EE145M Spring 92 Final
College of Engineering
Electrical Engineering and Computer Science
Berkeley

Problem 1 (total 36 points):
Define the following terms (30 words or less)

a. (6 points) **Glitch** (of a D/A converter)

b. (6 points) **Transition Voltages** (of an A/D converter)

c. (6 points) **Frequency Aliasing**

d. (6 points) **Sample and Hold Amplifier**

e. (6 points). **Flash A/D Converter**

f. (6 points) **Successive Approximation A/D Converter**

Problem 2 (41 points)

You have a data-acquisition system that can sample an analog waveform, digitize it and transfer the resulting digital number into computer memory every 10 micro(s) .(Note: This system has no analog filtering before digitizing).

a. (5 points) What is the sampling frequency?

b. (18 points) You sample a sine wave with frequency f=25kHz, look at the resulting data, and observe that there are four samples per sinewave period. How many samples per apparent sinewave period would you expect to observe if the input frequency were 10, 50, 75 and 100 kHz?

c. (18 points). You acquire 1024 samples of a 9766-Hz sine wave oscillating between 0 and 2V, and take the fast Fourier transorm of the resulting data. List the location (frequency indices) of all non-zero Fourier amplitudes. (Hint : 1024 x 0.9766 = 1.0000.)

Problem 3 (total 45 points):

You have been using the system described in Problem 2 for input frequencies below 20kHz for some time nad with great success until a colleague in the next room turns on a pure 1,000-Mhz (+/-1Hz) sine-wave oscillator and some of the unwanted signal gets into the analog input of your system.

a. (15 points) What would be the effect of the 1Mhz signal on your digitized data? Explain.

b. (15 points). If you took several 1024 point data sets, where the start time was determined at random push of a button), would be the effecgt of the 1 Mhz signal be the same for each data set? Give a reason for your answer.

c. (15 points) How could you most easily eliminate the effect of the unwanted 1 Mhz signal in you digitized data?

Problem 4 (total 30 points) :

Given the input x0 = 1, xi = 0 for all i <> 0 (impulse input).

- numerically compute the output yi, i = 1, 2, 3, 4 of the following digital filters (assume yi = 0 for all i =<0)
- Sketch yi to visualize the filter outut shape

a. (6 points) yi = $x_{i-1} - x_{i-2}$

b. (6 points) yi = $x_{i-1} - 2x_{i-2} + x_{i-3}$

c. (6 points) yi = $0.1x_i + 0.9y_{i-1}$

d. (12 points) For each of the following descriptions, write the letter (a, b or c) of the digital filter that most closely corresponds and whether it is an infinte impulse response filter (IIR) or a finite impulse response filter (FIR).

	a, b or c	IIR or FIR
Second derivative	___________	_________
First derivative	___________	_________
Low Pass filter	___________	_________

Problem 5 (Total 48 points)

a. (12 points) Give the steps you would use to compute the input waveform u(t) needed to produce a desired output y(t) of an analog filter.

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                 |                  |
u(t) -------> |    Analog filter     | --------> y(t)
                 |__________________|
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b. (12 points) Draw a block diagram of a microcomputer-based system for sampling, digital storage and playback of an audio music performance. Show all essential components and signal connections.

c. (12 points) Given a single-pole low-pass analog filter with corner frequency fc=1/(2*pi*RC), design a filter that would most closely match the properties of the analog filter. Describe any differences.

d. (12 points). After sampling a non-integral number of periods of a periodic waveform, how would you apply windowing to reduce leakage in the FFT? Sketch a typical window and describe (simply) how it reduces leakage.
