16.317: Microprocessor Systems Design I

Fall 2014

Lecture 26: Key Questions
November 12, 2014

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 stepper motoro control 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
```