NAME (please print) ____

STUDENT (SID) NUMBER ______________________________

UNIVERSITY OF CALIFORNIA

College of Engineering
Electrical Engineering and Computer Sciences
Berkeley

EECS 145M: Microcomputer Interfacing Lab

LAB REPORTS:

1 ________	2 ________	3 ________
8 ________	9 ________	10 ________
21 ________	22 ________	23 ________
24 ________		

Total of top 4 Lab Grades	________	(400 max)
Total of top 4 Question Sections	________	(100 max)
Lab Bonus	________	
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 1998 FINAL EXAM (May 22)

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. **In answering the problems, you are not limited to the particular equipment you used in the laboratory exercises.**

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

FINAL EXAM GRADE :

1 ________ (20 max)	2 ________ (20 max)	3 ________ (60 max)
4 ________ (70 max)	5 ________ (30 max)	TOTAL ________ (200 max)

Initials ________________________

Problem 1 (total 20 points):

1a. (10 points) Given a set of measurements (a_i, $i = 1$ to N), how would you compute the standard deviation of the mean ($\sigma_{\bar{a}}$)?

1b. (10 points) Given two sets of measurements (a_i and b_i, $i = 1$ to N) (and assuming the null hypothesis), how would you determine the probability that the difference between their means ($\bar{a} - \bar{b}$) occurred by chance?

Problem 2 (total 20 points)

2a. (10 points) If an arbitrary waveform $h(t)$ is periodic with period P, what can you say about its Fourier transform $H(f)$? (*Hint:* Recall the Fourier convolution theorem.)

2b. (10 points) If an arbitrary waveform $h(t)$ is multiplied by a window function $w(t)$ [that is, $g(t) = h(t)\ w(t)$], how are the Fourier transforms $G(f)$ and $H(f)$ related? (*Hint:* Recall the Fourier frequency convolution theorem.)

Initials ________________________

Problem 3 (total 60 points) *Note:* It may be helpful to read part 3e before beginning work on part 3a.

3a. (10 points) If a 10 Hz sinewave is sampled at 1024 Hz for 0.5 second (2^{10} = 1024), what does the FFT look like? Sketch the approximate relative magnitude of the FFT coefficients in the space below, and label the horizontal axis with both FFT coefficient index and frequency (Hz).

3b. (10 points) If an 11 Hz sinewave is sampled at 1024 Hz for 0.5 second, what does the FFT look like? Sketch the approximate relative magnitude of the FFT coefficients in the space below, and label the horizontal axis with both FFT coefficient index and frequency (Hz).

3c. (10 points) If a 500 Hz sinewave is sampled at 1024 Hz for 0.5 second, what does the FFT look like? Sketch the approximate relative magnitude of the FFT coefficients in the space below, and label the horizontal axis with both FFT coefficient index and frequency (Hz).

3d. (10 points) If a 524 Hz sinewave is sampled at 1024 Hz for 0.5 second, what does the FFT look like? Sketch the approximate relative magnitude of the FFT coefficients in the space below, and label the horizontal axis with both FFT coefficient index and frequency (Hz).

3e. (20 points) For each of the four FFT plots above, describe whether they were affected by aliasing or spectral leakage and if so, how they were affected and what you would do to fix the problem.

Initials ________________________

Problem 4. (70 points) Design an automated (i.e. computer controlled) system for the assembly line testing of **eight** units of a new type of 12-bit A/D converter.

You are provided with the following:

- eight sample A/D converters (in production, they would be tested eight at a time)
- a microcomputer
- a 16-bit D/A converter with 1/2 LSB absolute accuracy and 10 μs settling time
- two 16-bit parallel input ports
- two 16-bit parallel output ports
- eight 16-bit tri-state drivers

You may assume the following:

- The 16-bit parallel output port is in “transparent” mode (no handshaking). New data can be written to the port at 500 kHz.
- You have a timer function wait(N), that can delay program execution for N μs.
- The A/D converter requires a “start conversion” low-to-high edge signal and after conversion provides an “output data available” low-to-high edge. The A/D converter sets “output data available” low and resets all internal functions when “start conversion” goes low.
- For highest possible reliability, you wait until the A/D has signaled that its data are ready before reading its output. (A coworker will worry about measuring the conversion time.)

Hint: Think about Laboratory Exercise 9 (A/D converters) and how you would automate the measurement and data analysis procedures.

4a. (20 points) Draw a block diagram of the major components, including two of the A/D converters being tested. Show and label all essential data and control lines.

Initials ________________________

4b. (10 points) List the steps your program must do to measure the first transition voltage V(0,1) of the first A/D converter (pseudocode is OK, so long as the logic is clear).

4c. (10 points) How would you determine the maximum absolute accuracy error of the A/D? (Explain the procedure in steps or with a flow diagram.)

Initials ________________________

4d. (10 points) How would you determine the maximum linearity error?

4e. (10 points) How would you determine the maximum differential linearity error?

4f. (10 points) With what accuracy could this system measure the quantities in parts **b.**, **c.**, and **d.** in units of 1 LSB of the A/D?

Initials ________________________

Problem 5 (30 points)

5a (20 points) Sketch a simplified block diagram of the flash A/D converter circuit, labeling the essential internal components and signals.

5b (10 points) For an 8-bit flash converter with an input range from 0.00 V to 2.55 V, describe what happens when the input voltage changes from 1.27 V to 1.28 V.