BIRZEIT UNIVERSITY

Computer Organization and architecture (ENCS238)
Midterm Exam

SummerII semester 2014/2015   Date: 13/8/2015
Instructors: Dr. Abualsoud Hanani

Time allowed: 90 minutes

Name: _____ Key _____ ID: _____

Instructions:

- You have 90 minutes (1.5 hours), budget your time carefully!

- Turn off your mobile.

- To make sure you receive credit, please <u>write clearly</u> and show your work.

Question	Maximum	Mark	ABET SO
1	10		
2	10		A
3	10		C
4	10		E
Total	40		

Question 1 (10 marks)

1. Virtually all computer designs are based on the von Neumann architecture. A high level view of this architecture has the following three components:
   (A) Buses, memory, input/output controllers   (B) Hard disks, floppy disks, and the CPU
   (C) Memory, the CPU, and printers   (D) memory, input/output modules, and the CPU

2. Which of the following languages a program is written in can be executed by a CPU directly?
   (A) C   (B) C++
   (C) Assembly   (D) Machine language
   (E) None of the above

3. When perform $(10000111)_2 - (11001000)_2$, how will the Condition Code bits be set.
   (A) CF=0, OF=0   (B) CF=1, OF=0

   (C) CF=0, OF=1   (D) CF=1, OF=1

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4. Moore's law states that the size of integrated circuits will double every year.
   (A) True   (B) False

5. A Stack-organized Computer uses instruction of
   (A) Indirect addressing   (B) Two-addressing

   (C) Zero addressing   (D) Index addressing

6. 1MB (one Mega Bytes) is
   (A) 10^6 bytes   (B) 2^{30} bytes
   (C) 10^{20} bytes   (D) 2^{20} bytes
   (E) None of the above

7. A computer's memory is composed of 16K bytes. How many bits are required for memory address if smallest addressable unit is one byte?
   (A) 13   (B) 14
   (C) 16   (D) 10

8. Programs are transferred into the CPU for execution directly from
   (A) Keyboard   (B) Hard drives
   (C) Main memory   (D) none of the above

9. As the density of integrated circuits increases, the speed of the digital logic increases because of the many transistors available for each operation.
   (A) True   (B) False

10. What is the most positive value that can be stored using 12-bit unsigned binary representation?
    (A) 2^{11} (B) $2^{11} - 1$ (C) 2^{12} (D) $2^{12} - 1$ (E) 2^{13} (F) $2^{13} - 1$

1	2	3	4	5	6	7	8	9	10
D	D	A	B	C	D	B	C	B	D

Question 2 (10 points)

a) State whether the following instructions are legal or illegal? If illegal say why?[6pts]

1. MOV AX, BL — illegal, two Registers must be of same size

2. PUSH CL — illegal, push takes only 16-bit operand

3. MUL AX, BX — illegal, Mul takes one operand only.

4. INC BL, 1 — illegal, Inc takes one operand

5. SAR AX, 3 — illegal, shift of more than one bit must be in CL

6. MOV [1000], [2000] — illegal, two memory operands are not allowed.

b) Find binary representation of $(-24)_{10}$ when using the following sign representations: (use minimum number of bits) [4pts]

(i) Sign magnitude $1\ 11000$

(ii) One's complement   ~~1011100~~ $1\ 00111$

(iii) Two's complement $1\ 01000$

(iv) Biased (Excess)   min. is 6 bits
$$Bias = 2^{-1} = 3)$$
$$-24 + 31 = 7 \Rightarrow 000111$$

Question 3 (10 points)

(a) A Digital computer has a memory unit with 32 bits per word (each memory element=32bits). The instruction set consists of 132 different operations. Register file consists of 24 registers, each of 16 bits length. All instructions have an operation code part (opcode), register operand and memory address part. Each instruction is stored in one word of the memory. [4pts]

i) How many bits are needed for the opcode?
$$\lceil log_2(132) \rceil = 8\ bits$$

ii) What is the minimum number of bits are required for the register field?
$$5\ bits$$

iii) How many bits are left for the address part of the instruction?
$$32 - 8 - 5 = 19\ bits$$

iv) What is the maximum allowable size for memory that can be accessed directly in **Bytes**?

$$2^{19}\ words = 512k\ Words$$
$$= 512k \times 4\ bytes = 2^{19} \cdot 2^2\ bytes$$
$$= 2^{21}\ bytes = 2\ MBytes$$

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(b) In an 8086 computer system, the initial values of registers and memory locations is as follows. [6pts]

AX - 0000H; BX - 0045H; CX - 000AH; DX - 0000H; SI - 5200H; DI - 5300H;

IP - 0100H; CS - 1EF2H; DS - 0A34H

Physical Address	Content	Physical Address	Content
0F540H	FFH	0F640H	F0H
0F541H	00H	0F641H	B0H
0F542H	ABH	0F642H	0BH
0F543H	45H	0F643H	4FH
0F544H	00H	0F644H	00H
0F545H	24H	0F645H	25H
0F546H	8CH	0F646H	8DH
0F547H	88H	0F647H	77H

Fill in the following table to show the source, destination, data size, and value written for each instruction. Assume that the instructions are executed sequentially in the order given below.

Instruction	Source	Destination	Data size (in bytes)	Value written
MOV BX, [SI]	memory at address F540H	Register BX	two	00FFH
XOR WORD PTR [DI], 255	Immediate no. 255 from instruction	memory at address F640H	two	B00FH
CMP AX, [DI + 4]	AX and mem. at address F644H	only Flags	two	None.
ADD BX, [5305H]	BX and mem. at address F645H	Register BX	two	8E24H
JMP [9000H]	Reg. IP and 9000H	Register IP	two	9100H
DEC AX	AX	AX	two	FFFFH

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Question 4 (10 points)

Complete the following 8086 assembly program which counts and displays on the screen the number of even integers in array Array1: (Note: your program should be generic which can be used for Array1 of different numbers)

.model small

.stack 100H

.data

Array1 db 20, 23, 44, 55, 2, 12, 45, 88, 34, 11, 8, 9, 16, 34, 44, 11, 13, 34, 11, 4

.code

MOV AX, @data

MOV DS, AX

```
LEA BX, Array1
XOR SI, SI
XOR BL, BL
Mov CX, 20
again:
    Mov AL, [BX+SI]
    Test AL, 01H
    JNZ No
    Inc BL
No:
    Inc SI
    Loop again
    Mov AL, BL
    Mov AH, 00
    Mov BL, 10
    Div BL
    ADD AX, 3030 H
    Mov BX, AX
    Mov AH, 02
    Mov DL, BL
    Int 21H

    Mov DL, BH
    Int 21H
```

MOV AH, 4CH

INT 21H

end