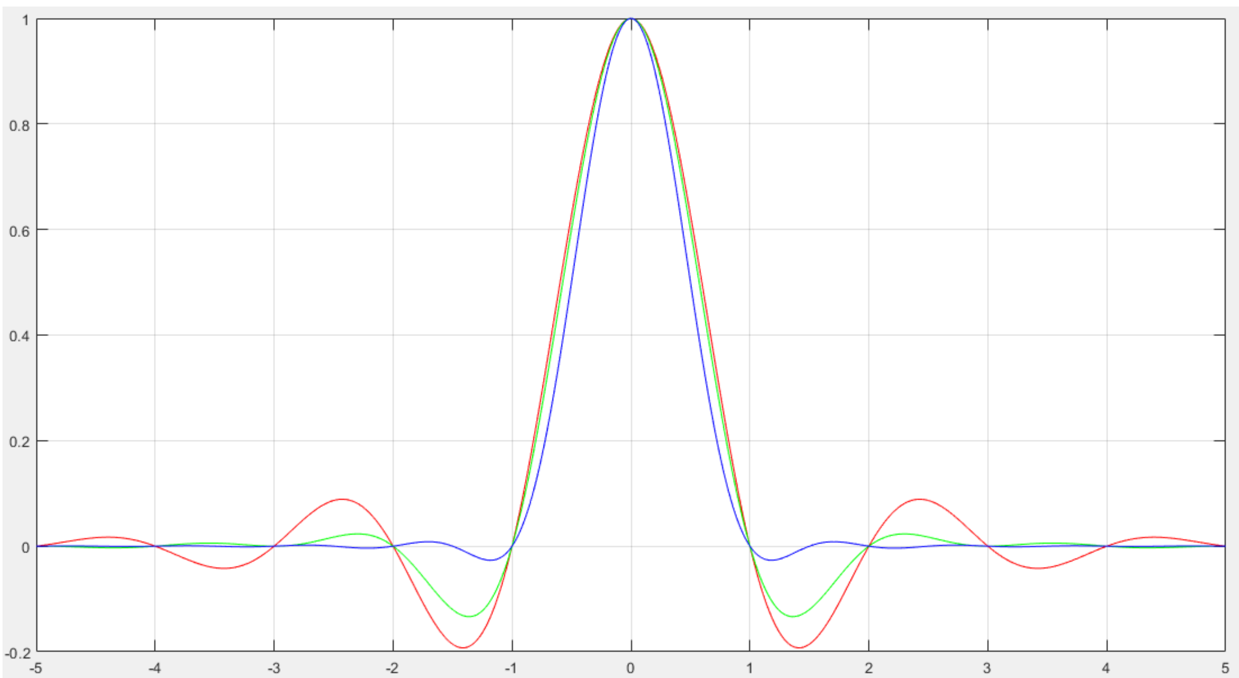
CT Assignment 5

Simulations Report:

a. -Here we are plotting the time domain waveform of the sampled raised cosine pulse for different excess bandwidths over the time interval [-5T,5T]. For this we have taken the code fragment from Madhow book.

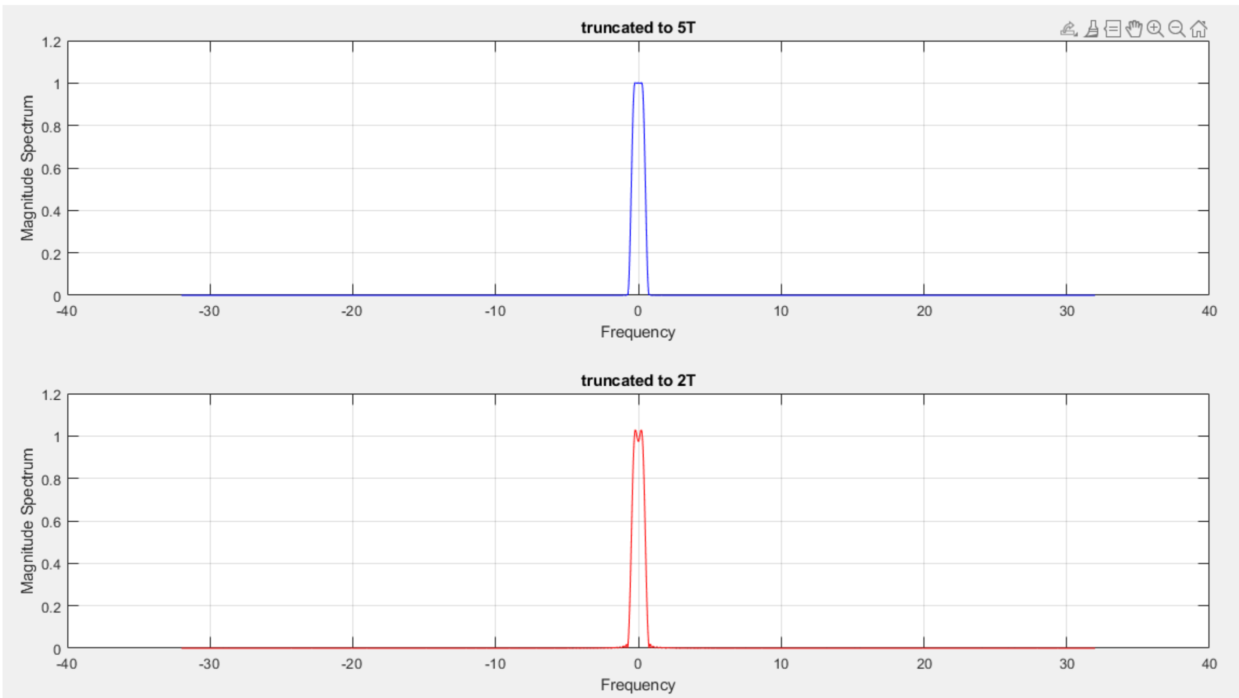
   In the code we have the parameters:
   A – excess bandwidth
   M – samples
   Length – the length till where to truncate the signal.
   T = 1 (to get the plot normalized).
   Then we plot the equation of the raised cosine w.r.t to the time axis specified. The plot is for different excess bandwidth –



   Red plot is for 25% excess bandwidth. Green plot is for 50% excess bandwidth. Blue plot is for 100% excess bandwidth.

We can observe that as the excess bandwidth is being increased the oscillations or the side lobes are being reduced and becoming straighter.

b. In this case we have fixed the excess bandwidth to be 50% and the truncation intervals are [-5T,5T] and [-2T,2T] and compute the Fourier transform in the two cases. For this we have taken the code fragment again from Madhow for computing the DFT. The plots for the Fourier transform for the two cases are –



The parameters are –
A = 0.5, m = 32
Length1 = 2 and Length2 = 5
Ts = 1/32 and T =1
We find out the fft using the code fragment.
As the signal is truncated more from [-2T,2T] to [-5T,5T] we can observe that the bandwidth occupied will become less.

c. Now we compute the 95% occupied bandwidth of the signal by using the function “obw(pxx,fs,freqrange,p)”.

Pxx - power spectral density.

Fs - the set of frequencies where we estimate.

Freqrange – the range of frequencies where we want the 95% bandwidth computation.

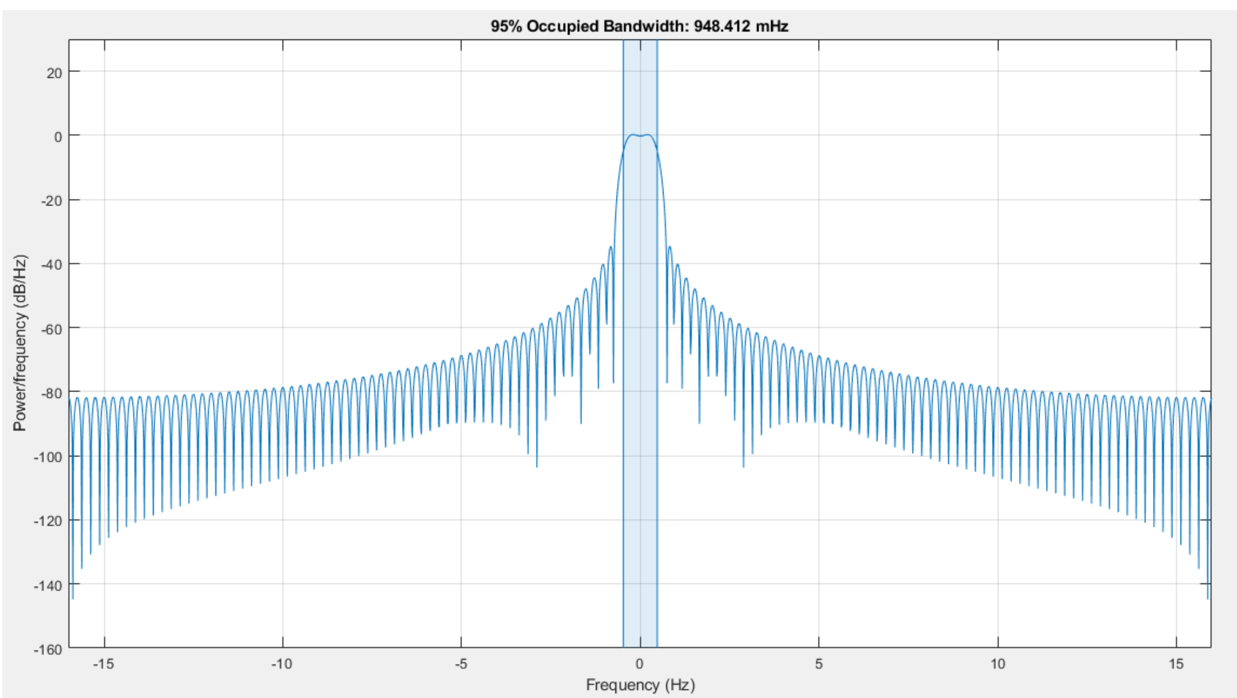
P - %bandwidth.

We find the power spectral density by using the formula,

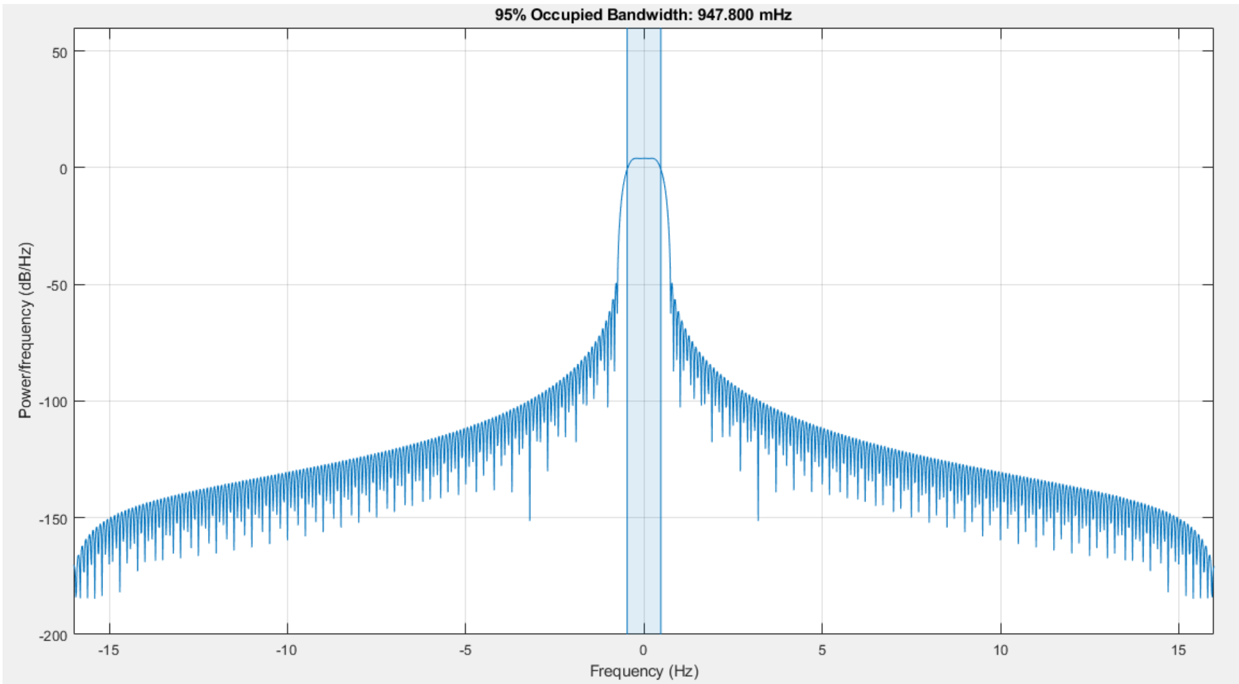
Sx(f) = |X(f)|^2/T where X(f) is the Fourier transform of the truncated signal. T is the length of the truncated signal.

Now substituting these in the function we get the 95% bandwidth as shown in the figure –

This figure gives the 95% bandwidth when the signal is truncated from [-2T,2T].



This figure gives the 95% bandwidth when the signal is truncated from [-5T,5T].



We can see here as the signal is truncated from [-2T,2T] to [-5T,5T] the occupied bandwidth is reduced considerably.

Theoretically calculating the 95% bandwidth:

We first find out the power of the signal which is given by |x(t)|^2 integrated from -inf to inf. Taking 95% of this gives us 95% power of the signal.

Now we compute the integral from -B/2 to B/2 of pxx for this we decompose the integral into 2 times integral from 0 to B/2(as the signal is symmetric). This can be further decomposed into 0 to (1-a)/2 and (1-a)/2 to B/2(here we can check that B/2 is greater than (1-a)/2). Now equating this integral to the 95% power we get the value of the B. I have calculated this using wolfram calculator and the value of B is nearly 0.95Hz.