Ankara University
Computer Engineering Department
COM325 / COM3525 Microprocessors Midterm Exam

Name-Surname:
Number:
Signature:
Duration: 120mins.
Notes: **1.** The questions will be answered by only using the techniques discussed in the classes.

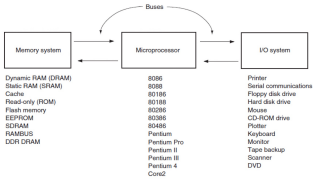
2. The microprocessor system that will be considered is the 16-bit 8086 architecture. More recent properties, instruction sets cannot be employed to answer the questions.

3. Use the given spaces under each question to write your answers by giving detailed descriptions and using minimal number of assembly instructions, each line commented.
Good luck!

QUESTIONS

1. (20 points) Answer the following questions considering microprocessors:

a. (10 points) Draw the block diagram of the simple microprocessor based personal computer system, identifying the main components and buses.



b. (5 points) Write down the three main tasks performed by microprocessors.

1. Data transfer between itself and the memory or I/O system.
2. Simple arithmetic and logic instructions
3. Program flow via simple decisions.

c. (5 points) List the three types of buses used by the microprocessor indicating the type of information carried by each.

the address bus constains 20 or more connections, conveys the memory address to the memory. (Transfers Addresses)

The data bus transfers information between MP and its memory and I/O system. (transfer Data)

The control bus contains lines that select the memory or I/O and cause them to perform a read or write operation. (Control R/W operations, transfer signals to perform actions.

2. (25 points) Perform the following conversions between different number systems.

a. (5 points) Convert unsigned binary 1001.0110 to decimal.

8 4 2 1 2^{-1} 2^{-2} 2^{-3} 2^{-4}
1001.0110
9.375
$\frac{1}{4} + \frac{1}{8} = \frac{3}{8}$
0.25 0.125

9.375

b. (5 points) Convert hexadecimal 0xABCD to binary.

1010 1011 1100 1101

64 32 16 8 4 2 1

c. (5 points) What number does signed decimal -67 represent in unsigned decimal system? (Use 8-bit representation.)

189

67 → 01000011
-67 → 10111101 → unsigned 189

d. (5 points) Convert decimal 0.625 to binary.

0.625 × 2 = 1.25 → 1
0.25 × 2 = 0.5 → 0
0.5 × 2 = 1.0 → 1
⇒ 0.101

e. (5 points) Convert decimal 678 to packed and unpacked BCD forms.

Packed : 00000110 01111000

UnPacked : 00000110 00000111 00001000

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3. (15 points) Considering the values of the registers below, find the physical address to be accessed for instructions and data.
CS= 1800H, DS=0100H, SS=0100H, BX=0200H, ARRAY = A100H, DI=0200H, IP=1500H, SP=FFFE

a. (5 points) Find the address of the next instruction to be executed.

CS:IP → 1800H x 10H + 1500
19500H

b. (5 points) Find the address of the destination operand for the instruction:

```
MOV ARRAY[BX+DI], DX
```

01000
0A100
00200
00200 +
0B500H

0B500H

c. (5 points) Find the stack address where the operand will be added for the instruction, assume that the stack is initially empty:

```
PUSH AX
```

the high order 8-bit (AH) will be added to: // the low order 8bit(AL)
= SS*10 + SP-1H
= 1000 + FFFE -1
= 10FFDH

01000 + FFFEH -2H
= 10FFCH

4. (20 points) Find the value of the accumulator register (AL) which initially stores the hexadecimal value 0xD1 and the carry flag (CF) after the following operations. Assume that the operations are to be applied to this original value separately (not one after another) and assume that CF is cleared before all operations.

AL: D1
1101 0001

a. (5 points) `SAL AL, 2`

AL

0	1	0	0	0	1	0	0

CF

1

b. (5 points) `SHR AL, 3`

AL

0	0	0	1	1	0	1	0

CF

0

c. (5 points) `ROL AL, 2`

AX

0	1	0	0	0	1	1	1

CF

1

d. (5 points) `RCR AL, 3`

AX

0	1	0	1	1	0	1	0

CF

0

5. (20 points) Write down the assembly code to perform the following tasks. Do not make any assumptions, write all the necessary code for the required tasks using the specified methods.

a. (5 points) You are required to find the sum of two 32-bit numbers 0x56781234 and 0xABCDFED0. Store the first number in BX-AX and the second one in DX-CX registers. The final result will be stored in BX-AX.

```
mov BX 0x5678;        Add AX, CX;
mov AX 0x1234;        Adc BX, DX;
mov DX 0xABCD;
mov CX 0xFED0;
```

b. (5 points) Write down the assembly code to swap contents of two registers: AX and BX using the stack.

① `XCHG AX, BX;`

②
```
Push Ax;
Push Bx;
Pop Ax;
Pop Bx;
```

③
```
mov dx, ax;
mov ax, bx;
mov bx, dx;
```

c. (10 points) A list stored in variable TABLE stores the byte values of 3FH, 06H, 5BH, 4FH:

```
TABLE DB 3FH, 06H, 5BH, 4FH
```

You are required to access the second element in this table using translation, invert the middle four bits of this element and then add 1 to the result.

The final result should be stored in the offset address 0x30 of the data segment memory location accessed using destination index register (DI). Original table should not be altered in any way.

```
TABLE DB 3FH, 06H, 5BH, 4FH

mov AL, 1 ;
mov BX, offset TABLE;
XLAT;

XOR AL, 0x3C;
Inc AL;
mov DI, 0x30;
mov DS:[DI], AL ; // or  mov offset DI, AL
```


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