

## ECE310: Quiz#10 (3pm Section E) Fall 2018

1. (5 pts) A video signal  $x_c(t)$  is assumed to be bandlimited to 10 MHz. It is desired to filter this signal with a **bandstop** filter that will block the frequencies between 2 MHz and 3 MHz and pass the other, by using a digital filter with frequency response  $H_d(\omega)$  sandwiched between an ideal A/D and an ideal D/A.
  - (a) Determine the Nyquist sampling rate for the input signal, and specify the frequency response  $H_d(\omega)$  for the necessary discrete-time filter, when sampling at the Nyquist rate.
  - (b) Smart Alec claims that the system can perform the desired filtering function even when the sampling rate is lower than the Nyquist rate. Is that true? Justify your answer.
2. (5 pts) A system for processing analog signals  $x_c(t)$  is composed of the following parts, connected in cascade: (i) an ideal analog LPF with cutoff frequency  $F_c$ ; followed by (ii) a causal digital system whose input  $x[n]$  and output  $y[n]$  are related as  $y[n] = -0.3y[n - 2] + x[n]$ , which is sandwiched between an ideal A/D and an ideal D/A operating at a sampling rate of 20 kHz. The output of this entire system is denoted by  $y_c(t)$ .
  - (a) What is the largest value of  $F_c$  for which the entire system will act as an analog LTI system, from input  $x_c(t)$  to output  $y_c(t)$ ? Justify your answer.
  - (b) For the  $F_c$  determined in (a), determine the analog frequency response  $H_c(\Omega)$  of the entire system.