Name (Last, First) _____ Student ID number _____

UNIVERSITY OF CALIFORNIA

College of Engineering
Electrical Engineering and Computer Sciences Department

EECS 145M: Microcomputer Interfacing Laboratory

Spring Midterm #1 (Closed book- equation sheet provided- calculators OK)
Wednesday, February 26, 2001

PROBLEM 1 (20 points)

How would you use electronic components, a computer with a digital I/O port, and statistical analysis to determine whether racecar drivers or jet fighter pilots have the faster reaction time? List all the steps that you need to accomplish to make a valid determination.

PROBLEM 2 (20 points)

You have designed a camera and computer system for recognizing automobile license plate numbers as cars pass on a highway. You would like to send the numbers to a nearby central computer as soon as possible, but the central computer is frequently busy with other tasks. Therefore, you store each number in local memory until it can be sent and use "data available" and "ready for data" handshaking signals to ensure that all license plate numbers are reliably transferred.

You may assume that each computer has a digital I/O port.

2a (10 points) Draw a block diagram of your system, including both computers and their digital I/O ports. Label data and handshaking lines.

2b (10 points) List the hardware and software steps needed from the passing of a car to the reliable transfer of its license plate number to the central computer.

PROBLEM 3 (60 points)

Design a microcomputer-based system for converting two lists of digital numbers into two analog waveforms (like left and right stereo).

Requirements:

- You will use a single 12-bit D/A converter
- Your computer has a single 16-bit digital output port
- Your computer has a 1 MHz clock that can be set to zero with the command reset_clock; and provides the number of μs (as a 32-bit integer) with the command val_time = time();
- The digital waveforms are stored in the computer as 12-bit numbers in the arrays val_right[] and val_left[]
- The two analog voltages converted from the ith digital values val_right[i] and val_left[i] are to appear at the two analog outputs of your circuit as simultaneously as possible (<< 1 μs) at a frequency as close to 40 kHz as possible.
- The two analog waveforms must be glitch free

You may assume that:

- All I/O operations such as reading the clock or writing to the digital output port take 1 μs.
- After writing a new digital input to the D/A converter, its output settles to 1/2 step size in 0.5 μs
- The operating system never interrupts your program
- You may use any circuit elements discussed in the course, but keep it simple

Hint: more than one S/H amplifier will be needed here.

3a. (20 points) Draw a block diagram of your system, showing and labeling all essential components, connections, and signals.

3b. (20 points) In proper time sequence, list the program and hardware steps necessary for your system to produce the two analog waveforms.

3c. (15 points) Draw a timing diagram for one complete cycle of your system, starting with the analog output voltages corresponding to val_right[i] and val_left[i] and ending with the analog output voltages corresponding to val_right[i+1] and val_left[i+1]. (Note: rather than drawing waveforms, you can just write the value of the different signals as time progresses)

3d. (5 points) What difficulties would you encounter storing and playing 2 hours of stereo music using this system?