ECE383 Sample questions for Exam #2

The exam will focus on material from lecture 5 through lecture 8. Knowledge from earlier lectures (1-4) may be required, but will not be the focus of the exam questions.

1. Refer to the PIC24 system diagram given below.

![PIC24 System Diagram](image)

   a) What is the purpose of the MCLR# pin?
   b) What is the purpose of the 910 \( \Omega \) resistor labeled as R1?
   c) What is the purpose of the .1 \( \mu F \) capacitor labeled as C2?
   d) Assuming the voltage drop across the L1 LED is 2 volts, what is the current flowing through resistor R1 when the LED is on.

2. Give possible values for the WDTPRE and WDTPOST fields to enable a watchdog timer (WDT) reset of approximately 1 second for the PIC24 processor. Assume the WDT is clocked using a 32.768kHz oscillator. Use attached sheets describing the WDT operation as needed.

3. What is the difference between the PIC24 SLEEP and IDLE modes of operation?

4. What are the differences between the CNx interrupts and the external interrupts (INT0, INT1 and INT2)?

5. What are the differences, and similarities, between LATx and PORTx?

6. What is the purpose of weak internal pullup and open drain output capabilities on the PIC24 processor?
7. What is the purpose of the $\text{MCLR#}$ pin on the PIC24 processor?

8. Assume the following circuit is used in a PIC24 system.

![Circuit Diagram]

a) Write an inline macro named \texttt{CONFIG\_SW1()} that, when used, would correctly configure RB12 as a digital input as shown.

b) Write an inline macro named \texttt{CONFIG\_LED1()} that, when used, would correctly configure RB13 as a digital output as shown.

c) Write an inline macro named \texttt{CONFIG\_LED2()} that, when used, would correctly configure RB14 as a digital output as shown.

d) What is the purpose of the two resistors in series with LED1 and LED2?

e) Write a C program that would use the macros defined above and would alternate lighting LED1 and LED2 every time SW1 is pressed.

9. Write an interrupt service routine that would use the hardware in problem 8 and would sample SW1 every 20 ms.
10. Write a program that uses Timer2 to generate a square wave output on pin RB13 with a period of 10 ms.

11. An I²C device has a device specific address of 0b1011. Show a diagram similar to slide 8-4 from the lectures that would allow the device to have a peripheral address of 0b1011110 in a PIC24 system. Show all connections between the I²C device and the PIC24 processor.

12. Show the timing diagram corresponding to the PIC24 performing a write1I2C1() operation to the device in problem 11. The data byte to write has the value 0xAA.

13. What is the C keyword **volatile** used for in the PIC24 code discussed in class?

14. Write a complete C main() function and corresponding ISR that would detect a falling edge transition on pin RB13. The falling edge transition should cause an INT1 interrupt. The ISR should set a semaphore (named **PIN_CHANGE**) when the transition occurs. The main() routine should monitor the semaphore and toggle an LED attached to RB15 whenever the falling edge occurs. The main() routine is also responsible for performing all necessary PIC24 configuration and for clearing the semaphore when the LED is toggled. The ISR should only set the semaphore if it has been previously cleared by the main() routine.

15. Assume a PIC24 system has a 10-bit successive approximation analog-to-digital converter (ADC) with Vref=3.3 volts.

   a. How many clock cycles does the PIC24 take to convert an analog voltage to a digital value?
   b. Assuming Vin=2.50 volts, show the operation of the ADC for each bit of the digital value produced. Show your work similar to that given in lecture slide 7-10.