March 27, 2010

COMPUTER ENGINEERING DEPARTMENT

COE 205

COMPUTER ORGANIZATION & ASSEMBLY PROGRAMMING

Major Exam I

Second Semester (092)

Time: 8:00-10:00 PM

Student Name : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Student ID. : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Question** | **Max Points** | **Score** |
| **Q1** | **76** |  |
| **Q2** | **12** |  |
| **Q3** | **12** |  |
| **Total** | **100** |  |

Dr. Aiman El-Maleh

# **[76 Points]**

# **(Q1)** Fill the blank in each of the following:

## The advantages and disadvantages of programming in assembly language are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## The advantages and disadvantages of DRAM are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## The instruction set architecture of a processor is composed of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## In protected mode, the logical address consists of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## In protected mode, the linear address is computed based on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## Given that variables I and J are Dword variables, their content can be swapped using the following instructions:

## \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Given that variable I is defined as Qword, the content of I is incremented using the following code:

## \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Given a magnetic disk with the following properties: Rotation Speed = 5000 RPM (rotations per minute), Average Seek = 4 ms, Sector = 512 bytes, Track = 250 sectors. The average time to access a block of 50 consecutive sectors is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## The integer number -2000 is represented in hexadecimal using 16-bit 2’s complement representation as \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## Assuming 16-bit 2’s complement representation, the hexadecimal number EC10 represents the decimal number\_\_\_\_\_­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## Assuming 4-bit 2’s complement representation, the largest number that can be stored is \_\_\_\_\_\_\_\_ in decimal and \_\_\_\_\_\_\_\_ in binary and the smallest number that can be stored is \_\_\_\_\_\_\_\_ in decimal and \_\_\_\_\_\_\_\_in binary.

## Given that the number 88h is represented using 8-bit 2’s complement representation, the equivalent number represented using 16-bit 2’s complement representation is \_\_\_\_\_\_\_\_\_\_\_.

## Given that register AL=C4 stores an ASCII character, then the stored character is \_\_\_\_\_\_\_\_ and the used parity is \_\_\_\_\_\_\_. Note that ‘A’=41h and ‘a’=61h.

## The \_\_\_\_\_\_\_\_\_\_\_\_ register holds the address of the next instruction to be fetched from memory.

## Given that the instruction ADD AX, I (having the machine code 03060000) is stored at address 0000002C, then the address of the next instruction to be fetched from memory is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## Given a processor with an 8-stage pipeline and clock frequency of 2 GHZ, the time that will be required to execute a program of 4 billion instructions assuming that there will be no pipeline stalls is nearly \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ seconds.

## Assume that the range of addresses from 00000 to 00A1A is used by another program. Given that a program has a code segment of 8 Kbyte and a data segment of 3 Kbyte, the code segment number allocated is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the data segment number allocated is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## Assume that DS=00EF, CS=013A, ES=0112, SS=0FEC, IP=00FF, BX=309A, and SP=01FC. Based on 16-bit real-mode addressing, the linear address of the next instruction to be fetched from memory is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## Assume that DS=00EF, CS=013A, ES=0112, SS=0FEC, IP=00FF, BX=309A, and SP=01FC. Based on 16-bit real addressing mode, the linear address of the source operand in the instruction MOV AX, [BX+5] is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## The addressing mode of the source operand in the instruction MOV EAX, [MSG+1] is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## Assume that AX=00FFh. Executing the instruction INC AL produces the result AX=\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## The addressing mode of the source operand in the instruction MOV SI, [EBX] is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## The assembler allocates \_\_\_\_\_\_\_\_ bytes for the variable *Array* defined below:

## *Array Dword 5 dup(30, 30 dup(0))*

## 

## The content of register EAX after executing the following instructions is\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## 

## I=5

## J EQU 10

MOV EAX, I-J

I=I-3

ADD EAX, I+J

## 

## Assuming the following data segment and assuming that variable X is given the linear address 00404000h, then the linear address for variables Y and Z will be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## .DATA

## X BYTE 1, 2, 3, 4, 5

## ALIGN 4

Y DWORD 4, 5

## ALIGN 2

## Z WORD 7, 8, 9

## Assuming the following data segment and assuming that variable X is given the linear address 00404000h, then the content of register EAX after executing the instruction MOV EAX, Y-5 is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## .DATA

## X BYTE “EXAM I”, 0

WORD 10, 20

## Y DWORD 30, 40

## Assuming the following data segment and assuming that variable X is given the linear address 00404000h , after executing the code given below, the content of register EAX=\_\_\_\_\_\_\_\_\_\_\_ and EBX=\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## .DATA

## X WORD 10, 20, 30

## Y DWORD 30, 40, 50

## .CODE

## MOV EAX, TYPE Y

## MOV EBX, OFFSET Y-2

## After executing the code given below, the content of registers EAX and EBX will be \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_.

## .DATA

## ARRAY DWORD 10, 20, 30,

## 40, 50, 60

## .CODE

## MOV EAX, LENGTHOF ARRAY

## MOV EBX, SIZEOF ARRAY

## After executing the code given below, the content of register EAX will be \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## .DATA

## ARRAY WORD 10, 20, 30, 40, 50, 60

## .CODE

## MOV EAX, DWORD PTR ARRAY+3

## Assuming that variable ARRAY is defined as shown below:

## ARRAY DWORD 1, 2, 3, 4, 5, 6

The content of register AX after executing the instruction MOV EAX, ARRAY+2will be *\_\_\_\_\_\_\_\_\_\_\_\_.*

## Assume that AL=93h. Executing the instruction MOVSX EBX, ALproduces the result EBX=\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

## Assume that AX=A100h. Executing the instruction *NEG AX* produces the following results: AX=\_\_\_\_\_\_, overflow flag=\_\_\_, sign flag=\_\_\_, zero flag=\_\_\_, carry flag=\_\_\_, auxiliary flag=\_\_\_ and parity flag=\_\_\_.

## Assume that AX=ABCDh and BX=8876h. Executing the instruction *ADD AX, BX* produces the following results: AX=\_\_\_\_\_\_, overflow flag=\_\_\_, sign flag=\_\_\_, zero flag=\_\_\_, carry flag=\_\_\_, auxiliary flag=\_\_\_ and parity flag=\_\_\_.

## Assume that AX= 98A0h and BX= FFDAh. Executing the instruction *SUB AX, BX* produces the following results: AX=\_\_\_\_\_\_, overflow flag=\_\_\_, sign flag=\_\_\_, zero flag=\_\_\_, carry flag=\_\_\_, auxiliary flag=\_\_\_ and parity flag=\_\_\_.

## The content of register EAX after executing the instructions below will be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

.DATA

ARRAY DWORD 1, 2, 3, 4

DWORD 5, 6, 7 , 8

DWORD 9, 10, 11, 12

RS EQU SIZEOF ARRAY

.CODE

MOV ESI, 2\*RS

MOV EDI, 3

MOV EAX, ARRAY[ESI+EDI\*TYPE ARRAY]

# **[12 Points]**

# **(Q2)** Consider a program that has the following data segment assuming a flat memory model:

*X EQU 16*

*Y BYTE 17*

*Z WORD 18*

*W DWORD 19*

Indicate whether the following are valid **IA-32** instructions or not. **If invalid, give the reason**:

## 1. MOV EAX, W-1

## 2. MOV Z, Word PTR Y

## 3. MOV DS, X

## 4. MOV Z, X

## 5. MOV AX, OFFSET Z

## 6. MOVSX EAX, X

## 7. MOV W, Dword PTR AX

## 8. INC [EBX]

**[12 Points]**

# **(Q3)** Suppose that the following directives are declared in the data segment with a starting linear address of 00404000. Show the linear addresses of allocated memory and their corresponding content in hexadecimal. Note that the ASCII code for character ‘a’ is 61h and that of character ‘A’ is 41h. The ASCII code of character ‘0’ is 30h.

I BYTE 10,“10”,0

WORD 10, -10

J DWORD 112, -112

K EQU 100

L BYTE K+20

BYTE 2, 2 dup(1,-1)

|  |  |  |
| --- | --- | --- |
| Variable | Linear Address (Hex.) | Content (Hex.) |
| I | 00404000 |  |
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