



I.T.Ü. Faculty of Computer and Informatics – Microprocessor Systems Midterm 1

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Time: 120 mins.

Student #	Name	Signature

Q1	Q2	Q3	Q4
25 %	30 %	30 %	15 %

Do Not Use Any Reference Other Than the Approved Printouts

Write your name on all answer sheets

Good Luck

Q1) A sample program for the Educational-CPU is provided below in machine code and the assembler. The contents for some of the registers and memory contents before executing the program are provided in the below table.

- Fill-in the Program Counter (PC) column for each instruction, and the (a), (b), (c), (d) fields.
- Complete the table for memory addresses and registers with their updated contents after the program execution.
- In order to execute the instruction in Step 14, how many memory read and how many memory write operations should be made?

Step	PC	Machine Code	Assembler
1	0010	20 05 0F FF	START YÜK SK, FFFF (a)
2	0014	70 45	ART SK
3	0016	4B 42	SİL C
4	0018	5D 42 (b)	ART C
5	001A	00 80 00 01	YÜK A, <SK+\$00>+01
6	001E	00 81 00 01	REW YÜK B, <SK+\$00>+01
7	0022	50 42	ART C
8	0024	43 01	TOP A, B
9	0026	89 02 (c)	DTV FWD
10	0028	80 F4 (d)	DAL REW
13	002A	01 80 00 01	FWD YAZ A, <SK+\$00>+01
14	002E	01 62 00	YAZ C, <SK+\$00>
15	0031	C3	SON KES

a) FFFF b) 50 c) 02 d) F4

Mem. Address or Register	Data (Before program execution)	Data (After program execution)
A	AA	5D
B	AA	80
C	AA	04
D	AA	—
SK	A000	1005
0FFF	15	—
1000	25	—
1001	39	—
1002	7F	—
1003	80	—
1004	81	5D
1005	82	04
1006	83	—
1007	84	—

c) 3 memory read, 1 memory write

Q2) Memory map for an 8-bit CPU with 16-bit address bus is as follows:

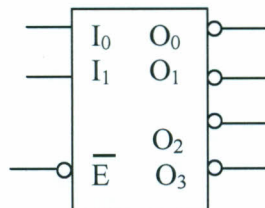
- RAM of 3Kx8 starting from address \$4000
- ROM of 2Kx8 ending at \$5FFF

The RAM chips to be used in the design are 1Kx8

The ROM chips to be used in the design are 2Kx8

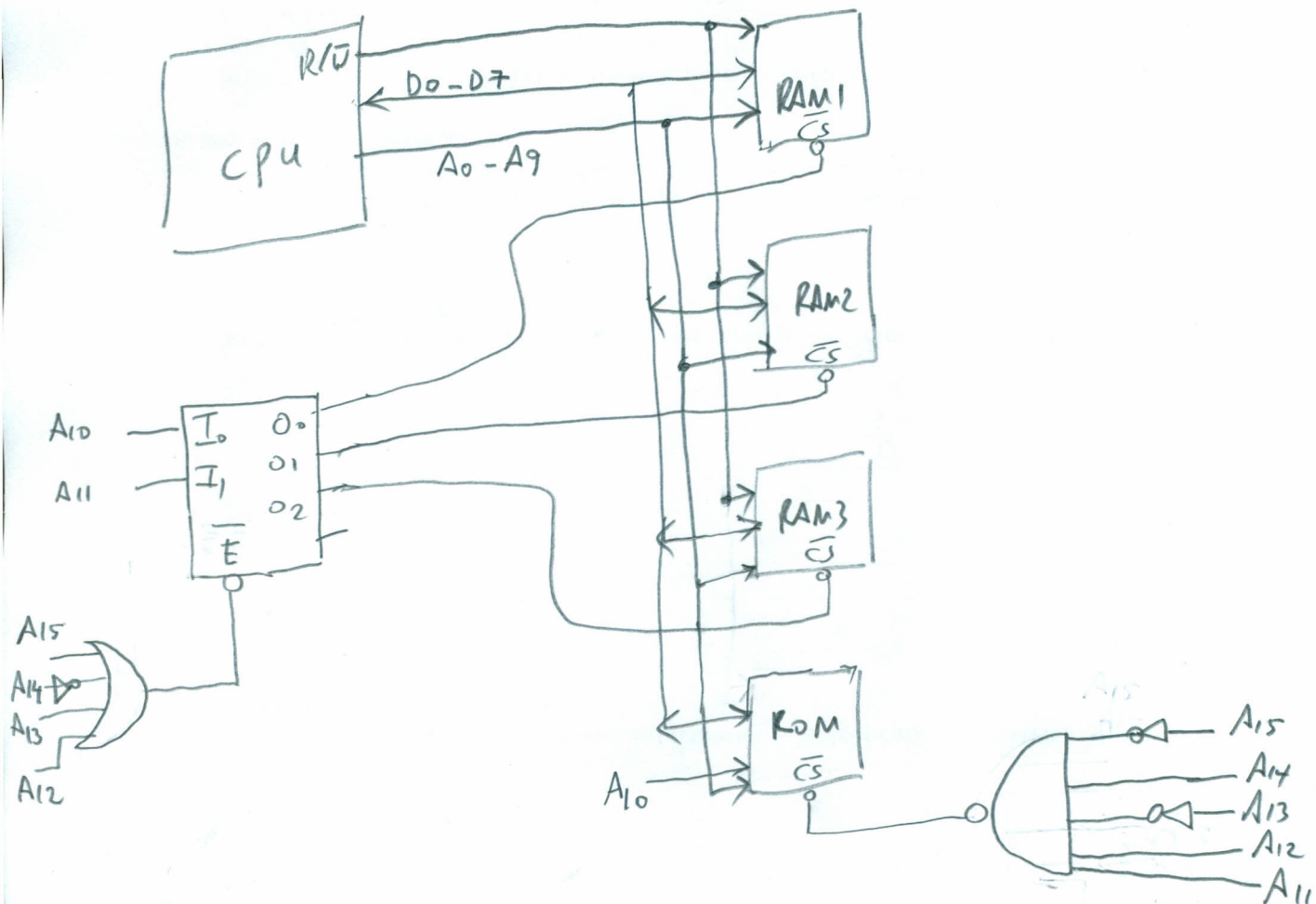
Design the memory unit using below decoder and minimum number of gates.

Show the connections to the CPU.



\overline{E}	I_1	I_0	O_0	O_1	O_2	O_3
1	X	X	1	1	1	1
0	0	0	0	1	1	1
0	0	1	1	0	1	1
0	1	0	1	1	0	1
0	1	1	1	1	1	0

RAM1 \$4000 to \$43FF
 RAM2 \$4400 to \$47FF
 RAM3 \$4800 to \$4BFF
 Rom \$5800 to \$5FFF



Q3) Ten unsigned 8-bit numbers are stored in memory starting at address \$1000

Write a program with the Instructions of the Educational-CPU that stores the largest and the smallest of these numbers in memory addresses \$1500 and \$1501. Write brief explanations next to your code lines. (Note: Write the code such that the number array is scanned only once)

(THERE ARE MANY WAYS TO WRITE THIS CODE. BELOW IS AN EXAMPLE)

```
START      SIL    $1500      : Max = $00
           YAZ    $FF, $1501  : Min = $FF
           YUK    SK, $1000   : SK (IX) will be used to scan
                               numbers.
           YUK    B, $0A      : Counter for 10 numbers
REW1       YUK    A, <SK + $00> + $01
           KAR    A, <$1500>
           DEI    LARGE      : If A > Max ⇒ Jump to Large
REW2       KAR    A, <$1501>
           DEU    SMALL      : If A < Min ⇒ Jump to SMALL
REW3       AET    B          : Decrement B
           SIN    B, $00
           DEE    FINISH     : Are all numbers scanned?
           DAL    REW1
LARGE     YAZ    A, $1500    : UPDATE $1500 if Large
           DAL    REW2
SMALL     YAZ    A, $1501    : update $1501 if small
           DAL    REW3
FINISH    KES
```

Q4) Explain briefly the main features that characterize the capabilities of a CPU.

Speed: Amount of process done in certain time.

Word length

instruction set and, instruction format

addressing capability: (addressing modes)

addressing Capacity

understand what these are.