Lab Report – 6

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Q1:

(b) First two plots have the real and imaginary parts of the signal. Imaginary parts are 0. Third plot has the magnitude of fourier transform given by $\sqrt{(\text{real part})^2+(\text{imag part})^2}$. The fourth plot has phase of transform given by $\tan^{-1}((\text{imag part})/(\text{real part})$. It is in multiples of pi as the imaginary part is zero.

(c) Time-Scaling property supports our observation.

If $x(t) \leftrightarrow X(\omega)$

Then, $x(at) \leftrightarrow (1/|a|)X(\omega/a)$

(d) The shape of graph is an increasing amplitude sinusoid till mid and then a decreasing amplitude sinusoid.

(e) xt can be made using piecewise function in MatLab as shown below:

```
xt = piecewise((t>=-T)&(t<=0), t+1, (t<=T)&(t>=0), 1-t, 0);
```

Q4:

(b) We observed that the fourier coefficients of input signal was non-zero for frequency = 1. We used a Low-Pass filter in this case. For W_c = 0.5, this gets filtered out and we do not get any signal as reconstructed output But, when W_c = 2, this does not get filtered out and we get the complete signal reconstructed back.

(c) We observed that the fourier coefficients of input signal was non-zero for frequency = 1. We used a High-Pass filter in this case. For W_c = 2, this gets filtered out and we do not get any signal as reconstructed output But, when W_c = 0.5, this does not get filtered out and we get the complete signal reconstructed back. (opposite to previous Low-Pass case)

(d) This filter causes a phase shift in the reconstructed signal as well as a decrease in the amplitude which also manifests the complex nature of the signal.

Q5:

As our input signal is a sinusoidal signal, the sinc_recon works the best for reconstruction of signal from the sampled points. The zero-order and linear interpolation does not work efficiently at all. The reconstruction gets better and better as we move from zero-order interpolation to linear interpolation to sinc_recon.

Q8:

The frequency of signal is 5/2 Hz. Thus, w_{max} for the signal is 5/2 Hz.

Nyquist rate = 2 x w_{max} = 2 x (5/2) = 5 Hz.

As the sampling interval increases, the accuracy of reconstruction decreases because the sampling frequency and hence number of samples decreases.