MENG

1. You have access to a cheap analog low-pass filter which has a fairly flat unit gain response from $\Omega=0$ to $\Omega=60$ *KHz*, and a stopband attenuation of *100 dB* for $\Omega>80$ *KHz*. With this analog anti-aliasing filter you are asked to design a 16-bit A/D converter system with a baseband sampling rate at *60 KHz*.

a) If you were to use the above analog filter for the design of an oversampling A/D converter system, what is the **minimum** sampling frequency that you should choose?

b) With the sampling rate that you picked in part (a), draw a block diagram of the A/D converter system from the analog input signal to the final sampled output sequence at *60 KHz*. This block diagram needs to include the specification (passband bandwidth, stopband attenuation, gain, etc.) of any filter that would be needed in the system.

c) Is your answer in part (b) the most hardware-efficient solution? If not, use another sampling rate to design this A/D converter system with less amount of computation. Draw a block diagram to describe this system.

a): The minimum sampling rate is 30Khz + 80Khz = 110 Khz

b): The block diagram consists of the above anti-aliasing filter, a sampler at 110Khz, followed by an up-converter by a factor of 6, a digital filter, and a down-converter by a factor of 11. The digital filter specs are: passband, $\pi/11$; stopband attenuation: 100dB, gain: 6.

c): 120Khz.