EE 230
Homework 13
Spring 2010

Solve any 5 of the following 8 problems.

Problem 1   A 4-bit ADC has the first transition point at V_{LSB} and subsequent transition points spaced V_{LSB} apart. If V_{REF} for this ADC is 5V, what is the quantization error for VIN=0.33V?

Problem 2   If a sampling clock is fixed at 10KHz, what is the maximum frequency component of an input signal that can be present if there is to be no aliasing in the ADC process?

Problem 3   Assume a signal is band limited to 1KHz but there is an unwanted component present at 3.2KHz. If the desired signal is a 100Hz sinusoid of amplitude 3V p-p centered around 2.5V and V_{REF}=5V, determine the magnitude of the aliased signal and the frequency of the aliased signal if the input is sampled at 2KHz and the amplitude of the undesired 3.2KHz signal is 0.5V p-p (and also centered around 2.5V).

Problem 4   If a lowpass filter with a dc gain of 1 and 3 poles, all at 3KHz is used as an antialiasing filter, at what frequency will the aliased signal of Problem 2 appear and what will be the amplitude of the aliased signal?

Problem 5   Assume a periodic signal has three components, one of amplitude 3V p-p at 1KH, a second of amplitude 1V p-p at 2.5KHz, and a third of amplitude 500mV p-p at 4 KHz. Determine the minimum sampling rate needed to sample this periodic signal if no information is to be lost in the sampling process.

Problem 6   A 12-bit ADC with a V_{REF} of 5V is used to digitize small signals with a quiescent value of 2.5V and a variation around the 2.5 V of $\pm$ 100mV. What is the SNR of the digitized signal if the ADC is ideal?

Problem 7   A 12-bit ADC with V_{REF} of 5V is used to digitize a sinusoidal signal a quiescent value of 2.5V and a p-p amplitude that is restricted 1.5V p-p. What is the ENOB of this ADC with this input signal due to quantization noise?

Problem 8   The device noise at the input to a 10-bit ADC with V_{REF}=5V was measured to be 21.5mV.

   a) What is the quantization noise of this 10-bit ADC (in V_{RMS}) if the input is a sinusoid of 4V p-p? (assume the input has a dc offset to that the input is within the operating range of the ADC.
   b) What is the ENOB when compared to an ADC that is ideal except for quantization noise?