Information for Candidates
1. This examination paper contains 5 questions totaling 40 marks.
2. The marks for the questions are:
   - Question 1 (10 marks), Question 2 (5 marks), Question 3 (5 marks),
   - Question 4 (13 marks), Question 5 (7 marks),

Advice to Candidates
1. You should attempt ALL requested parts.
2. You should write your answers clearly.

Basic notions: The aim of the questions in this part is to evaluate the required minimal student knowledge and skills. Answers in the pass category represent the minimum understanding of IA-32 Processor Architecture, Assembly Language Fundamentals: Instructions, Directives, Identifiers, Defining Data, Symbolic Constants, Data Transfers, Addressing, and Arithmetic instructions Addressing Modes, Conditional and Unconditional instructions, Stack, Pointers, Arrays and Procedures.

**Question 1 Multiple Choices (10 marks)**

Identify the choice that best completes the statement or answers the question.

1) An assembly language program is translated to machine code by
   a) an assembler  
   b) an interpreter  
   c) a compiler  
   d) a linker

2) What are the names of the 4 segment registers?
   a) Data, Index, Code, Stack  
   b) Stack, Index, Extra, Code  
   c) Stack, Extra, Code, Data  
   d) Stack, Data, Base, Counter

3) Which of the following is an illegal instruction?
   a) MoV Ax, 3000  
   b) and bx, bx  
   c) iNc Al, 1  
   d) add ax, 30

4) Which of the following is an illegal **8086** instruction?
   a) ret  
   b) add bx, 25000  
   c) and ax, dx  
   d) push al

5) Given that the **bl** register contains ‘b’, the effect of the following instruction
   
   and bl, 1101 1111

   is to
   a) clear bl  
   b) store ‘B’ in bl  
   c) store ‘B’ in bl  
   d) leave bl unchanged

6) Given the following array definition, which letter choice contains a valid constant declaration named **ArrayCount** that automatically calculates the number of elements in the array?
   
   newArray DWORD 10,20,30,40,50
   a) ArrayCount = ($) - newArray) / 4  
   b) ArrayCount = ($) - newArray) / 2  
   c) ArrayCount = (newArray -$ ) / 4  
   d) ArrayCount = (newArray -$ ) / 2

7) Which of the following defines a constant **Max**?
   a) Max db 80  
   b) Max equ 80  
   c) mov Max, 80  
   d) Max dw 80
8) The effect of the following instructions

```
push ax
add ax, 4
pop bx
mov cx, ax
push bx
pop ax
```

on the `ax` register is

a) leave it with its original value  
   c) clear it  
b) add 4 to it  
d) double it

9) Given that the subprogram `WriteChar` displays the character in al, the effect of the following instructions:

```
mov al, 'c'
sub al, 2
call WriteChar
```

is to

a) display 2  
c) display 'c'
b) display 'a'  
d) display a blank

10) The interrupt service routine should end with ________ instruction that returns control to the interrupted software.

a) an IRET  
c) an RET  
b) an INT  
d) an INTO

**Question 2**  
(5 marks)

a) For the following instructions, decide which instructions are valid and which are invalid. Fill the box opposite to each instruction with V if valid and I if invalid. In case of invalid state the reason.

(2.5 marks)

<table>
<thead>
<tr>
<th>N</th>
<th>Instruction</th>
<th>Answer</th>
<th>Reason</th>
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<tbody>
<tr>
<td>[1]</td>
<td>CMP DX</td>
<td></td>
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<tr>
<td>[2]</td>
<td>MOV DS, AX</td>
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<td></td>
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<tr>
<td>[3]</td>
<td>MOV BL, AX</td>
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<td></td>
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<tr>
<td>[4]</td>
<td>SUB DS, 3H</td>
<td></td>
<td></td>
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<tr>
<td>[5]</td>
<td>ADD AL, 982H</td>
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b) Assume that we have the following data definitions:  
(2.5 marks)

```
myBytes BYTE 10h, 20h, 30h, 40h
myWords WORD 8Ah, 3Bh, 72h, 44h, 66h
myDoubles DWORD 1, 2, 3, 4, 5
myPointer DWORD myDoubles
```

Fill in the requested register values on the right side of the following instruction sequence:

```
mov esi, OFFSET myBytes
mov ax, [esi] ; a. AX =----------
mov eax, DWORD PTR myWords ; b. EAX =----------
mov esi, myPointer
mov ax, [esi+2] ; c. AX =----------
mov ax, [esi+6] ; d. AX =----------
mov ax, [esi-4] ; e. AX =----------`
```
Familiar and Unfamiliar problems solving: the aim of the questions in this part is to evaluate that the student has some basic knowledge of the key aspects of the lecture material and can attempt to solve familiar and unfamiliar problems of Assembly Language Fundamentals: Instructions, Directives, Identifiers, Defining Data, Symbolic Constants, Data Transfers, Addressing, and Arithmetic instructions Addressing Modes, Conditional and Unconditional instructions, Stack, Pointers, Arrays and Procedures.

**Question 3**

a) What will be the final value of EAX in the following assembly code? (5 marks)

```
mov eax, 0
mov ecx, 10
L1:
    mov eax, 3
    mov ecx, 5
L2:
    add eax, 5
    loop L2
    loop L1
```

**Solution**

b) Write the value stored in AL, SI, CX after the execution of the following code. (3 marks)

```
.DATA
GRADES DW 15,12,14,10, 18, 16, 11, 17, 19, 9
.CODE
MOV AX, 0
MOV SI, 4
MOV CX, 6
L1:
    ADD AX, GRADES[SI]
    ADD SI, 2
    LOOP L1
```

**Solution**

<table>
<thead>
<tr>
<th>AL</th>
<th>SI</th>
<th>CX</th>
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**Question 4**

a) W and X are arrays of 100 words. Write code to copy the array W into the X array using a single index register as a subscript for both arrays. (13 marks)

**Solution**
b) The array C of 100 bytes is assumed to contain string of ASCII characters. Check it to see if it contains the ' $ ' character and go to location HasDollar if it does. (4 marks)

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c) Write assembly language program (complete) that displays the message 'Faculty of Engineering' followed by Carriage Return and Line feed: (6 marks)
- The code must contain the following:
  - Memory model declaration suitable for MS-DOS applications.
  - Stack with 256 bytes.
  - Line feed (moves to next output line) ASCII Code is 0Ah.
  - Carriage return (moves to leftmost output column) ASCII Code is 0Dh.
  - DS must point to the string's segment, and DX must contain the string's offset.
  - Use interrupt INT 21, function number 09h to display the message to standard output.
  - Terminate your program using the termination process of interrupt INT 21, function number 4Ch.

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Question 5 (7 marks)

a) List five steps of Instruction Execution Cycle. (2.5 marks)

b) List five Memory Models that can be used in assembly language. (2.5 marks)

c) Explain the main characteristics of the Real-Address Mode used in assembly language (2 marks)

Good Luck