Department of Electrical and Computing Engineering

UNIVERSITY OF CONNECTICUT

ECE 3411 Microprocessor Application Lab: Spring 2018

Lab Test 5

There are 1 set of problem in this test. There are 3 pages in this booklet. Answer each question according to the instructions given.

You have **180 minutes** to answer the questions. Once you are done, you need to show the output to the Instructor or TA and upload in Husky CT "Lab Test 5". Upload option in the Husky CT will be unavailable after 180 Minutes.

Answer questions sequentially to complete the tasks easily — 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 DEVICESOFF.

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

a(x/40)	b(x/30)	c(x/30)	Total 100(xx/100)

Name:

Student ID:

Q1. [100 points] Write a **task-based C program** for ATmega328P XPlained mini kit and demonstrate its performance that it shows the following functions:

a. [40 points] Set up the ADC based temperature sensor (MCP9700) and I2C based temperature sensor (TC740A) to sense the ambient temperature. Use photo sensor (PDV-P9001) to sense the brightness.
UART will display the option for selecting menu in set up mode and display the measurements to the UART console in execution mode.
PWM and SPI peripherals will be used as outputs.

(i) Use external switch (SW1) connected to the interrupt (INT1) for entering to the set-up mode. Once the SW1 is pressed UART console will go to set up mode to display the selection options.

(ii) In execution mode, UART will display the readings in the following format "T1(C)=23.18, T2(C)=23.28, B=5". Here, T1 is temperature from ADC, T2 is temperature from I2C and B is brightness level from photosensor. Brightness level will be determined by the following notes.
Note: If photo-sensor gives 0V, then bright level =0; if it gives 0.5V, bright level =1; if 1V, bright level =2;…….. if 5V, bright level =10.

(iii) In set up mode, UART will ask for the peripherals to be output. The display will show "Which input you want as PWM output. After entering that option, display will show "Which input you want as SPI output?". You need to enter T1, T2 or B to select output options.

Input options	Output options
T1 (ADC based temperature)	SPI (LED connected)
T2 (I2C based temperature)	PWM (LED connected)
B (ADC based photosensor)	

(iii) Once the options are selected, your system will go to execution mode. In execution mode, you will use SPI and PWM.

b. [30 points] Use SPI to control the glow of LED.
(i) Use SPI based DAC (MCP4921). Connect a LED and a resistor to the output of the DAC to control the glow of LED.
(ii) If option B is selected for SPI, you need to control the glow of LED in the range of level 0 to 10. If level is 0, the LED will be completely off or emit minimum light. If level is 10, then LED will glow with maximum brightness.

(iii) If either option T1 or T2 is selected for SPI, you need to control the LED glow by converting temperature to the SPI output using following formula.

$$V_{out\,spI} = \frac{T - 15}{20} \times 5$$

Where, T is the temperature reading.

c. [30 points] Modulate the selected input, using a 1kHz PWM signal connected to one of the pins of PORT D.
(i) Set up 1kHz PWM signal to be output in one of the pins of PORT D. Keep the LED connected to that pin also.

(ii) If option B is selected for PWM, duty of the PWM will be based on the brightness levels with limit of 5 to 95%. i.e. if level is 5, then duty is 50%.

(iii) If either option T1 or T2 is selected for PWM, duty of the PWM will be based on the following formula with limit of 5 to 95%.

$$Duty(\%) = \frac{T - 15}{20} \times 100$$