ECE 376 - Test #2: Name _____

C-Programming on a PIC Processor

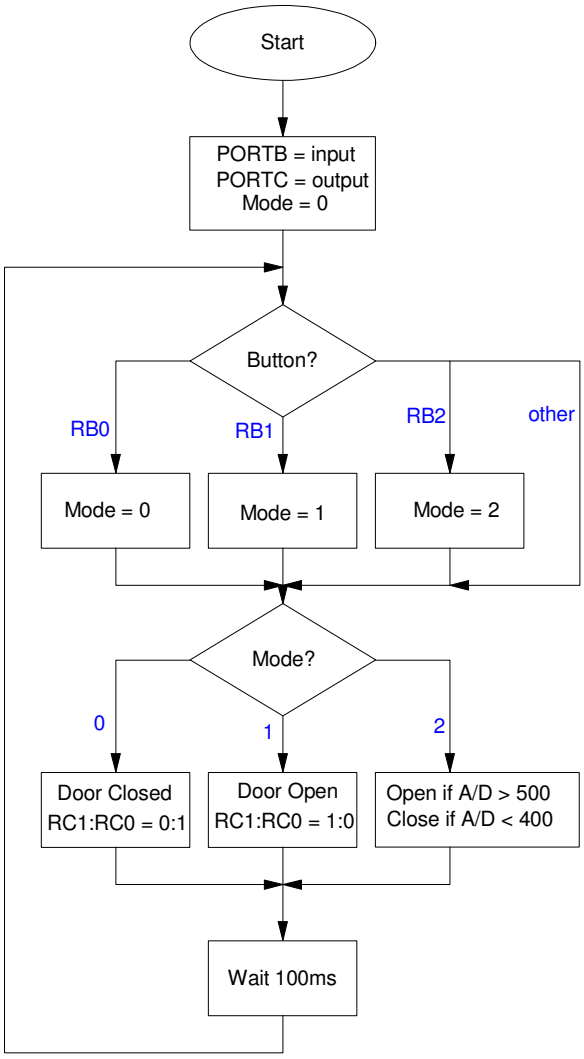
Open book, open notes. Calculators and Matlab permitted. Individual effort (help from other people or web sites where other people help you solve the problems not permitted).

1) C Coding & Flow Charts (25 points)

Write a C program to control a window for a green house. Assume

- Three buttons are connected to RB2:RB1:RB0
- A temperature sensor is connected to RA0, and
- A motor is connected to RC1:RC0
  - RC1:RC0 = 1:0 = open
  - RC1:RC0 = 0:1 = close

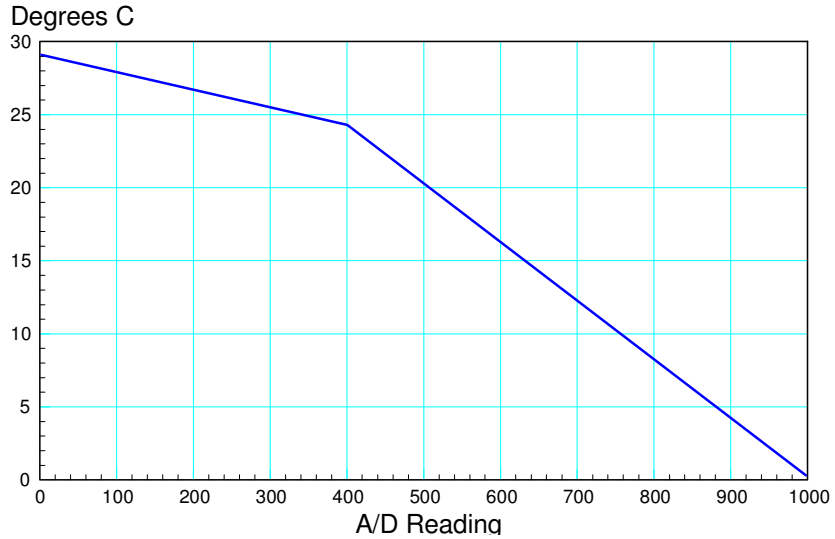
```
void main(void) {

   unsigned char Mode;
   Init_A2D();  // A=analog, B/C/D = binary
```



2) Subroutines: (25 points)

Assume the relationship between the A/D reading and the actual temperature is as follows. Write a C subroutine which is

- Passes the raw A/D reading (0..1023),
- Returns the temperature in degrees C, and
- Takes into account the bend in the curve when the A/D reading is 400

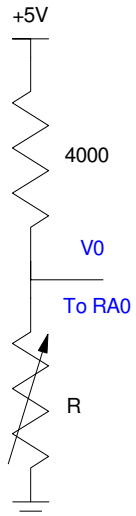



```
float Problem2(unsigned int A2D) {
```

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

$$R = 5000 \cdot \exp\left(\frac{3200}{T+273} - \frac{3200}{298}\right)\Omega$$



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

At this temperature, determine

- The resistance, R,
- The voltage, V0,
- The A/D reading, and
- The smallest change in termperature you can detect

T (degees C) birth date (1..31)	R Ohms	V0 Volts	A/D Reading 0 .. 1023	Smallest change in T you can detect

4) chi-squared test (10 points)

It's conjectured that numbers, such as stock prices, have a logarithmic distribution (it's more likely that a stock price is in the range of 10..19 than 90..99). To test this, the frequency of the first digit of 100 random stocks were recorded. Determine using a chi-square test if the data fits a log distribution.

1st Digit of Stock Price	p log distribution	np expected results: log pdf	N actual results	Chi-Squared
1	0.3155	31.55	27	
2-3	0.3155	31.55	45	
4-5	0.1845	18.45	12	
6-7	0.1309	13.09	15	
8-9	0.1016	10.16	1	
			Total	

Chi-Squared Table

Probability of rejecting the null hypothesis

dof	99.9%	99%	95%	90%	80%	60%	40%	20%	10%	5%	1%
1	10.81	6.64	3.84	2.71	1.65	0.71	0.28	0.06	0.02	0	0
2	13.81	9.21	5.99	4.61	3.22	1.83	1.02	0.45	0.21	0.05	0.01
3	16.25	11.35	7.82	6.25	4.64	2.95	1.87	1.01	0.58	0.22	0.07
4	18.46	13.28	9.49	7.78	5.99	4.05	2.75	1.65	1.06	0.48	0.21
5	20.50	15.09	11.07	9.24	7.29	5.13	3.66	2.34	1.61	0.83	0.41
6	22.43	16.81	12.59	10.64	8.55	6.21	4.57	3.07	2.20	1.63	0.87
7	24.31	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 value of five 100nF capacitors were recorded:

- Data = {104.0nF, 94.19nF, 104.1nF, 104.7nF, 105.2nF}
- mean = 102.439nF
- st dev = 4.6362nF

a) Use a student-t test to determine the probability that a random 100nF capacitor has a value less than 90nF

b) Use a student t-test to determine the 99% confidence interval for the value of a random capacitor.

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