Computer Organization and Architecture (EET2211)

LAB IV: Product and Division of Two Numbers without using Arithmetic Instructions

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I. OBJECTIVE:

1. Multiply two 16 bit numbers without using arithmetic instructions.
2. Divide two 16 bit numbers without using arithmetic instructions.

II. PRE-LAB

For Obj. 1:

a) **Find the product and quotients of two 16 bit numbers.**

Let the two 16bit numbers be 32(0020h) and 8(03h). Their product is 256 (0100h) and quotient is 3.

b) **Write the assembly code.**

```
org 100h
mov ax, 0000h
mov ds, ax
mov ax,[3000h]
mov cl, 02h
sal ax, cl
mov [3002h], ax
hlt
ret
```

For Obj. 2:

a) **Find the quotient and remainder obtained from division of two 16 bit numbers.**

Let two number be 200(00c8h) and 4(0004h). Quotient is 50 (00032h) and remainder is 0.

b) **Write the assembly code.**

```
org 100h
```

```
        mov ax, 0000h

        mov ds, ax

        mov ax,[3000h]

        mov cl,02h

        shr ax,cl

        mov [3002h], ax

        hlt

        ret
```

III. LAB:

Assembly Program:

For Obj. 1:

```
; SASWAT MOHANTY
; 1941012407

; Multiply two 16 bit numbers without using arithmetic
instructions.

org 100h

mov ax, 0000h
mov ds, ax
mov ax,[3000h]      ; Value stored at 3000 = 0030
                    ; Binary of 0030 = 0000 0000 0011 0000
mov cl, 02h         ; We have to perform 2 left shift
                    ; After 1st shift -> 0000 0000 0110 0000 = 0060
                    ; After 2nd shift -> 0000 0000 1100 0000 = 00C0
sal ax, cl          ; Output value = 00C0
mov [3002h], ax     ; Value at 3002 = 00C0
hlt

ret
```
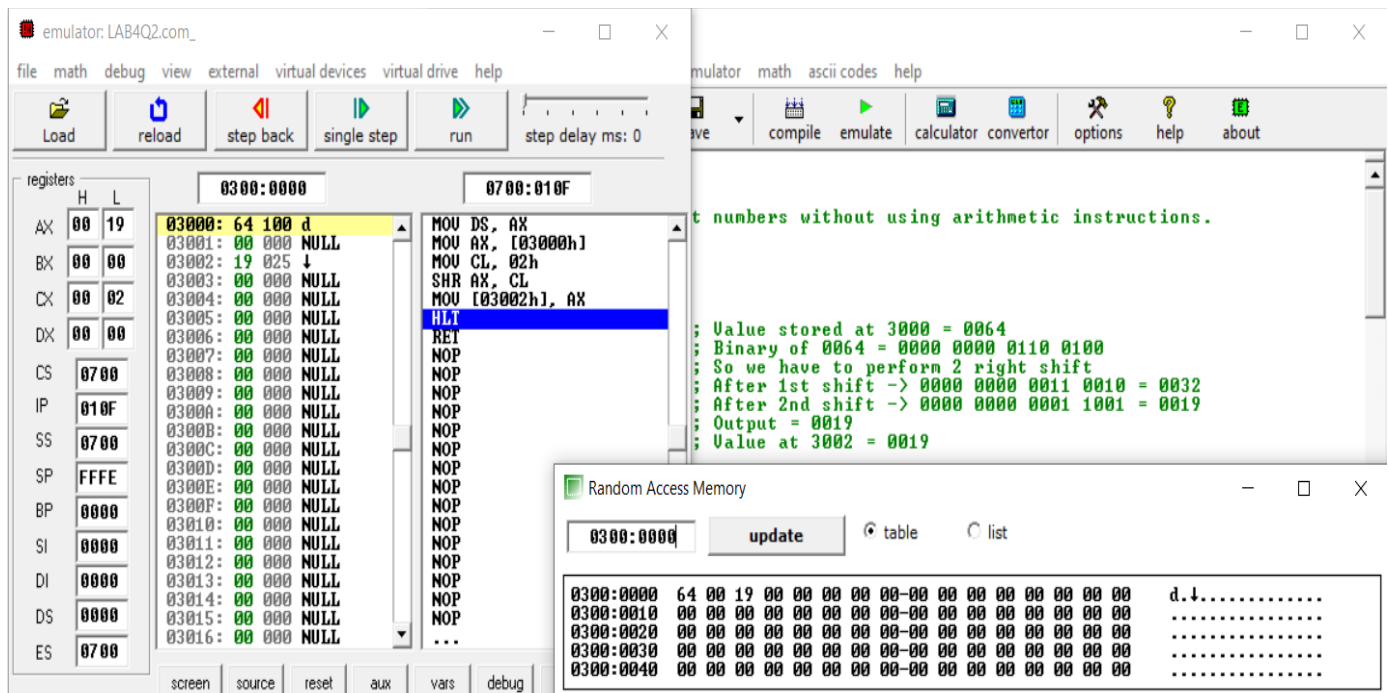
For Obj. 2:

```
; SASWAT MOHANTY
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; Divide two 16 bit numbers without using arithmetic instructions.

org 100h

mov ax, 0000h
mov ds, ax
mov ax,[3000h]     ; Value stored at 3000 = 0064
                   ; Binary of 0064 = 0000 0000 0110 0100
mov cl,02h         ; So we have to perform 2 right shift
                   ; After 1st shift -> 0000 0000 0011 0010 = 0032
                   ; After 2nd shift -> 0000 0000 0001 1001 = 0019
shr ax,cl          ; Output = 0019
mov [3002h], ax    ; Value at 3002 = 0019
hlt

ret
```

Observations (with screen shots):

For Obj. 1:

For Obj. 2:

Conclusion:

From the above experiment we conclude that the given objective i.e. multiplication and division of any number can be done, provided the divisor is a multiple of 2, by shifting the number left or right 'X' times where x is the power to 2 which when calculated gives the divisor.

IV. POST LAB:

1. Briefly discuss the instructions used in objectives 1.

org 100h

mov ax, 0000h

mov ds, ax

mov ax,[3000h]   *// at 3000 memory location we store the multiplicand*
                                       (In our case 0030h i.e. 48)

mov cl, 02h   *// here we store the multiplier (In our case 02h i.e. 4)*

```
sal ax, cl            // then we left shift the multiplicand 2 places to obtain
                         the output (In our case 00C0h i.e. 192.)

mov [3002h], ax       // result stored in ax is then shifted to 3002 memory
                         location.

hlt

ret
```

2. Briefly discuss the instructions used in objectives 2.

```
org 100h

mov ax, 0000h

mov ds, ax

mov ax,[3000h]        // at 3000 memory location we store the divisor
                         (In our case 0064h i.e. 100)

mov cl,02h            // here we store the dividend (In our case 02h i.e. 4)

shr ax,cl             // then we right shift the divisor 2 places to obtain
                         the output (In our case 0019h i.e. 25)

mov [3002h], ax       // result stored in ax is then shifted to 3002 memory
                         location.

hlt

ret
```

3. What is the difference between the microprocessor and microcontroller?

Microprocessor	Microcontroller
Microprocessor consists of only a Central Processing Unit.	Micro Controller contains a CPU, Memory, I/O all integrated into one chip.
Microprocessor is used in Personal Computers.	Micro Controller is used in an embedded system.

Microprocessor uses an external bus to interface to RAM, ROM, and other peripherals.	Microcontroller uses an internal controlling bus.
Microprocessors are based on Von Neumann model	Micro controllers are based on Harvard architecture.
Microprocessor is complicated and expensive, with a large number of instructions to process	Microcontroller is inexpensive and straightforward with fewer instructions to process.

4. What is assembler?

An assembler is a program that converts assembly language into machine code. It takes the basic commands and operations from assembly code and converts them into binary code that can be recognized by a specific type of processor.