NAME (please print) ____

STUDENT (SID) NUMBER ______________________________

UNIVERSITY OF CALIFORNIA, BERKELEY

College of Engineering
Electrical Engineering and Computer Sciences

EECS 145M: Microcomputer Interfacing Lab

LAB REPORTS:

1 __________________	2 __________________	3 __________________
8 __________________	9 __________________	10 __________________
21 __________________	22 __________________	23 __________________
24a __________________	24b __________________	

Total of top 4 Long Lab Grades	________________	(400 max)
Total of top 4 Short Lab Grades	________________	(100 max)
Lab Participation	________________	(100 max)
Mid-Term #1	________________	(100 max)
Mid-Term #2	________________	(100 max)
Final Exam	________________	(200 max)
Total Course Grade	________________	(1000 max)

COURSE LETTER GRADE

Spring 2010 FINAL EXAM (May 11)

Answer the questions on the following pages completely, but as concisely as possible. The exam is to be taken ***closed book***. Use the reverse side of the exam sheets if you need more space. Calculators are OK.

Partial credit can only be given if you show your work.

FINAL EXAM GRADE :

1 __________ (15 max) 2 __________ (30 max) 3 __________ (30 max)

4 __________ (20 max) 5 __________ (65 max) 6 __________ (40 max)

TOTAL __________ (200 max)

Initials ____

PROBLEM 1 (total 15 points)

1.1 (15 points) List the essential handshaking steps for the reliable transfer of digital data from one circuit or computer to another.

PROBLEM 2 (total 30 points)

2.1 (15 points) Draw the block diagram for the 8-bit flash A/D converter, showing all essential components and interconnecting lines.

2.2 (15 points) Describe the operation of the 8-bit flash A/D converter.

PROBLEM 3 (20 points) Design a Butterworth anti-aliasing low pass filter that meets the following requirements:

- Gain > 0.99 for frequencies below 10 kHz
- Gain < 0.001 for frequencies that alias below 10 kHz
- The sampling frequency is 60 kHz
- The filter has the minimum number of components (lowest order)

PROBLEM 4 (total 30 points)

4.1 (5 points) Describe how a gradually increasing digital input to an D/A converter can cause a brief output error called a "glitch".

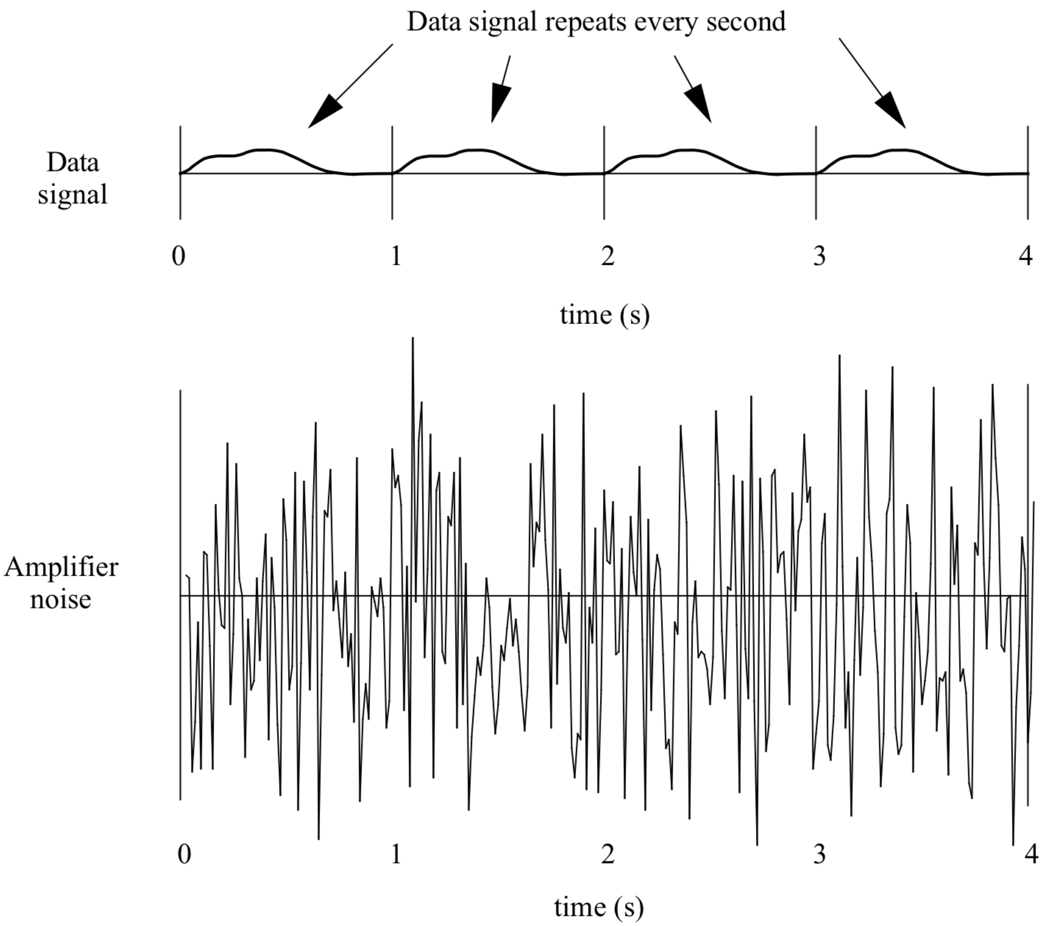
4.2 (15 points) Draw a circuit for eliminating D/A output glitches.

4.3 (10 points) Describe how your circuit eliminates glitches in its output.

Initials ____

PROBLEM 5 (total 65 points):

You have a sensor that when triggered produces a very weak signal with a frequency content from 1 Hz to 1 kHz. To see the signal you need an amplifier, but all amplifiers add random noise to the amplified signal. In this case the noise is much greater than the signal and extends from 0 Hz to 1 MHz but can be neglected above 1 MHz. To extract the signal, you trigger the sensor periodically 100 times, sample the amplifier output, and use Fourier analysis.



5.1 (20 points) Sketch your design in block form, including the sensor, amplifier, interfacing circuits, and computer. Label all components and signals.

5.2 (15 points) Describe the process of sampling the amplified signal and performing the FFT.

5.3 (15 points) Describe the output of the FFT.

5.4 (15 points) Describe how you would recover the data signal with the maximum signal to noise.

Initials ____

PROBLEM 6 (40 points)
Design a computer-based system for the real-time tuning of musical instruments.

Assume the following:

- You will develop the system using a computer with digital and analog I/O similar to the 145M lab.
- The user enters the desired frequency f and a frequency differential Δf in Hz using the keyboard
- There are 5 LEDs that light up depending on whether the note being played is $2\Delta f$ low, $1\Delta f$ low, in tune, $1\Delta f$ high, or $2\Delta f$ high. The user can then adjust the pitch of the instrument so that its frequency matches the desired frequency.
- You will use digital filters to determine which LEDs to light.

6.1 (15 points) Draw a block diagram of your system, showing and labeling all essential components, connections, and signals.

6.2 (15 points) List the software and hardware processes necessary to use the program for a note being played Δf below the desired frequency.

6.3 (10 points) Give an explicit formula for the digital filter used in part **6.2**.