**AR101 – COMPUTER ORGANIZATION AND ARCHITECTURE**



**NAME:** 

**STUDENT NO:**

**YEAR/SECTION:**

**DATE:**



**INSTRUCTIONS:**

Determine the contents of all affected general-purpose registers and flags after executing the following program Code:

Note: Each instruction code is dependent in one another, so, whenever possible refer to the following register contents listed and assume all flags are set initially to Zero (0).

| AX | 0015h | BP | 0002h | CS | 3000h |
| --- | --- | --- | --- | --- | --- |
| BX | 0019h | SP | 0035h | DS | 2000h |
| CX | 0012h | DI | 0017h | SS | 2000h |
| DX | 001Bh | SI | 001Eh | ES | 4000h |

SF=0 ZF=0 PF=0 CF=0 AF=0 OF=0

Assembly Code:

* ADD instructions

ADD AX, BX

ADD [SI], DX

AX = 0015H = 0000 0000 0001 0101

BX = 0019H = 0000 0000 0001 1001

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

AX = 0000 0000 0010 1110

AX = 002E

ADD [SI], DX

[SI] = DSX10+SI

DX = 001BH

DSx10+SI

SI = 001EH

000 0010 0000 0000 0000 0000

0000 0000 0001 1110

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

000 0010 0000 0000 0001 1110

SI = 02001EH

DX = 001BH = 0000 0000 0001 1011

SI = 000 0010 0000 0000 0001 1110

DX = 0000 0000 0001 1011

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

000 0010 0000 0000 0011 1001

SI = 020039

* ADC Instructions

MOV AX, FAFAh

MOV BX, [SP]

ADD AX, BX

ADC SI, DI

MOV AX, FAFAH

AX= 0015H = 0000 0000 0001 0101

FAFAH = 1111 1010 1111 1010

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1111 1011 0000 1111

AX= FB0FH

MOV BX, [SP]

SP=0035H

SSX10H+SP

SS = 2000HX10H+0035H

10 0000 0000 0001 1110

0000 0000 0011 0101

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

10 0000 0000 0101 0011 =SP

=10 0000 0000 0101 0011

SP=20053H

ADDITION:

BX+SP

BX=0019H = 0000 0000 0001 1001

SP=20053H= 10 0000 0000 0101 0011

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

BX = 10 0000 0000 0110 1100

10 0000 0000 0110 1100

BX = 2006CH

ADDITION:

ADD AX, BX

AX = FB0FH = 1111 1011 0000 1111

BX = 2006CH = 10 0000 0000 0110 1100

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

AX = 10 1111 1011 0111 1011

AX= 10 1111 1011 0111 1011

ADD AX, BX

AX = 2FB7BH = 10 1111 1011 0111 1011

* INC Instructions

INC AX

INC BX

INC CX

INC DX

INC AX INC BX

AX= 0015H = 0000 0000 0001 0101 BX = 0019H = 0000 0000 0001 1001

1 1

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

AX = 0000 0000 0001 0110 BX = 0000 0000 0001 1010

INC CX INC DX

CX= 0012H = 0000 0000 0001 0010 DX = 001BH = 0000 0000 0001 1011

1 1

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

CX = 0000 0000 0001 0011 DX = 0000 0000 0001 1100

* DAA Instructions

MOV AL, 00F5h

MOV BL, 00F5h

ADD AL, BL

DAA

MOV AL, F5H

MOV BL, F5H

ADD AL, BL

DAA

MOV AL, F5H = 1111 0101

MON BL, F5H = 1111 0101

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1 1110 1010 = 1EAH

0110 0110 = 66H

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

10 0101 0000 = 260H

THE IMMEDIATE RESULT IS GREATER THAN 9, DAA ADJUSTS BY ADDING 6 TO THE LSB

MOV AL, 260H

ADD AL, 260H

AL= 0015 = 0000 0000 0001 0101

260H = 10 0101 0000

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

AL = 0000 0010 0110 0101

AL =0265H

MOV BL, 260H

BL= 0019H = 0000 0000 0001 1001

260H = 10 0101 0000

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

BL = 0000 0010 0110 1001

BL= 0269H

ADD AL, BL

AL = 0000 0010 0110 0101

BL = 0000 0010 0110 1001

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

AL = 0000 0100 1100 1110

AL= 04CEH

DAA

AL= 04CEH, 260H

ADD AL,260H

0000 0100 1100 1110

10 0101 0000

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0011 0001 1110 = DAA

DAA = 031EH

* AAA Instruction

MOV AL, 0074h

MOV BL, 0075h

ADD AL, BL

AAA

MOV AL, 0074h ASCII value of 4

MOV BL, 0075h ASCII value of 5

ADD AL, BL

AAA

MOV AL, 74H

MOV BL, 75H

ADD AL, BL

AAA

MOV AL, 74H

AL=0015 = 0000 0000 0001 0101

74H = 0111 0100

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0000 1000 1001 = 9

AL=0089H = ASCII VALUE = 9

MOV BL,75H

BL=0019H = 0000 0000 0001 1001

75H = 0111 0101

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0000 1000 1110 = 9

BL=008EH = ASCII VALUE E

ADD AL, BL

AL=0089H = 0000 0000 1000 1001

BL=008EH = 0000 0000 1000 1110

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0001 0001 0111 = 0117H

AL=0000 0000 1001 1000 = 0098H ASCII VALUE 1000 = 7H

AAA

0000 0001 0001 0111 = 0117H

0111 = 7H

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0001 0001 1110 = 011EH

AAA= 011EH

* SUB Instructions

SUB AX, BX

SUB [SI], DI

SUB AX, BX

SUB [SI], DI

SUB AX, BX

AX = 0015H = 0000 0000 0001 0101

BX = 0019H = 0000 0000 0001 1001

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

AX = 0000 0000 0001 1100

AX= 001BH

SUB [SI], DI

PHYSICAL ADDRESS

FORMULA: DSX10+SI

2000HX10H= 000 0010 0000 0000 0000 0000

SI = 001EH = 0000 0000 0001 1110

DS = 000 0010 0000 0000 0000 0000

SI = 0000 0000 0001 1110

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

SI = 000 0010 0000 0000 0001 1110

SI = 02001EH

SUB SI, DI

SI = 02001EH = 000 0010 0000 0000 0001 1110

DI = 0017H = 0000 0000 0001 0111

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

SI = 000 0010 0000 0000 0000 0111

SI= 020007H

* SBB Instructions
* Include Code LIST = 0027h

MOV AX, 7AFAh

MOV BX, LIST

SUB AX, BX

SBB SI, DI

SUB [SI], DI

AX = 7AFAH = 0111 1010 1111 1010

BX = 0027H = 0000 0000 0010 0110

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

AX = 0111 1010 1101 0100 = 7AD4H

MOV AX, 7AD4H

AX = 0015H = 0000 0000 0001 0101

7AD4H= 0111 1010 1101 0100

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

AX= 0111 1010 1100 0001 = 7AC1H

MOV BX, 7AD4H

BX = 0019H = 0000 0000 0001 1001

7AD4H = 0111 1010 1101 0100

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

BX = 0111 1010 1100 0101 = 7AC5H

SUB AX, BX

AX = 7AC1H = 0111 1010 1100 0001

BX = 7AC5H = 0111 1010 1101 0101

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

AX = 0111 1111 1110 1100 = 7FECH

SBB

SI, DI

SI = 001EH = 0000 0000 0001 1110

DI = 0017H = 0000 0000 0001 0111

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

SI = 0000 0000 0000 0111 = 0007H

* DEC Instructions

DEC AX

DEC BX

DEC CX

DEC DX

DEC AX

AX= 0015H = 0000 0000 0001 0101

1

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

AX = 0000 0000 0001 0100 = 0015H

AX=0015H

DEC BX

BX = 0019H = 0000 0000 0001 1001

1

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

BX = 0000 0000 0001 1000 = 0018H

BX= 0018H

DEC CX

CX= 0012H = 0000 0000 0001 0010

1

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

CX = 0000 0000 0001 0001 = 0011H

CX= 0011H

DEC DX

DX = 001BH = 0000 0000 0001 1011

1

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

DX = 0000 0000 0001 1010 = 001AH

DX=001AH

* DAS Instructions

MOV AL, 003Fh

MOV BL, 0015h

SUB AL, BL

DAS

MOV AL, 003Fh

MOV BL, 0015h

SUB AL, BL

DAS

003FH = 0000 0000 0011 1111

0015H = 0000 0000 0001 0101

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0000 0010 1010

0110

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0000 0010 0100 = 0024H

MOV AL, 003FH = MOV AL, 0024H

AL = 0015H, 0024H

= 0000 0000 0001 0101

0000 0000 0010 0100

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0000 0011 0001

AL = 0031H

MOV BL, 0015H

BL = 0019H, 0015H

= 0000 0000 0001 1001

0000 0000 0001 0101

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0000 0000 0100

BL = 0004H

SUB AL, BL

AL = 0031H

BL = 0004H

= 0000 0000 0011 0001

0000 0000 0000 0100

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0000 0011 0101 = AL = 0035H

DAS = 0035H

* AAS Instructions

MOV AL, 008Eh

MOV BL, 0062h

SUB AL, BL

AAS

MOV AL, 008Eh ASCII Value = E = 14

MOV BL, 0062h ASCII Value = 2

SUB AL, BL

AAS

MOV AL, 0083H ASCII Value = E = 14

14 = 1110

2 = 0010

\_\_\_\_\_\_\_\_\_

1100 = 9

MOV AL, 0089H

AL = 0015H, 0089H

AL = 0000 0000 0001 0101, 0000 0000 1000 1001

SUB:

= 0000 0000 0001 0101

0000 0000 1000 1001

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0000 1000 1100 = 0089H

AL = 0089H

MOV BL, 0062H

BL = 0019H, 0062H

BL = 0000 0000 0001 1001, 0000 0000 0110 0010

SUB:

BL = 0000 0000 0001 1001

0000 0000 0110 0010

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0000 1111 1011 = 00FBH

BL = 00FBH

SUB AL, BL

AL = 0089H = 0000 0000 1000 1100

BL = 00FBH = 0000 0000 1111 1011

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

0000 0000 1111 0011 = AL

= 00F3H

AAS = 00F3H