

FACULTY OF ENGINEERING, UNIVERSITY OF JAFFNA

DIGITAL SIGNAL PROCESSING – EC5011

LABORATORY SESSION 4

UPSAMPLING AND DOWN SAMPLING

PART A: Up-sampling and Down-sampling

A analog signal $x(t) = A_1 \sin(2\pi f_1 t) + A_2 \sin(2\pi f_2 t) + A_3 \sin(2\pi f_3 t)$, where $A_1 = 3000$; $f_1 = 1000 \text{ Hz}$, $A_2 = 2000$; $f_2 = 2000 \text{ Hz}$, $A_3 = 1000$; $f_3 = 5500 \text{ Hz}$, is sampled at 15kHz. Number of samples = 2048. Determine the sampled signal $x[n]$.

- 1) Down sampling by a factor of 3 without filtering.
- 2) Down sampling by a factor of 3 with filtering.
- 3) Up sampling by a factor of 3 with filtering.
- 4) Change the sampling frequency to 6kHz (use required filters)

MATLAB:

Perform those multirate processing in Matlab and plot the magnitude spectrum of all input, output and intermediate signals (you can use subplots) as described below.

- a) Plot the magnitude spectrum of input, output and all intermediate signals having x-axis scaled to Hz for all the above questions. For each part use sub plot command to plot all graphs in one figure. (i.e., for one part (say (1)), all required plots should be in one figure)
- b) Plot the magnitude response of input, output and all intermediate signals having x-axis scaled to rad for the second and third questions. For each part use sub plot command to plot all in one figure.