CT Report-5

Question-a

We are required to run a code from the textbook. It is required to plot raised cosine versus the normalised time domain in the interval [-5T, 5T].

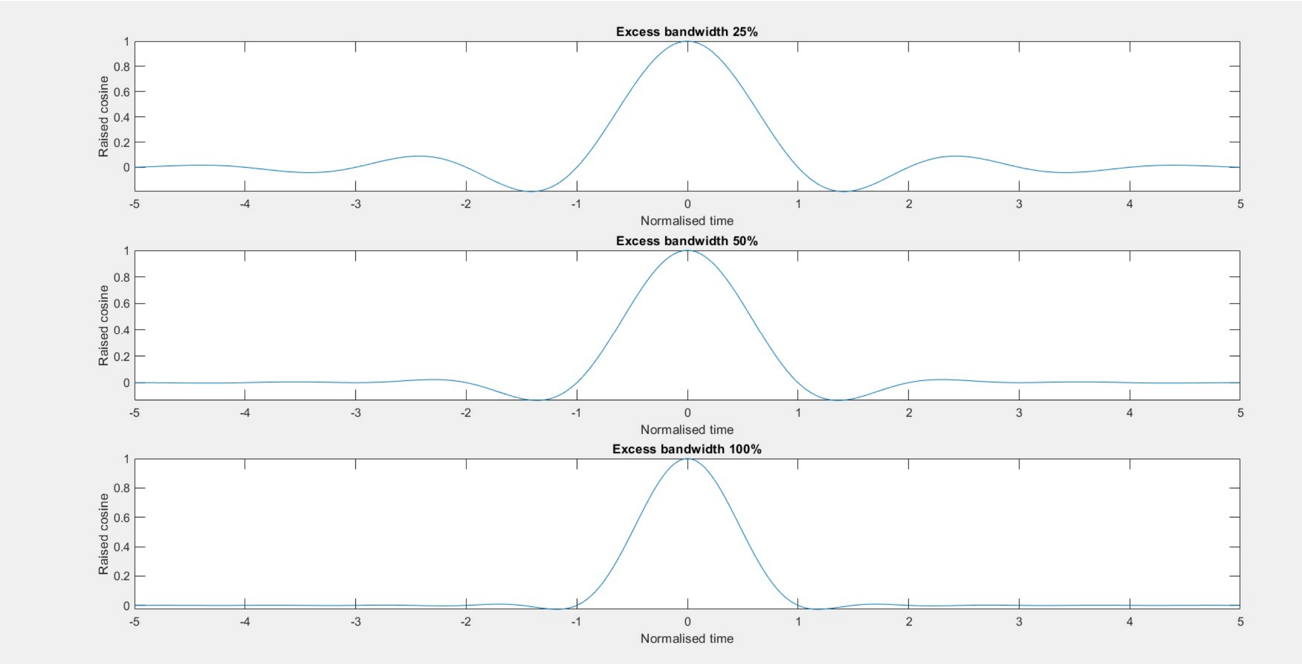
Parameters:

M=32 (number of samples required to calculate the sampling rate)

a=0.25, 0.5, 1 (excess bandwidth)

T=1(we have taken this for convenience)

Plots:



Explanation:

The plots are as expected. As we increase the excess bandwidth, we notice that the magnitude of the side lobes decreases and has minimal effect when the excess bandwidth is 100%(a=1).

This is understandable because if we are having the liberty of additional bandwidth which is additional cost and thus we get the better and ideal graph with very little distortion.

Question-b

We are required to calculate the Fourier transform and truncate it to

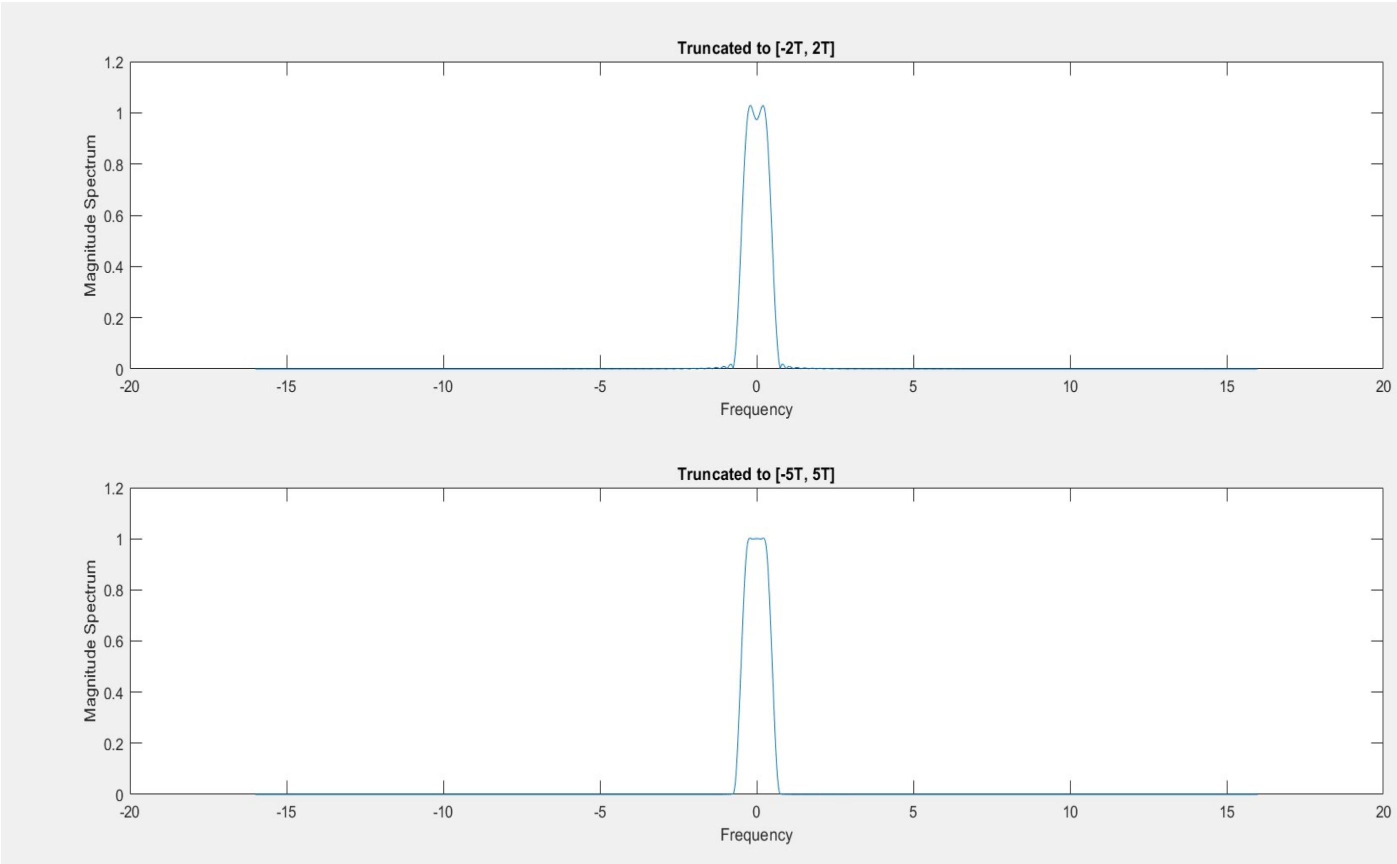
a)[-2T, 2T] b)[-5T, 5T] for parameters

a=0.5, m=32, T=1

fdesired=1/64 (The required resolution of frequency)

Tsample=1/32(This directly affects scaling. We have taking scale so that the magnitude is 1 for easy comparison).

Plots:



Explanation:

We have noticed that when we truncate to [-2T, 2T], we notice that the peak which is expected to be a constant has deviation because of the truncation. Also we have noticed that the sidelobes are also predominant due to the fact that the truncation is bad.

On the other hand, [-5T, 5T] has a near constant peak and there are practically no sidelobes.

We notice that the bandwidth for [-2T, 2T] truncation is more than [-5T, 5T]. This is quite understandable because due to the truncation error, there are additional points and the value does not become zero beyond the expected trapezoid and so increases the bandwidth.

Question-c

We are required to numerically calculate 95% bandwidth for the plots obtained in part b.

For solving this question we use a very useful inbuilt function obw to find the occupied bandwidth.

Parameters:

In addition to the parameters of b) i.e

a=0.5, m=32, T=1

fdesired=1/64 (The required resolution of frequency)

Tsample=1/32(This directly affects scaling. We have taking scale so that the magnitude is 1 for easy comparison).

Obw() has 4 parameters.

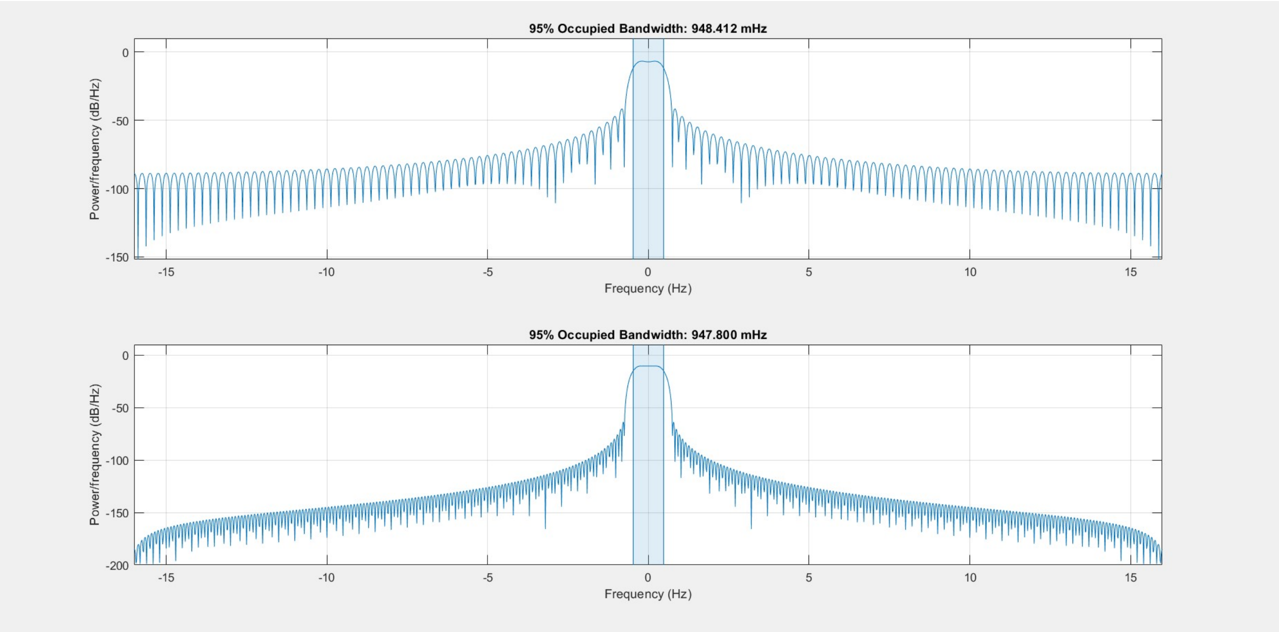
I)Power spectral density(We give (x(f))^2/length of truncation)

ii) freqs(which is the set of frequencies for which we estimate the bandwidth)

iii) A vector containing our frequency range. We simply give [] so that the appropriate range is taken as input.

iv) Percentage of bandwidth(Here 95% bandwidth)

Plots:



Explanation:

Our work became extremely easy because the function directly computed the bandwidth and it is 948.412mHz – For [-2T, 2T] and 947.8 mHz – For [-5T, 5T]

Our prediction that [-2T, 2T] has more bandwidth is true as observed from the figure.

Manual calculation:

We use the formula

$$\int_{-B/2}^{B/2} S_u(f)df = \gamma P_u = \gamma \cancel{\int_{-\infty}^{\infty}} S_u(f)df$$

Here gamma=0.95 in our case. Also we have assumed the bandwidth as B

Initially, we solve the value in the RHS where we find the integral from -inf to inf and multiply with 0.95. This value turned out to be 0.831.

To evaluate LHS, we use the symmetry property to change the integral as two times and the limits change from 0 to B/2. We solve this using online calculator as manually integrating is slightly difficult.

I have found our from online calculator that the value of B = 947.379 mHz

We notice that the value of bandwidth obtained is less when compared to the truncated values. This can be easily justified because truncation causes errors and thus causes a few non zero points leading to the increase of bandwidth.