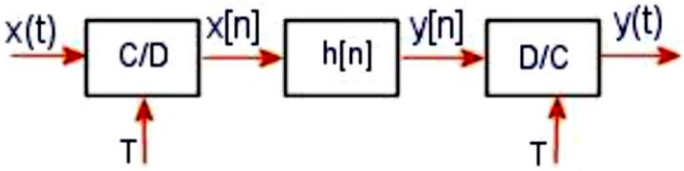
Software Portion of OHT-1 (Matlab)
BEE-7AB
Due Date: 23rd April 2018

Problem: You have studied sampling of the continuous-time signal to get discrete-time signal. After that you may apply some discrete-time signal processing. The processed signal is then converted back to continuous-time signal. Assume this as a telecommunication system where you receive a signal from transmitter, do some processing and re-transmit the signal. The overall system is represented as



Suppose
$x(t) = 0.5 \quad 0 \leq t \leq 0.5s$
$x(t) = -0.5 \quad 0.5s < t \leq 1s$

1. Plot the signal and its spectrum. Label correctly the x-axis and y-axis of plots in time (t) and frequency Ω. Although every sequence in Matlab is stored in array but you should assume this as a continuous-time signal.

2. This signal should be passed through analogue low-pass filter before converting it into discrete-time signal. Filter the signal with cut-off frequency of 20 Hz. You can take 3rd order Butterworth analog filter. Discuss why we need such filtering and why it is safe to choose these parameters of frequency and order? Plot and label the filtered signal and its spectrum. Also plot the frequency response of the Butterworth filter. Hint: Useful Matlab commands are "**butter** and **freqz**". Although analogue Butterworth filter should be designed but we don't have actual analogue signal so applying analogue filtering may not give you right answer. So design digital Butterworth filter and assume it as analogue.

3. Now practically C/D step is done using zero-order hold filter followed by quantization as practically multiplication with the continuous-time impulse train is not possible. Therefore, study the zero-order hold filter and quantization process in detail and apply in Matlab for C/D conversion. You cannot use Matlab's built-

in C2D conversion command. Is there any significance of sampling period T in designing zero-order hold filter? Should we take care of any Nyquist Criteria in designing zero-order hold filter? Also design a wrong zero-order hold filter to depict aliasing in frequency domain. Attach all relevant plots of zero-order hold filter and quantizer. Plot the sampled discrete-time signal and its spectrum. Plotting discrete-time signal uses "**Stem**" command of Matlab and mind the frequency axis of the spectrum of discrete-time signal.

4. Once you get $x[n]$, apply $h[n] = \frac{1}{2}\left[1 - \cos\frac{2\pi n}{20}\right]$ to get $y[n]$. Plot and label this system $h[n]$ and output $y[n]$.

5. Now convert the signal $y[n]$ using appropriate reconstruction filter. Apply again the zero-order hold filter before applying reconstruction filter. Plot the spectrum of the reconstruction filter and also its time-domain impulse response. Finally plot the signal $y(t)$.

Deliverable: Short report in hard form with the printout of the source code and all relevant plots. Explore the "Publish" operation in Matlab. Source code will also be uploaded to LMS as a single .m file as [firstname_lastname.m]

Warning: Any plagiarism will result in strict action and negative marking. Your source code should be able to generate exact plots as mentioned in the report. You must give bibliography should you want to get some help from published paper or internet sources.