

# Union College

## ECE352

### Assignment 3

*Due Date: Tuesday April 29<sup>th</sup>*

#### Problem 1.

Write a sequence of instructions in assembler to convert a 5-bit number in A to its BCD (Binary Coded Decimal) equivalent, i.e., the result in A should have the first 4 bits as the tens and last 4 bits as the units (example: A=18d=00010010 (binary) = 0001 1000 (BCD) [Final result in A])

#### Problem 2.

Write an assembly program, by following steps a to e below, which will read the **eight (8)** values in code memory given at the location given my myvals (in the code segment given below), and compute the average. Be very careful to account for the size of the result of the additions. Also, because we have 8 values, **division should be avoided** to make the calculation faster. Put the result of your calculation in the register R7.

```
                $include (c8051F020.inc)
                cseg at 0
                ljmp Main

myvals:         cseg at 2000h
                db 23h,58h,04h,99h,Aeh,1Ch,D3h,86h

Main:          cseg at 100h
                mov  WDTCN, #0DEh
                mov  WDTCN, #0ADh
```

- Write an algorithm to implement the program.
- Draw box diagrams to indicate what memory and registers will be used.
- Translate your algorithm into 8051 assembler code.
- Implement your code on your development board and test.
- Briefly comment on how accurate your solution will be to this problem.

### Problem 3.

How long does the following software delay subroutine take? (Note that the answer will be a function of R0). (Hint: First calculate the number of cycles.)

```
delay:    mov R7, #02h ; delay a while
Loop1:   mov R6, #00h
Loop0:   mov R5, #00h
         djnz R5, $
         djnz R6, Loop0
         djnz R7, Loop1
         djnz R0, delay
         ret
```

- a) Assuming a 2MHz internal clock?
- b) Assuming a 22.1184MHz external oscillator?

### Problem 4.

We are going to use Timer 1 in interrupt mode to blink the LED on the development board.

- a). Assume that timer 1 is set up to be in 16-bit mode, and sysclock is set to be the internal 2MHz oscillator (NOT divided by 12). Write the instructions that would configure Timer 1 to these specifications and enable the interrupt.
- b) Below is the interrupt service routine (ISR) for blinking the light. Note the write to the Timer 1 register. Calculate the delay between toggles of the LED.

```
mr1_isr:
    cpl LED
    mov TH1, #80h ;reinitialize timer
    mov TL1, #0
    reti          ; no need to clear timer interrupt flag, it is reset by hardware
```

### Problem 5.

Revise the interrupt service routine (ISR) in problem 4 so that the delay between toggles is 1 ms.

### Problem 6.

Write a C function to solve Problem 1.

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