ECE 376 - Test #2: Name ____________________

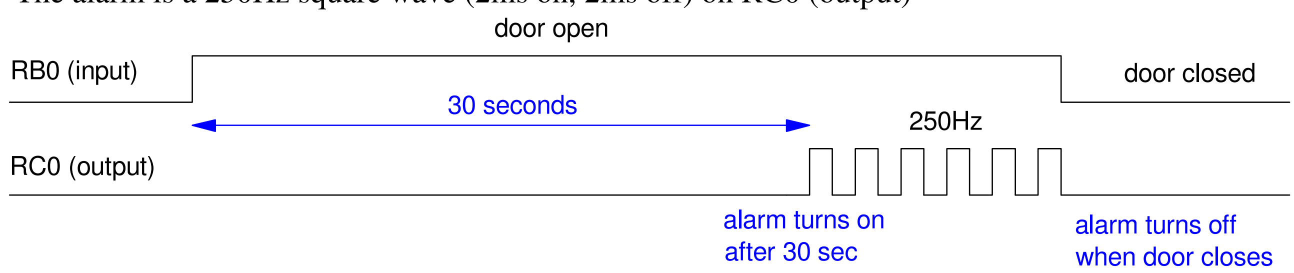
C-Programming on a PIC Processor

Open book, open notes. Calculators and Matlab permitted. Individual effort (help from other people or web sites where other people help you solve the problems not permitted).

1) C Coding & Flow Charts (25 points)

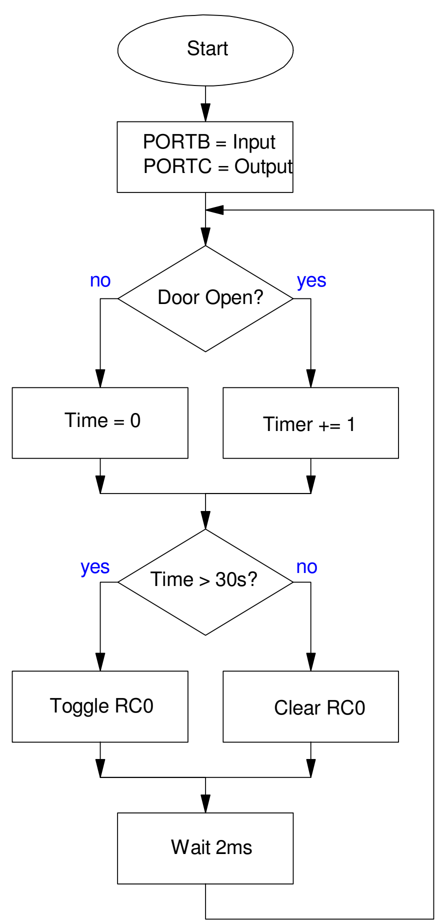
Write a C program for door alarm:

- RB0 is connected to a door (0V = closed, 5V = open)
- If the door is left open for 30 seconds, an alarm goes off
- Once the door is closed, the alarm turns off
- The alarm is a 250Hz square wave (2ms on, 2ms off) on RC0 (output)




```
void main(void) {

   ADCON1 = 0x0F;
```



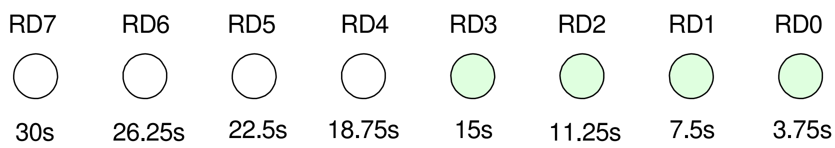
2) Subroutines: (25 points)

Assume TIME is a counter which is incremented every 2ms

- TIME goes from 0 (0 seconds) to 15,000 (30 seconds)

Write a C subroutine to display TIME as an 8-bit bar graph on PORTD.

- TIME is passed to the subroutine (0 to 15,000 corresponding to 0-30 seconds)
- Each LED represents 3.75 seconds (30 seconds / 8)
- Each 3.75 seconds, another LED lights up until all 8 LEDs are lit up at 30 seconds

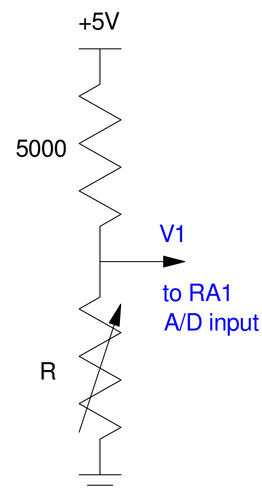



```
void BarGraph(unsigned int TIME) {
```

3) Analog Inputs (25 points)

Assume the A/D input to a PIC processor has the following hardware connection where R is a 3k thermistor where T is the temperature in degrees C

$$R = 3000 \cdot \exp\left(\frac{4000}{T+273} - \frac{4000}{298}\right)\Omega$$



Let T be your birth date (1..31) in degrees C

T = your birth date (degrees C)

At this temperature, determine

- The resistance, R,
- The voltage, V1,
- The A/D reading, and
- The smallest change in termperature you can detect

T (degees C) birth date (1..31)	R Ohms	V1 Volts	A/D Reading 0 .. 1023	Smallest change in T you can detect

4) chi-squared test (10 points)

If each NFL football game is a coin toss (50/50 chance of any team winning), the pdf for the number of wins a given team has after 16 games should be a binomial distribution (pdf for flipping a coin 16 times).

Use a chi-squared test to determine if the you can reject the hypothesis that NFL games are random using the number of wins each team had at the end of the 2018, 2019, and 2021 NFL season.

# Wins wins after 16 games	p binomial distribution	np expected results	N actual results	Chi-Squared
0-2	0.0021	0.20	1	
3-5	0.1030	9.88	21	
6-7	0.2968	28.49	22	
8-10	0.4931	47.34	30	
11-13	0.1030	9.88	21	
14-16	0.0021	0.20	1	

Chi-Squared Table

Probability of rejecting the null hypothesis

dof	99%	95%	90%	80%	60%	40%	20%	10%	5%	1%
1	6.64	3.84	2.71	1.65	0.71	0.28	0.06	0.02	0	0
2	9.21	5.99	4.61	3.22	1.83	1.02	0.45	0.21	0.05	0.01
3	11.35	7.82	6.25	4.64	2.95	1.87	1.01	0.58	0.22	0.07
4	13.28	9.49	7.78	5.99	4.05	2.75	1.65	1.06	0.48	0.21
5	15.09	11.07	9.24	7.29	5.13	3.66	2.34	1.61	0.83	0.41
6	16.81	12.59	10.64	8.55	6.21	4.57	3.07	2.20	1.63	0.87
7	18.47	14.06	12.02	9.80	7.28	5.49	3.82	2.83	2.17	1.24

5) t-Tests (15 points)

The number of points the Vikings have scored over the past six weeks are:

- Points Scored by Vikings: {23, 24, 28, 28, 29, 24}
- Mean = 26.00
- Standard Deviation = 2.61

a) What is the chance that the Vikings will score more than 30 points their next game?

b) How many points can the defense give up if the Vikings are to have a 95% chance of winning?

Student t-Table area of tail										
dof \ p	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
1	1	1.38	1.96	3.08	6.31	12.71	31.82	63.66	318.31	636.62
2	0.82	1.06	1.39	1.89	2.92	4.3	6.97	9.93	22.33	31.6
3	0.77	0.98	1.25	1.64	2.35	3.18	4.54	5.84	10.22	12.92
4	0.74	0.94	1.19	1.53	2.13	2.78	3.75	4.6	7.17	8.61
5	0.73	0.92	1.16	1.48	2.02	2.57	3.37	4.03	5.89	6.87
6	0.72	0.91	1.13	1.44	1.94	2.45	3.14	3.71	5.21	5.96
7	0.71	0.90	1.12	1.41	1.89	2.36	3.00	3.50	4.78	5.41
infinity	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.29