UNIVERSITY OF CALIFORNIA
College of Engineering
Department of Electrical Engineering
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	Homework 4	**EECS 247**
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Problem 1: DAC static tests

A 3-bit D/A converter were designed for an ideal LSB level of 50mV. The following output voltage levels were measured for the real D/A for the codes 000 through 111 respectively:

-2mV 52mV 98mV 160V 205V 245V 305V 363mV

- a- Find the offset & full-scale error in units of LSBs
- b- Find the end-point ideal & actual gain in LSB/code and compute the gain error in LSB/code.
- c- Find the end point corrected codes and new value for LSB and compute DNL & INL for all the codes.
- d- What is the maximum DNL & INL?

Problem 2: ADC static testing

The vector shown below is a ramp histogram of the output codes obtained for a 4-bit ADC.

2480 1102 810 1005 1106 1504 912 1207 1001 802 905 950 1150 600 1203 2302

Preferably write a Matlab program to:

- a- Calculate the DNL and INL for all codes in LSBs.
- b- Find the peak positive and negative DNL and INL.
- c- Include a copy of your program.
- d- Is monotonicity guaranteed for this ADC?

Problem 3: ADC spectral testing

Shown below is a 4096 point FFT of the output of a 9-bit A/D converter for full scale sinusoidal input.

1. In this test 211 number of cycles of the signal was sampled in the 4096 point FFT. What is the ratio of the sampling frequency to input frequency? Is windowing necessary? Why?
2. What is the SFDR of the ADC?
3. Compute the INL of the converter in LSBs.
   Note that: the definition of INL requires that the offset and gain of the ADC be adjusted for zero error at the end points. Also, the full-scale input sinusoid is centered around ½ of FS. For ease of computation, you can assume the transfer function has infinite number of steps.
   Hint: $\sin^3\alpha = \frac{3}{4}\sin\alpha - \frac{1}{4}\sin 3\alpha$
4. Use the rule of thumb expression for SFDR versus INL to find an approximate value for INL, compare the result with the more accurate one you found in 2).
5. Since this is the spectrum for a real ADC with both quantization noise and circuit generated noise (assume noise floor on the graph is at -80dBFS). Compute the approximate noise contribution by the circuit in terms of ADC LSB.
6. Find the ENOB for this ADC based on SNR only.
7. Find the ENOB for this ADC based on SNDR.