ELEC9721: Digital Signal Processing Theory and Applications

Lab 5 Preparation

You may *not* use Matlab's in-built functions downsample, upsample, resample for this lab.

Question 1:
The system in Figure 1 is used to downsample a signal. The low pass filter LPF has 3dB cut-off frequency fc. N is the downsampling rate.

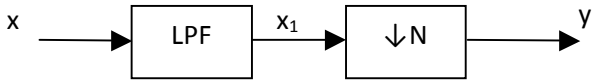

Figure 1

a. A signal x sampled at fs=16kHz is passed through this downsampling system. *Assume that the LPF is ideal*. The spectrum of x is given as below

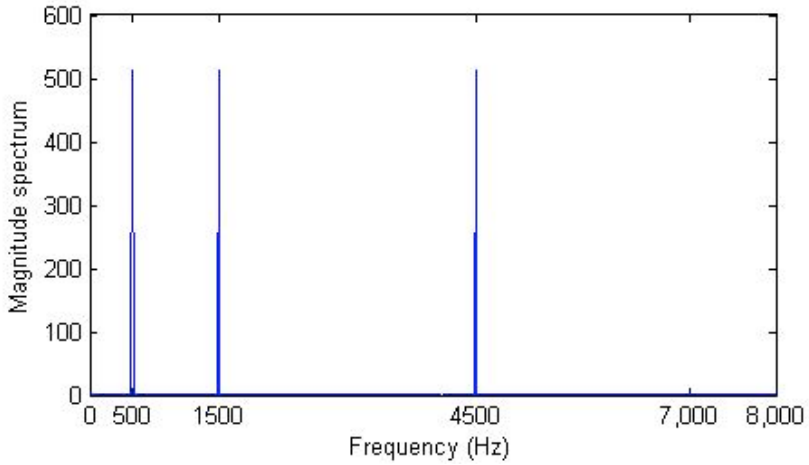

Figure 2

i. With fc=4kHz, and N=3, plot the magnitude spectrum of the signals x_1 and y when the x-axis is
   - ✓ In Hz scale and between zero to half of its sampling rate
   - ✓ In normalization scale and between [0 1]

ii. With fc=7.5kHz and N=3, repeat question (i)

b. Use the firpm function to design two LPFs (order 20) fc=4kHz and 7.5kHz. Create a signal like that in Figure 2 and show the spectrum at x1, i.e. the output of your filters.