ECE310: Quiz#10 (10pm Section G) Fall 2018

1. (5 pts) A music signal $x_c(t)$ is assumed to be bandlimited to 20 kHz. It is desired to filter this signal with a **highpass** filter that will pass the frequencies above 5 kHz 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 this 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 $y[n] = 0.3y[n-1]+x[n]$, which is sandwiched between an ideal A/D and an ideal D/A operating at a sampling rate of 10 kHz. The output of the 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.