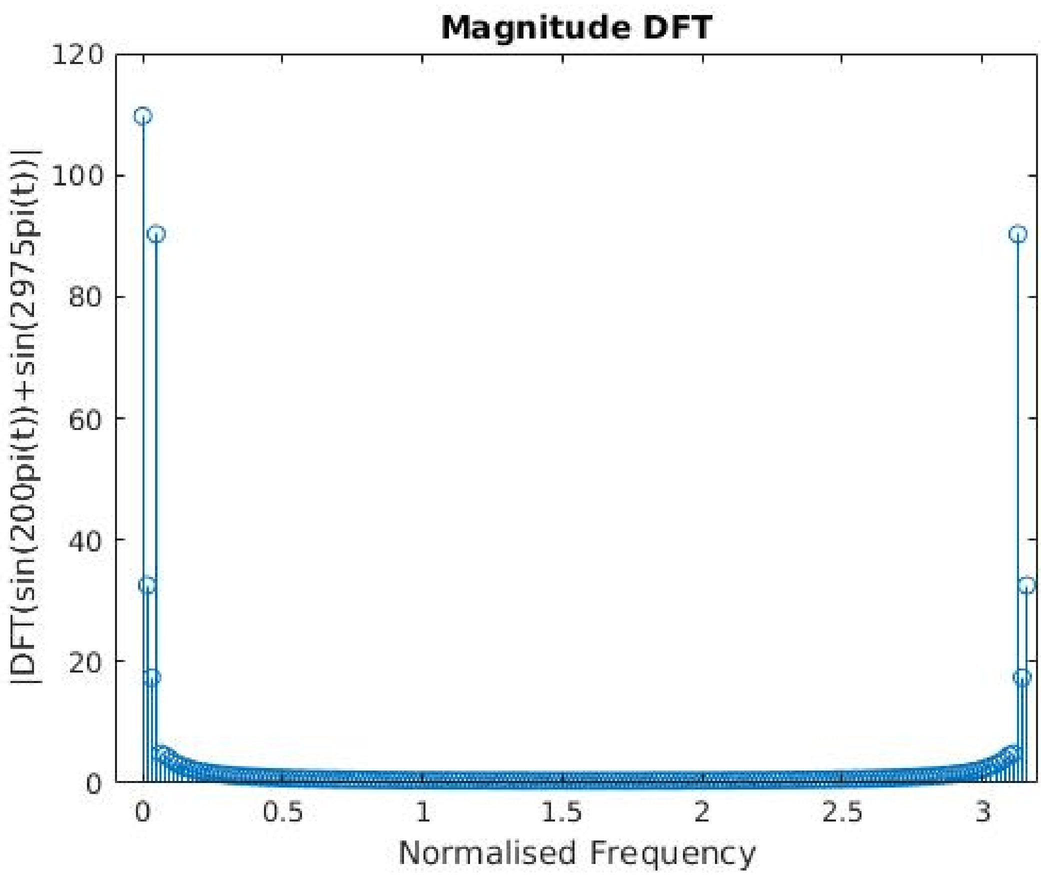

Figure 8: Modulus DFT of the Sampled Sine Wave

1.13 Part M

The code required to pass the signal described in Part K is passed through the filter designed in Part I may be found in the EE401AssignmentCode.

1.14 Part N

The resulting output from the filtering of the Signal described in Part K may be seen in the figure below:

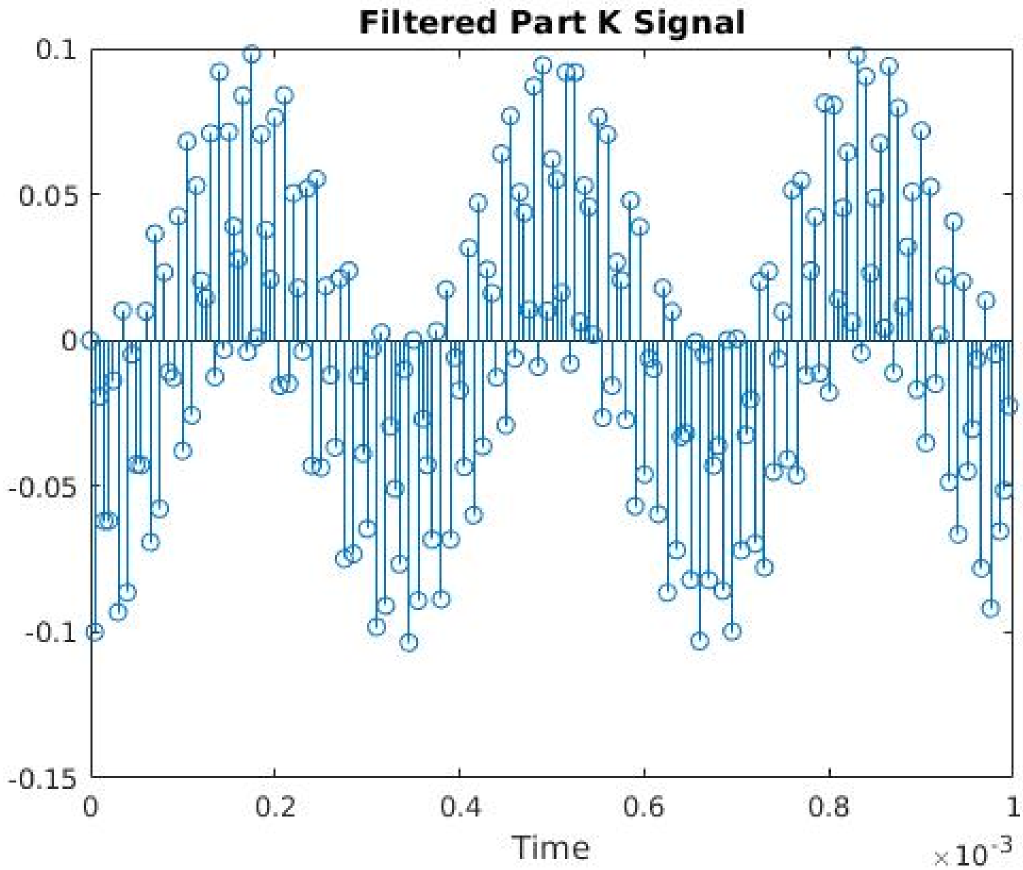

Figure 9: Filtered Sine Wave Signal

1.15 Part O

The figure below displays the modulus of the DFT of the filtered signal in Part N,

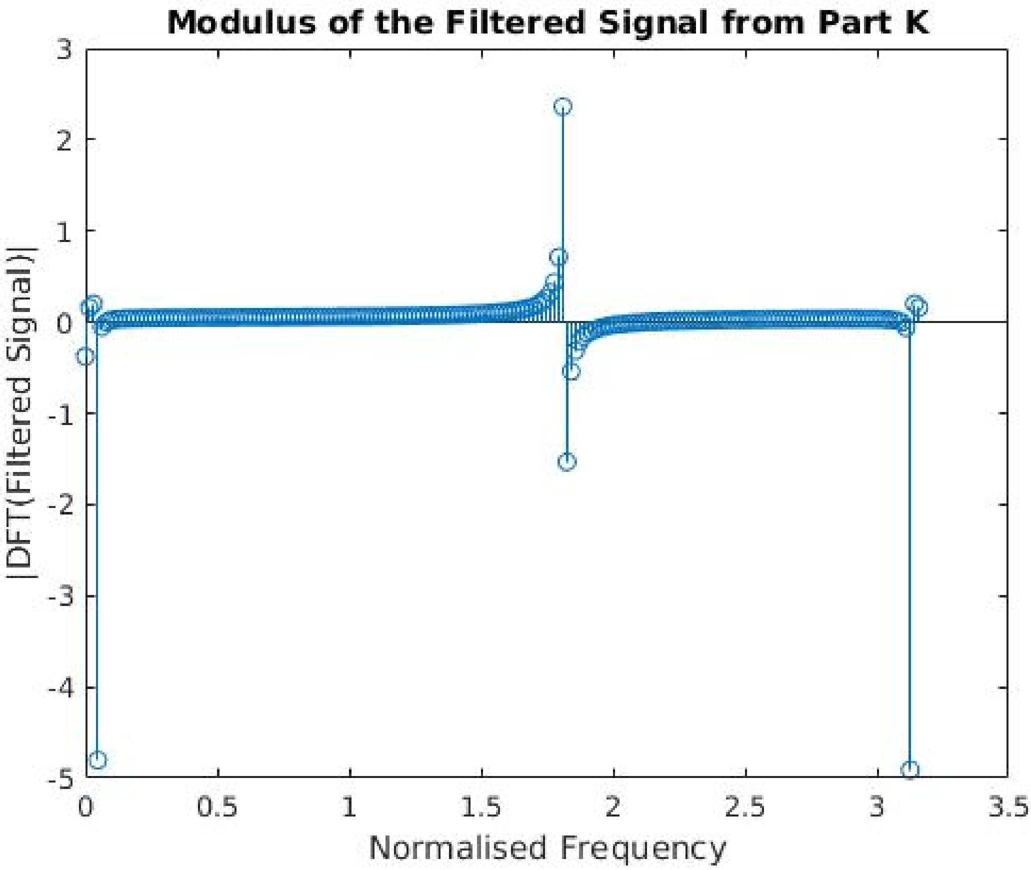

Figure 10: Modulus DFT of Sampled Sine Wave

1.16 Part P and Q

Unfortunately a solution to part p and part q could not be achieved. The signal from part k was passed into the function and filtered in the FIR filter, however an IIR filter could not be made by modifying the code.

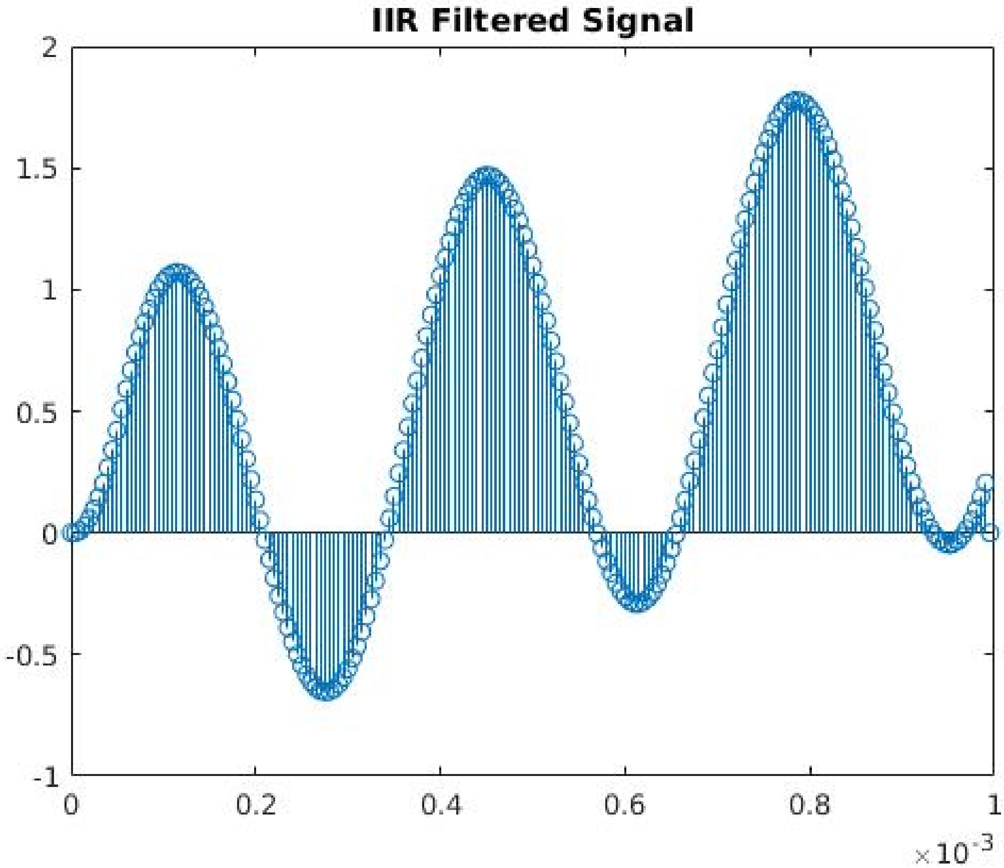

Figure 11: Filtered Sine Wave Signal