Department of Electrical and Computing Engineering

UNIVERSITY OF CONNECTICUT

ECE 3411 Microprocessor Application Lab: Fall 2015

Lab Test II

There are 2 longer programming problems in this test. There are 4 pages in this booklet. Answer each question according to the instructions given.

You have **100 minutes** to answer the questions. Once you are done, you need to show the output to the Instructor or TA and e-mail the code to the TA.

Some questions are harder than others and some questions earn more points than others—you may want to skim all questions before starting.

If you find a question ambiguous, be sure to write down any assumptions you make.
Be neat and legible. If we can't understand your answer, we can't give you credit!

Write your name in the space below. Write your initials at the bottom of each page.

THIS IS AN OPEN BOOK, OPEN NOTES TEST.
YOU CAN USE YOUR LAPTOP BUT PLEASE TURN YOUR NETWORK DEVICES OFF.

Any form of communication with other students is considered cheating and will merit an F as final grade in the course.

Do not write in the boxes below

1 (x/60)	2 (x/40)	Total (xx/100)

Name:

Student ID:

1. [60 points]:

a. Write a C program for your AVR that performs the following functions:

- It *always* blinks an LED at a constant frequency of 1Hz with 50% duty cycle.
- It is always ready to receive characters over UART and as soon as a character is received, it echoes/prints it back to the Terminal immediately without waiting for a return key (`'\r'`) or a next line character (`'\n'`).
- Once a return key (`'\r'`) or a next line character (`'\n'`) is received, it converts all the characters received so far (since last `'\r'` or `'\n'`) to lower caps and prints them on the Terminal. E.g. `'A'` becomes `'a'`, whereas `'b'` remains `'b'` and so on.

b. Extend Task1(a) such that your code now prints the received characters on the Terminal over UART as well as on the LCD.

- The first row of the LCD should be used to immediately print the received characters without waiting for a return key (`'\r'`) or a next line character (`'\n'`).
- The second row of the LCD should be used to print all the characters received so far (since last `'\r'` or `'\n'`) converted to lower caps.
- It should still *always* blink an LED at a constant frequency of 1Hz with 50% duty cycle.

c. Extend Task1(b) such that now you can choose to print the received characters either on UART or on LCD based on a push switch.

- Upon startup, the characters are printed on Terminal over UART.
- A button push toggles the printing between LCD and UART. Notice that a single button push must only toggle the printing mode once.
- It should still *always* blink an LED at a constant frequency of 1Hz with 50% duty cycle.

2. [40 points]: Write a 4-digit PIN based User Authentication program for your AVR. The detailed description of this program is as follows.

- **Setup Phase:** Upon startup, the system prints a message over UART asking the user to setup a new 4-digit PIN code. The user enters the PIN by typing it in the Terminal. Once the PIN is received, it is saved for future use.
- **Login:** Once the PIN is setup, if a push switch `SW1` is pushed then the system asks the user over UART to enter the PIN code in order to 'Login'. If this PIN matches the previously stored PIN, an LED starts blinking at constant 1Hz frequency indicating that the user is logged in. As long as the user is logged in, any further pushes to `SW1` switch should have no effect.
- **Logout:** If the user is currently logged in and a push switch `SW2` is pushed, the blinking LED should turn OFF indicating that the user is logged out.

Notice that the system will go through the Setup Phase everytime the AVR is turned on from powered off state.

Hint: Both `SW1` and `SW2` can be programmed without debouncing. Also the UART can be programmed using `fscanf` and `fprintf` functions.

Bonus Question: Explain why the two push switches can be used without debouncing and why UART can be programmed with blocking functions (`fscanf` and `fprintf`).

Initials:

End of Quiz

Please double check that you wrote your name on the front of the quiz.

Initials: