CSE 421 Final Examination
Fall 2004-2005

Time: 120 minutes. Open books, open notes, closed communications. Write clearly, no points will be awarded if your writing can not be read. Be clear. Anything that can be misunderstood, will.

1 An Engineering Problem*(60 points)*

You have a printer, which only has a parallel interface, and the device (let us say, calculator) only has a standard serial interface. Therefore, you need to build a system that will receive serial input from calculator and feed the output to the printer.

The protocol on the calculator side is as follows: The calculator sends character codes, one at a time from the serial port. It will only send a second character when it hears the same character it sent back. Thus, it guarantees it will not to overrun the buffers of the printer it is sending data to, and also knows the correct data has been received by the printer. It is possible to set the serial communication parameters to any desired rate up to 9600 bps, and the calculator supports all standard asynchronous communication modes.

The printer has an 8-bit data input. In addition, it has one input which is called “data ready”, and when the printer detects a high-to-low transition on that line, it reads the data at the input and prints it. It also has an output line, called “busy”, which it normally keeps low, but raises it high when it is busy printing a character and is not ready to read any more data at the input. The printer is able to print 80 characters per second on the average.

You decide to build the system using a 6803-series microprocessor, a PIA and an ACIA. Answer the following questions:

a. Given that your communication is going to happen over a short length of cable, with virtually no noise, and also that the character set used for printing uses codes greater than 127, what communication mode would you pick for the ACIA?

b. Given that the printer can print 80 characters per second, what is the slowest communication speed you must use on the ACIA if you want to utilize the full performance of the printer?

c. What communication clock speed would you use for the ACIA in this case? How would you set the ACIA to communicate at the proper speed with this clock?

d. Which port of the PIA would you use to connect to the printer? Why?

e. Where would you connect the additional two lines of the printer?

f. How would you set up the chosen port of the PIA? (DDR and Control registers.)

g. Write an assembly subroutine that will initialize the system, including the ACIA and the PIA. Use the symbols `PIA` and `ACIA` for the base addresses of the chips.

h. Explain *in English* how you would move the data from the serial line to the parallel port, and talk properly to both sides. Include whether or not and how to use interrupts in your discussion. Assume there are no communication errors.

2 Write Interesting Code *(20 points)*

Suppose that in a certain application, the NMI vector points at location 0xC000. But, in our application, we want the CPU to go and start executing code at location 0xC100 when an NMI happens, and *never return* using `RTI` from this interrupt. And, this should work no matter how many times an NMI happens consecutively (given enough of a break for processing, of course!). Write the code that should be put at location 0xC000 to accomplish this goal.

3 Write More Code *(20 points)*

Suppose you need to use a *second stack* in your system, apart from the one in general use. You have reserved the memory area 0x0400 to 0x04FF for this purpose. What you should do is this: Write two subroutines, called PUSHA and PULLA. Subroutine PUSHA should push the value of accumulator A to this alternate stack, and return. PULLA should retrieve the value of accumulator A from the alternate stack. Also write a routine called INIT which will initialize the alternate stack. The PUSHA subroutine should not modify any registers (when it returns!), and PULLA should modify only accumulator A.