মেট্রোপলিটন ইউনিভার্সিটি
Metropolitan University

Department of Computer Science and Engineering

Course Code: CSE238	Credits: 1.5
Course Name: Microprocessor & Interfacing Lab	Faculty: FRS

Lab 02

Introduction to Arithmetic Operations, Instruction: MUL, DIV

Activity Detail:

Discussion: Registers 16-bit storage for holding data temporarily during operations. Do not confuse with RAM. Registers can be divided into 4 types.

i. *Data Registers:* AX, BX, CX, DX These 4 registers are used to hold data for carrying out mathematical and logical operations. These 4 registers are byte accessible. This means each 16-bit register can be used as two separate8-bit registers. AX = AH and AL, same goes for others. These four registers also perform other special functions. AX = During multiplication and division, one of the numbers must be inside AX or AL. BX = Used as address registers. CX = used in loop. CX increases automatically by 1. DX = Used in multiplication/division and i/o operations.

ii. *Segment Registers:* CS, DS, SS, ES To understand the these registers we must understand what memory segments are. The 8086 is a 16-bit Microprocessor and contains a physical memory of 20 bits. Now to store a value of 10 bits the registers had to be of 20 bits each but they are not. To overcome this problem the whole memory is divided into a 3 segments data segment, stack segment and code segment. The segment registers will contain the address of the segments. Each segment register will be combined with index registers (16 bit) to form

a 20-bit storage to store memory locations. [Page 94 - Microprocessors & Interfacing].

iii. *Index and Pointer Registers:* SP, BP, SI, DI They contain the offset addresses mentioned in the previous section. There are restrictions of using a segment register and index registers.

SP used with SS
BP used with DS, SS
SI used with DS
DI used with DS.

iv. *Data Types:*

1. Numbers: Must specify the base of the number at the end. If not specified the numbers will be considered as decimal.
   For binary, add a 'b' at the end of the bit-string.
   e.g. 1110b
   For decimal, just type the number without any suffix or prefix. e.g. 1101
   For hexadecimal, start with a 0 and end with 'h'.
   e.g. A06 = invalid, 0A06h = valid
2. Characters: Enclosed by single quotes. For example, 'a'. The assembler converts every character into its ASCII value while storing
3. Strings: Array of character ends with a $ and enclosed by double quotes.
   e.g. "hjshj$"
4. Data types: DB = define byte, DW = define word
5. Variables: In java the syntax for defining a variable is,
   data_typevar_name; /= value;
   In assembly it is,
   var_name data_type value.
   e.g.: m db 4
   Variables are saved in the data segment of the memory.

v. *MUL:* Multiplication between 2 numbers. You must be very careful while carrying out multiplication. This is because two n bit numbers will result a 2n bit number. Therefore, multiplication is divided into 2 branches. Byte multiplication where the operands are 8-bit numbers and word multiplication where the numbers are 16-bit numbers. For Byte multiplication one number is contained in the source and the other number has to be in AL. The result is saved in AX. The source can be a register or a memory location but not a constant.

Example: MUL BL

The 8-bit number is AL is multiplied by the 8-bit number in BL. The result is in AX.

For word multiplication one number is contained in the source and the other number has to be in AX. The result will be a 32-bit number. The higher 16 bits will be in DX and the lower 16-bit will be in AX. The source can be a register or a memory location but not a constant.

vi. *DIV:* When division is performed there are 2 results- quotient and remainder. Division is also divided into byte and word form.
In the byte form the divisor is an 8 bit register or memory location. The dividend is 16 bit and it must be in AX. After division the 8-bitquotient is in AL and the 8-bit remainder is in AH. The divisor can't be a constant.

Example: DIV BL

The 16-bit number is AX is divided by the 8-bit number in BL. The quotient is in AL and the 8-bit remainder is in AH.

In the word form, the divisor is a 16-bit register or memory location. The dividend is 32 bit and it must be in DX:AX. After division the 16-bit quotient is in AX and the 16-bit remainder is in DX. The divisor can't be a constant.

Problem Solving

Task 01

Perform the following arithmetic operations:

1. X * Y
2. X / Y
3. X * Y / Z

Task 02

Perform the following arithmetic operations:

(A + B) * (C - D) / E

Task 03

Perform the following arithmetic operation:

(1 + 2) * (3 – 1) / 5 + 3 + 2 – (1 * 2)

Code Template

```
.MODEL SMALL

.STACK 100H

.DATA


.CODE
MAIN PROC

;iniitialize DS

MOV AX,@DATA
MOV DS,AX

;enter your code here









;exit to DOS

MOV AX,4C00H
INT 21H

MAIN ENDP
END MAIN
```