

ECE 376 - Homework #3

Binary Inputs, Outputs, and Timing. Due Monday, January 31st

Please make the subject "ECE 376 HW#3" if submitting homework electronically to Jacob_Glower@yahoo.com (or on blackboard)

Solder your PIC board (50pt)

Demonstrate that your PIC board works

- In person, video, demo during Zoom office hours
- 50pt: Board your built powers up & you're able to download code
- 25pt: Board soldered but not working (swap for a working board)
- note: If your board doesn't work, we have working boards we can swap with you

Assembler Coding

1) Determine the content of the W register and memory locations A and B after each operation:

Command	W	A	B
<code>; Start</code>	7	8	9
<code>addwf B,F</code>			
<code>incf A,W</code>			
<code>subwf A,F</code>			
<code>sublw 9</code>			
<code>movlw 3</code>			
<code>andwf A,F</code>			
<code>iorwf B,W</code>			

Binary Inputs

Assume the resistance - voltage relationship for a thermistor is (T is temperature in Celsius)

$$R = 1000 \cdot \exp\left(\frac{3905}{T+273} - \frac{3905}{298}\right) \Omega$$

2) Design a circuit that output

- 0V for temperatures less than 35C
- 5V for temperatures more than 35C

3) Design a circuit with hysteresis that outputs

- 0V when the temperature is less than 35C
- 5V when the temperature is more than 40C
- No change (0V or 5V) for temperatures inbetween 35C and 40C

Binary Outputs

4) Design a circuit which allows your PIC board to turn on and off an RGB Piranha LED at 0mA (off) and 20mA (on). Assume the specifications for the LEDs are:

Color	Vf @ 20mA	mcd @ 20mA
red	2.0V	10,000
green	3.2V	10,000
blue	3.2V	10,000

5) Design a circuit which allows your PIC board to turn on and off a 1W LED. The specs for the LED are:

- Vf = 3.2 - 3.6V
- Current = 350mA
- 100 Lumens (equivalent to a 10W light bulb).

<https://www.ebay.com/itm/1W-3W-5W-10W-50W-100W-High-power-SMD-Chip-LED-COB-White-Blue-Red-Light-Beads/124011607823>

Timing:

6) Write a program which outputs the music note D3# (155.56 Hz)

- Verify the frequency of the square wave you generate
- (Pano Tuner app on you cell phone works well for this)

Lab:

Problem 7-10) Design an embedded system with your PIC board which includes some timing. Some suggestions are

- Binary Clock: Have the PIC count 0..10 at a rate of once per second on PORTD. When PORTD reaches 10, it clears and PORTC increments.
- Electronic Dice: Generate random numbers based upon which button is pressed
 - RB0: 4 sided die (numbers 1..4)
 - RB1: 6 sided die (numbers 1..6)
 - RB2: 10 sided die (numbers 1..10)
 - Beep for 1 second at 220Hz each time a new number is generated
- Electronic Piano: Play notes B4 - B5 when you press buttons RB0 .. RB7
- Strobe Light: Generate a strobe light on RC0. The light should be
 - On for 1ms then Off for 99ms
 - repeat
- Other

7) Requirements: Specify

- The inputs
- The outputs
- How they relate (what your program does)

8) Analysis, Code, and Flow Chart. Give computations for resistor values (if any), timing, assembler code, and a flow chart for your code

9) Validation: Collect data in the lab to verify your code works.

- For a binary clock, is it counting once per second?
- For the dice, are the results random? Is the beep 220Hz? Is it 1 second?
- For the piano, is each note correct in frequency?

10) Demonstration: Demonstrate that your embedded system works (either in person or with a video)