ECE 376 - Homework #3

Binary Inputs, Binary Outputs, and Timing. Due Monday, September 15th

Solder your PIC board (50pt)

Demonstrate that your PIC board works

- In person, video, de1mo during Zoom office hours
- 50pt: Board you built powers up & you're able to download code
- 25pt: Board you built is 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. You'll need a working board for the rest of the course.

Binary Inputs

A thermistor has the following temperature - resistance relationship:

$$R = 1000 \exp\left(\frac{3905}{T+273} - \frac{3905}{278}\right)\ \Omega$$

where T is the temperature in degrees C.

1) Design a circuit which outputs
   - 0V when T < 5C
   - 5V when T > 5C

2) Design a circuit which outputs
   - 0V when T < 0C
   - 5V when T > 5C
   - No change for 0C < T < 5C

Binary Outputs

3) Design a circuit which allows your PIC board to turn on and off an RGB Piranah 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

1W Star LED

4) The star LED in your lab kit is a 1W white LED with a 6.8 Ohm resistor attached.

- Vf = 3.0V @ 330mA
- 200LM @ 330mA

a) Set up the following circuit so your PIC board can turn the LED on/off

- The 200 Ohm resistor limits the current (200 to 1k works)

b) Compute the

- Current to the LED
- The brightness of the LED

c) Build this circuit and measure

- Id (hint: measure Vr and compute the current)
- Vf (the voltage drop across the LED)

5) Use a 6144 NPN transistor as an electronic switch to turn on and off the LED (and amplify current).

- Ic(max) = 3A (Ib(max) = 25mA - the max output of a PIC)
- hfe (β) > 200

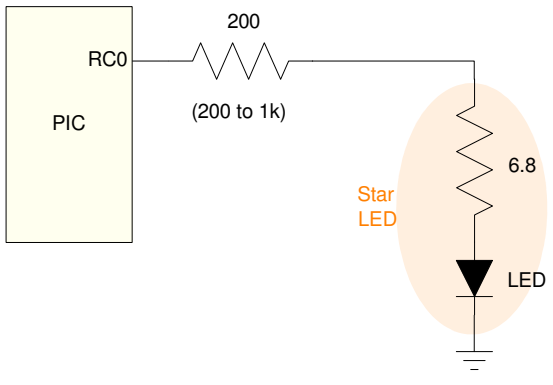
a) Set up the following circuit so that your PIC board can turn on and off the LED

b) Compute

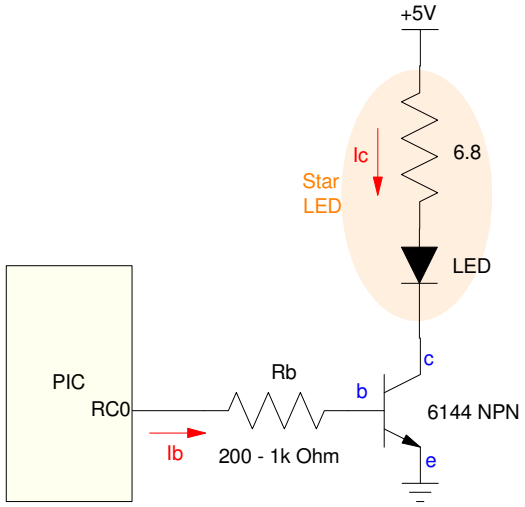
- The currents Ib and Ic and
- The brightness of the LED

c) Build this circuit and measure

- Id (hint: measure the voltage across the 6.8 Ohm resistor on the LED)
- Vf (the voltage drop across the LED)



Problem #4



Problem #5

Timing:

6) Write a program which outputs the music note G2 (98.00 Hz)
   - Verify the frequency of the square wave you generate
   - (Pano Tuner app on you cell phone works well for this)

4-Key Piano:

Design an embedded system to play four notes:

- Inputs: Buttons on RB0 / RB1 / RB2 / RB3
- Outputs: RC0
- Relationship: Output a square wave on RC0 based upon the button pressed:
  - RB0 F#3 185.00 Hz
  - RB1 G#3 207.65 Hz
  - RB2 A#3 223.08 Hz
  - RB3 C#4 277.18 Hz

7) Give a flow chart for your program

8) Give an assembler program for the 4-key piano.
   - Include computations for the wait loops

9) Validation: Collect data in the lab to verify your code works.
   - Are the frequencies correct?

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