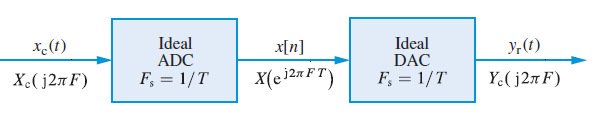
EE5630 DSP f2020 Matlab# 2 Due 23:59, 12/6/2020

MATLAB Problems: (You need to write MATLAB programs to fulfill the required function.)

You must type 1. The problem, 2. Your answer to the problem, including analysis/derivation if necessary, the required plots and your MATLAB programs in a file using MS Word with your student number and \_Matlab\_2 as the file name (e.g., x10900001\_Matlab\_2.docx), and submit the file via iLMS.)

1. (25%)

Consider the linear FM signal *xc*(*t*)= sin(*Bt*2/**) , 0 ≤ *t* ≤ *τ* with *B* = 10 Hz and *τ* = 10 s. It is applied to the talk-through system shown below with sampling rate of *Fs* = *B* Hz to obtain sampled signal *x*[*n*] and reconstructed signal *yr*(*t*). Simulate this operation in MATLAB and graph *xc*(*t*), *x*[*n*], and *yr*(*t*)in one figure using sub-plots.



2. (25%)

A multiband ideal bandstop filter is given by



**(a)** Determine the impulse response of the filter.

**(b)** Graph the impulse response for *n*d = 0 for −200 ≤ *n* ≤ 200.

**(c)** From the above truncated impulse response, compute and plot the magnitude response of the filter using MATLAB and compare it with the ideal filter response.

3. (25%)

An analog signal *xa*(*t*) = 5sin(200*t*) + 2cos(300*t*) is to be processed by a DSP system in which the sampling frequency is 1000 samples/sec.

(a) Design a minimum-order IIR digital filter that will pass the 150-Hz component with attenuation of less than 1 dB and suppress the 100-Hz component to at least 40 dB. The filter should have a monotone passband and an equiripple stopband. Determine the system function in rational function form and plot the log-magnitude response.

(b) Repeat (a) with optimal equiripple FIR filter.

(c) Generate 300 samples of *xa*(*t*) and show the processing results of (a) and (b).

4. (25%)

A digital signal *x*[*n*] contains a sinusoid of frequency 0.5 and a Gaussian noise *w*[*n*] of zero mean and unit variance; i.e., *x*[*n*] = 2cos(0.5*n*) + *w*[*n*]. We want to filter out the noise component using a **50th-order causal linear-phase FIR** filter.

1. Using Parks-McClellan algorithm, design a **narrow bandpass filter** with passband width of no more than 0.02 and stopband attenuation of at least 30 dB. Note that no other parameters are given, and you have to choose the remaining parameters for the remez function to satisfy the requirements. Provide a plot of the log-magnitude response in dB of the designed filter.
2. Generate 200 samples of *x*[*n*] and process through the above filter to obtain the output *y*[*n*]. Provide subplots of *x*[*n*] and *y*[*n*] for 100 <= *n* <= 200 on one plot and comment on your results