ECE 375 PRELAB 5

Lab Time: Friday 16:00 ~ 17:50

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QUESTIONS

1. For this lab, you will be asked to perform arithmetic operations on numbers that are larger than 8 bits. To be successful at this, you will need to understand and utilize many of the various arithmetic operations supported by the AVR 8-bit instruction set. List and describe all of the addition, subtraction, and multiplication instructions (i.e. ADC, SUBI, FMUL, etc.) available in AVR's 8-bit instruction set.

(a) Add

- ADC – Add with Carry
- ADD – Add without Carry
- ADIW – Add immediate to word

(b)Subtraction

- SBC – Subtract with carry
- SBCI – Subtract immediate with carry
- SBIW – Subtract immediate from word
- SUB – Subtract without carry
- SUBI – Subtract immediate

(c)Multiplication

- MUL – Multiply unsigned
- MULS – Multiply signed
- MULSU – Multiply signed with unsigned
- FMUL – Fractional multiply unsigned
- FMULS – Fractional multiply signed
- FMULSU – Fractional multiply signed with unsigned

2. Write pseudocode for an 8-bit AVR function that will take two 16-bit numbers (from data memory addresses $0111:$0110 and $0121:$0120), add them together, and then store the 16-bit result (in data memory addresses $0101:$0100). (Note: The syntax "$0111:$0110" is meant to specify that the function will expect little-endian data, where the highest byte of a multi-byte value is stored in the highest address of its range of addresses.)

```
LDI XH, $01
LDI XL, $10
LDI YH, $01
LDI YL, $20
LD r15, X+
LD r16, Y+
ADD r15, 16
STS $0100, r15
LDI r15, X
LDI r16, Y
ADC r15, r16
STS $0101, r15
```

3. Write pseudocode for an 8-bit AVR function that will take the 16-bit number in $0111:$0110, subtract it from the 16-bit number in $0121:$0120, and then store the 16-bit result into $0101:$0100.

```
LDI XH, $01
LDI XL, $10
LDI YH, $01
LDI YL, $20
LD r15, X+
LD r16, Y+
SUB r16, r15
STS $0100, r16
LDI r15, X
LDI r16, Y
SBC r16, r15
STS $0101, r16
```

REFERENCE

AVR Instruction Set Manual