

# 16.317: Microprocessor Systems Design I

Fall 2016

## Homework 9

Due **2:30 PM, Friday, 12/9/16**

### Notes:

- While typed submissions are preferred, handwritten submissions are acceptable.
- All solutions must be legible and contained in one file. Archive files are not acceptable.
- Electronic submissions should be e-mailed to Dr. Geiger at [Michael\\_Geiger@uml.edu](mailto:Michael_Geiger@uml.edu). Please include your name as part of your filename (for example, mgeiger\_hw9.pdf).
- This assignment is worth a total of 100 points.

1. (40 points) You are given the following function containing a delay loop:

```
Ten_1
    decfsz    COUNTL,F          ; Inner loop
    goto     Ten_1
    decfsz    COUNTH,F          ; Outer loop
    goto     Ten_1
    return
```

- a. (20 points) If COUNTL is initially 100, COUNTH is initially 10, the clock frequency is 500 kHz, and each instruction takes 4 clock cycles, how long does the whole delay loop take? You must show your work for full credit.
- b. (20 points) What are the maximum and minimum possible delays this function can generate? What initial values would COUNTL and COUNTH have in each case?

2. (40 points) You are given the following short PIC16F1829 assembly function:

```
F: movf    PORTC, W
   andlw   B'00000001'
   addwf   PCL, F
   retlw   B'11110000'
   retlw   B'00111100'
   retlw   B'00001111'
   retlw   B'11111111'
```

- a. (20 points) How many possible return values does this function have? Give an example of a value stored in PORTC that would cause the function to return each of those possible values.
- b. (10 points) Is it possible for the function to execute each of the 4 `retlw` instructions? If so, explain how, and if not, explain how you would modify the function to make each of those four instructions reachable.
- c. (30 points) Explain what effect each of the following pieces of code would have on I/O port A. Assume you are using the original version of the function F, not your (potentially) modified version from part (b).
- i. `call F`  
`xorwf LATA, F`
- ii. `call F`  
`iorwf LATA, F`
- iii. `call F`  
`andwf LATA, F`