ECE 376 - Homework #3

Binary Inputs, Binary Outputs, & LEDs - Due Monday, September 16th

Solder your PIC board (50pt)

Demonstrate that your PIC board works

- In person, video, de1mo 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

Binary Inputs

Assume a thermistor has a resistance-temperature relationship of

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

1) Design a circuit which outputs

- 0V when T < 40C
- 5V when T > 40C

2) Design a circuit which outputs

- 0V when T < 40C
- 5V when T > 45C

3) Design a circuit which outputs

- 0V when 40C < T < 45C
- 5V otherwise

Binary Outputs

4) Design a circuit which allows your PIC board to turn on and off an RGB Piranah LED at 0mA (off) and 15mA (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 5W LED at 500mA. The specs for the LED are:

- Vf = 6.0-7.0V
- Current = 700mA
- 500-600 Lumens (equivalent to a 60W 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

Assume you have a 6144 NPN transistor:

- max continuous current = 3A
- current gain = 300
- Vbe = 0.7V, Vce(sat) = 0.2V

Timing:

6) Write a program which outputs the music note G#3 (207.652 Hz)

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

Lab: Lights-Out Game

7) Give the flow chart for a program to turn your PIC board into *Lights-Out* game

- On power up, PORTC = 0xFF and PORTD = 0x00
- When you press and release a button, the corresponding pin on PORTC and its neighbors are toggeled
  - RB0: Toggle pins RC0, RC1
  - RB1: Toggle pins RC0, RC1, RC2
  - etc.
- Each time you press and release a button, PORTD increments by one

The goal of the game is to turn off all of the lights on PORTC in the minimum number of moves

8) Write the corresponding assembler code

9) Test your code.

- Compile and program your PIC board
- Verify each button's operation

10) (20 points) Demonstration

- In-person of with a video