

# 16.317: Microprocessor Systems Design I

Fall 2013

## Lecture 31: Key Questions

December 2, 2013

1. Describe the operation of the given subroutine, which implements a 10 ms delay loop.

```
.*****  
;  
; TenMs subroutine and its call inserts a delay of exactly ten milliseconds  
; into the execution of code.  
; It assumes a 4 MHz crystal clock. One instruction cycle = 4 * Tosc.  
; TenMsH equ 13 ; Initial value of TenMs Subroutine's counter  
; TenMsL equ 250  
; COUNTH and COUNTL are two variables  
TenMs  
    nop ; one cycle  
    movlw TenMsH ; Initialize COUNT  
    movwf COUNTH  
    movlw TenMsL  
    movwf COUNTL  
Ten_1  
    decfsz COUNTL,F ; Inner loop  
    goto Ten_1  
    decfsz COUNTH,F ; Outer loop  
    goto Ten_1  
    return
```

2. Describe the operation of the given subroutine, which toggles a series of 3 LEDs in sequence, assuming those LEDs are attached to bits 0-2 of Port D.

**BlinkTable**

```
    movf    PORTD, W      ; Copy present state of LEDs into W
    andlw   B'00000111'   ; and keep only LED bits
    addwf   PCL,F         ; Change PC with PCLATH and offset in W
    retlw   B'00000001'   ; (000 -> 001) reinitialize to green
    retlw   B'00000011'   ; (001 -> 010) green to yellow
    retlw   B'00000110'   ; (010 -> 100) yellow to red
    retlw   B'00000010'   ; (011 -> 001) reinitialize to green
    retlw   B'00000101'   ; (100 -> 001) red to green
    retlw   B'00000100'   ; (101 -> 001) reinitialize to green
    retlw   B'00000111'   ; (110 -> 001) reinitialize to green
    retlw   B'00000110'   ; (111 -> 001) reinitialize to green
```

*In calling program*

```
    call    BlinkTable    ; get bits to change into W
    xorwf   PORTD, F      ; toggle them into PORTD
```

3. Explain the basic operation of stepper motors.

4. Explain how a microcontroller can be used to control a bipolar stepper motor.

5. Explain the key parts of the Lab 4 code shown below (initialization not shown).

```
Loop:                                ; Return Here for Next Value
    movlw    HIGH ((250000 / 5) + 256)
    movwf    Dlay
    movlw    LOW ((250000 / 5) + 256)
    addlw    -1                        ; 250 ms Delay
    btfsc    STATUS, Z
    decfsz   Dlay, f
    goto     $ - 3

    movf     i, w
    call     SwitchRead
    movwf    PORTC

    incf     i, f                      ; i = (i + 1) % 8;
    bcf      i, 3
    goto     Loop
```

```
SwitchRead:
    addwf    PCL, f                    ; Staying in First 256 Instructions
    dt      b'011100', b'010100', b'000100', b'100100'
    dt      b'100000', b'101000', b'111000', b'011000'
    end
```