

United States Naval Academy

Electrical Engineering Department

EE361 Test 1

18 September 2008

1. Do a page check now. You should have one title page and seven pages of problems, totalling 8 pages in all. *Please do not remove staples from the examination booklet.*
2. *Do not discuss the test with anyone* until it has been graded and returned to you in class.
3. Show all work to receive maximum partial credit.
4. Work neatly and strive for clarity. Unclear answers earn little credit (if any).
5. You may use any calculator you have brought with you. You may not borrow a calculator from anyone during the exam. Although you may also use the computer at your seat and make use of the MPLAB program if it seems helpful, you may *not* make use of e-mail, chat, instant messenger, or any other program or device allowing one-way or two-way communications with other people, whether classmates or not.
6. If you make any assumptions necessary to proceeding, state them clearly.
7. Each problem is worth the following points:

Problem	Points	Score	Problem	Points	Score
1	4		4	16	
2	8		5	20	
3	8		Total:	56	

8. You have 1 hour 50 minutes to complete the test.
9. Upon the command of your instructor, you may commence work.
10. If you finish early, you may leave early. See point 2 above.

Good Luck!

Name: _____
Section: _____
Date: 18 September 2008

3. (8 pts) Consider a PIC16F884 instruction consisting of the hexadecimal code 344E.

(a) (4 pts) What is the instruction and exactly what does it do? Answer thoroughly.

(b) (4 pts) How long does the instruction take to execute on a machine if the oscillator frequency is $f_{OSC} = 500$ kHz?

4. (16 pts) Consider the binary string 1101 0101 0111 0000.
- (a) (4 pts) What is its meaning in decimal when it is interpreted as an unsigned binary number?
- (b) (4 pts) What is its meaning in decimal when it is interpreted as being a binary number in two's-complement format?

(c) (4 pts) What is its meaning in decimal when it is interpreted as a signed binary number (not a two's-complement binary number)?

(d) (4 pts) What is its meaning in decimal when it is interpreted as an unsigned binary number with 6 fractional bits, that is, 11 0101 0101.1100 00?

Listing 2: Listing for Problem 20

```
1 xinit equ D'365 '  
2 x equ D'320 ' ; A memory location for x  
3 yinit equ D'147 '  
4 y equ D'487 ' ; A memory location for y  
5 zz equ D'488 ' ; A memory location for z  
6 STATUS_Init equ B'01000000 '  
7 STATUS_Mask equ B'11100000 '  
8 movlw ~STATUS_Mask  
9 andwf STATUS,F  
10 movlw STATUS_Init  
11 iorwf STATUS,F  
12 movlw x  
13 movwf FSR  
14 movlw xinit  
15 movwf INDF  
16 incf FSR,F  
17 addlw yinit  
18 movwf zz
```

5. (20 pts) Consider the PIC16F884 program fragment in Listing 2, which contains errors and also lacks enough comments to make it easy to understand. Assume that all symbols defined in the file `p16f884.inc` file are already available.

(a) (8 pts) Use hexadecimal to express

- i. (4 pts) the address to which the contents of the W register are actually written by the instruction in line 15 and

- ii. (4 pts) the address to which the result in line 18 is actually written.
- (b) (4 pts) What are the values of the Z, DC, and C bits after line 17 has completed executing? Explain.
- (c) (8 pts) In a processor with an oscillator frequency $f_{\text{OSC}} = 10 \text{ MHz}$, how long does it take to execute this program fragment? Give your answer in microseconds with precision to the nearest $0.010 \mu\text{s}$.

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