

**Course Title:** Microprocessors and Assembly Language Lab (CSE-4504)

Department of Computer Science and Engineering (CSE)  
**Islamic University of Technology (IUT), Gazipur**

**Lab # 05**

*Bit Manipulation Instructions and Stack Operations in Assembly Language Program.*

**Objective:**

To understand some 8086 instructions related to bit manipulation and getting familiar with the use of 8086 stack operations using Assembly Language Program.

**Theory:**

- **Bit Manipulation Instructions**

- **Logical Instructions**

**NOT:** Invert each bit of a byte or word.

**NOT AX**

**AND:** And-ing each bit in a byte or word with the corresponding bit in another byte or word

**AND AX, F08AH**

**OR:** OR-ing each bit in a byte or word with the corresponding bit in another byte or word.

**OR AX, FFABH**

**XOR:** XOR-ing each bit in a byte or word with the corresponding bit in another byte or word.

**XOR AX, AX ;** Resets the contents of AX register

- **Shift Instructions**

**SHL:** Shifting bits of word or byte left putting zero(s) in LSB(s).

**SHL AL, 1**

If you SHL (AL = 00000001) 1 times, you get a value of 2 in AL or 00000010. Do it again and your bit(s) shift up by 1 more. SHL is a quick way to multiply a value by 2,4,8, etc because every time you SHL you double the value.

**SHL AL, CL ;** Takes the value in CL and shifts AL that many times.

**SHR:** Shifting of word or byte right putting zero(s) in MSB(s). Shift right will half your original value, making quick division a snap.

**SHR AL, 1**

**SHR AL, CL**

**ROL:** It rotates bits of byte or word left, by count. MSB is transferred to LSB.

**ROL AL, 1**

**ROL AL, CL**

**ROR:** It rotates bits of byte or word left, by count. LSB is transferred to MSB.

**ROR AL, 1**

**ROR AL, CL**

- **Stack Operation**

Stack is a section of memory for storing **return addresses**. It is also used to save the contents of registers for the calling program while a procedure executes. Another use of stack is to hold data or addresses that will be acted upon by a procedure. PUSH and POP instructions operate on stack and can be used for swap operations between registers.

**PUSH and POP:** 16-bit registers values can be **pushed** (the SS is first decremented by 2 and then the value is stored at the address in SP) or **popped** (the value is restored from the memory at SS and then SP is incremented by 2). For example:

**PUSH AX**       ; Push contents of AX register into stack segment SS:SP (top of stack)  
**POP BX**        ; Pop the value from SS:SP (top of stack) into BX register

**Assembly Language Program Example for PUSH and POP Instructions:**

```
org 100h
.DATA
r1 DW 100
r2 DW 500
r3 DW 600
.CODE
mov dx, r2          ; r2 = dx
add dx, r3          ; r2+r3 = dx
push dx             ; save value of dx in stack
mov cx, r1          ; r1 = dx
push cx
add cx, dx           ; r1 + (r2+r3)

mov bx, cx           ; mov cx having (r1) + (r2+r3) into bx
pop cx              ; pop old cx (r1) back to cx
pop dx              ; pop (r2+r3) back to dx
mov ax, cx           ; mov old cx(r1) to ax
ret
```

**Tasks to do:**

1. Write an assembly language code that takes N as a decimal digit (0 ~ 9) input and shows its *factorial* as output. [Hint: Use loop or array or both **and** use bit manipulation instructions]

**Sample Input / Output:**

Input the value of N: 5 (*Take the Input from User*)  
The Factorial of N is: 120 (*Store the Output in a Register and Variable*)

2. Write an assembly language code that takes N as a decimal digit (0 ~ 9) input and shows *fibonacci* series up to N-th element of the series. Hint: Use loop or array or both **and** use bit manipulation instructions]

**Sample Input / Output:**

Input the value of N: 7  
Fibonacci Series: 0 1 1 2 3 5 8