EASTERN MEDITERRANEAN UNIVERSITY

Faculty of Engineering
Department of Computer Engineering

CMPE 323: Microprocessors

Final Exam

Lecturer: Prof.Dr. Hasan Kömürcügil

Date: 27 / 01 / 2016
Time Allowed: 110 minutes

Name and Surname: SOLUTION

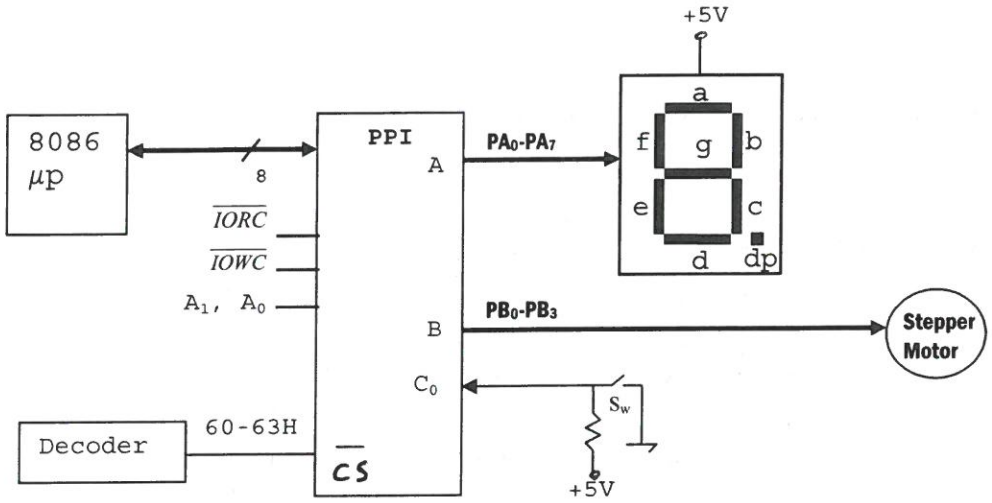
Student Number: .....

- There are 6 questions in this exam paper.
- Answer **all** questions.
- Write **clearly** and **tidily.**
- Correct answers **without sufficient explanation** might not get full points!
- Mobile phones **must be switched off** in the exam room.

Question	Points Gained
Q1 *(24 points)*	
Q2 *(12 points)*	
Q3 *(20 points)*	
Q4 *(14 points)*	
Q5 *(14 points)*	
Q6 *(16 points)*	
Total	

Q1) [24 *points*]

In the following system, the stepper motor is rotated clockwise (to the right) direction and "!¯" is displayed on the 7-segment if the switch (S_w) is closed. The motor rotates anti-clockwise (to the left) direction and "!_" is displayed on the 7-segment if the switch is open. After each rotation, the switch position should be detected. Complete the following assembly program that fulfils this task.



Note1: The command register format of the PPI is: `1 0 0 A Ch 0 B Cl`

`1=Input`
`0=Output`

Note 2: The 7-segmet display format is :

A7	A6	A5	A4	A3	A2	A1	A0
a	b	c	d	e	f	g	dp

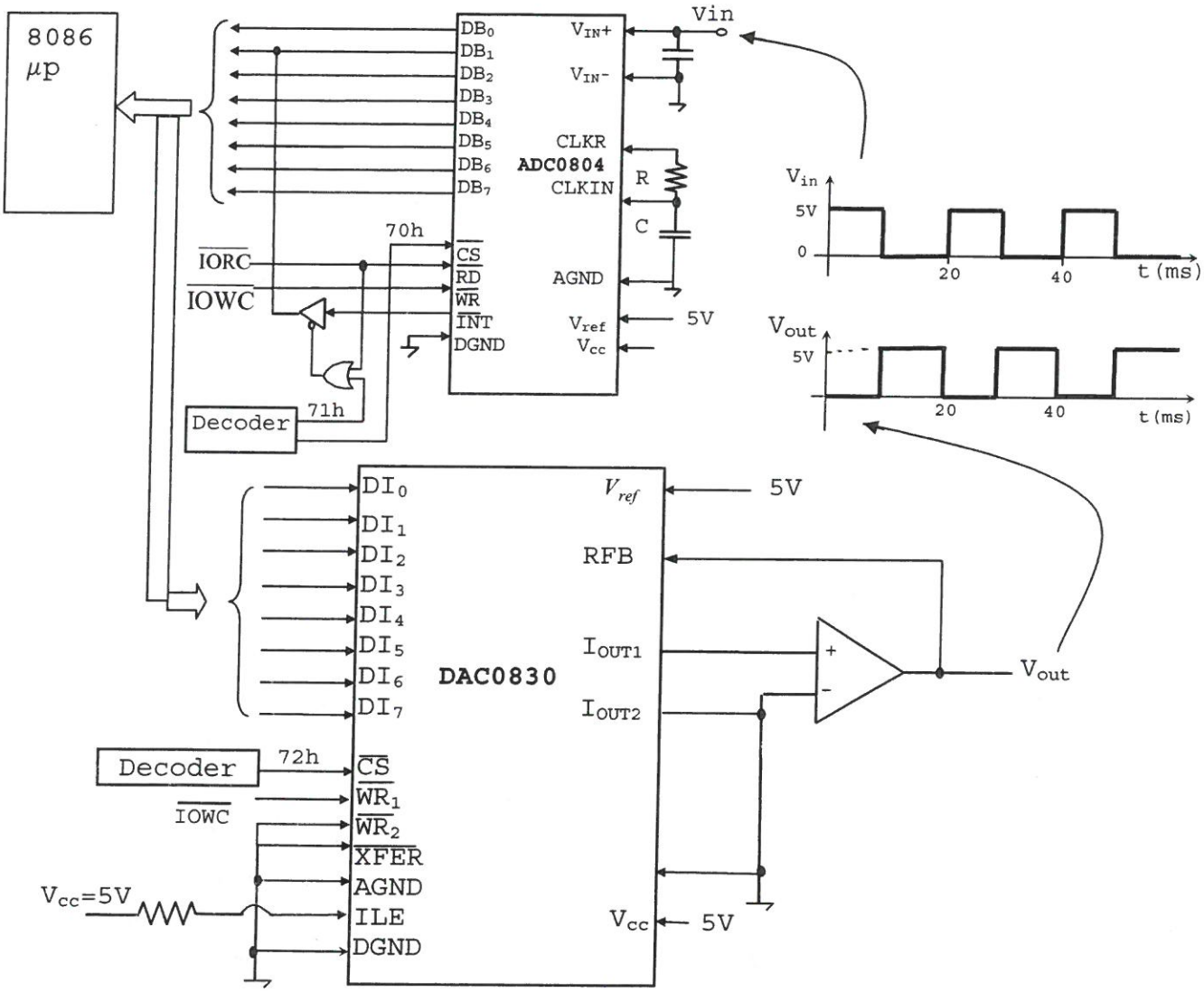
```
        Dosseg
        .Model small
        .Code
        Mov al, 10000001B
        Out 63h,al
        Mov bl,11001100B
Switch: In al, 62h
        And al,00000001B
        Shr al,1
        Jnc  Right
        Mov al, 11100011B
        Out 60h,al
        Rol bl, 1
        Mov al,bl
        Out 61h,al
        Call Delay
        Mov bl,al
        Jmp Switch
```

```
Right:  Mov al,01110011B
        Out 60h, al
        Ror bl,1
        Mov al, bl
        Out 61h,al
        Call Delay
        Mov bl,al
        Jmp Switch

Delay:  ..... 1μs
        ret
```

Q2) [12 pts]

Consider the following system. The 8-bit ADC0804 converter takes samples from the square waveform (V_{in}) and converts each sample into its 8-bit binary equivalent. Each 8-bit binary data is then transferred to the microprocessor by the help of "in" instruction used in the assembly program. Thereafter, the 8-bit data is processed by the assembly program in the microprocessor so as to produce a square waveform (V_{out}) at the output of the DAC0830 converter as shown below. In both converters 5V corresponds to FFh. Complete the following assembly program that fulfils this task.




```
                Dosseg
                .Model small
                .Code
Start:          Out 70h,al
Notrdy:         In al,71h
                Test al,02h
                Jnz Notrdy
                In al,70h
                Cmp al,0FFh
                Je Reverse
```

```
Reverse:        Mov al,0FFh
                Out 72h,al
                Jmp Start
                Mov al,0
                Out 72h,al
                Jmp Start
```

Q3) [20 *points*]

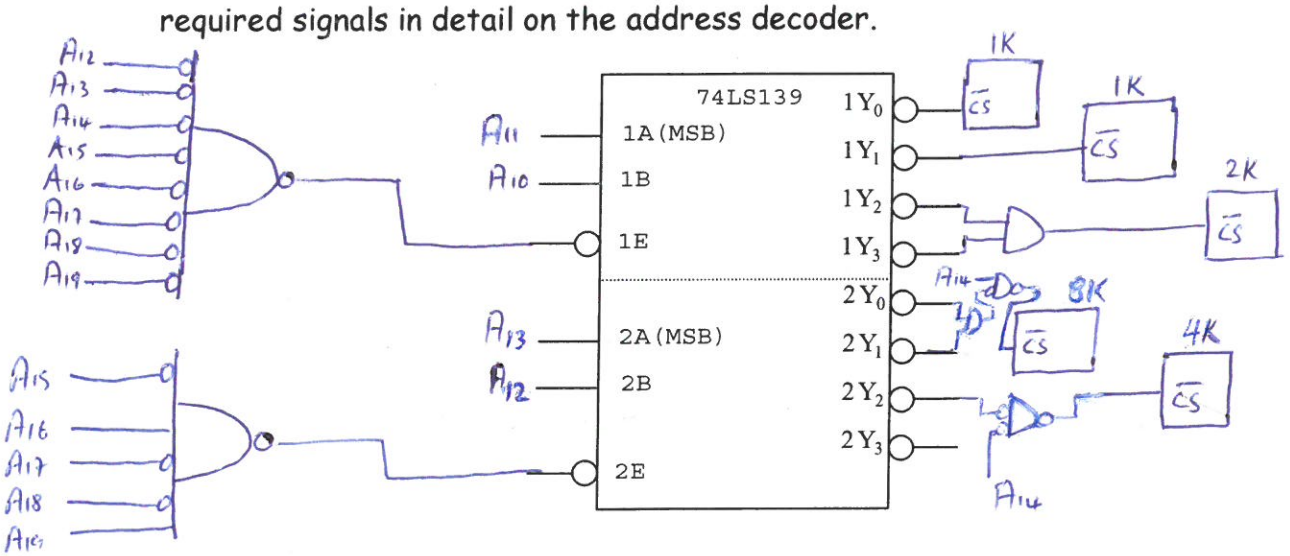
It is required to add 16KB of memory to an 80386 microprocessor based system which has 20-bit address and 8-bit data buses in the following address ranges:

- 2 (1Kx8) RAM chips to decode 00000h-007FFh
- 1 (2Kx8) RAM chip to decode 00800h-00FFFh
- 1 (4Kx8) RAM chip to decode 92000h-92FFFh
- 1 (8Kx8) RAM chip to decode 94000h-95FFFh

a) *[7 points]* Fill in the following table

A_{19}	A_{18}	A_{17}	A_{16}	A_{15}	A_{14}	A_{13}	A_{12}	A_{11}	A_{10}	A_9	A_8	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	Range
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	00000
0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	003FF
0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	00400
0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	007FF
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	00800
0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	00FFF
1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	92000
1	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	92FFF
1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94000
1	0	0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	95FFF

b) *[10 points]* Using 74LS139 decoder shown below, design an address decoding circuit to decode the above address ranges. Show your connections and the required signals in detail on the address decoder.



c) *[3 points]* How much memory (both size and its range) is available in the memory map for an additional memory chip?

Available address ranges in the memory map:

01000 - 91FFF

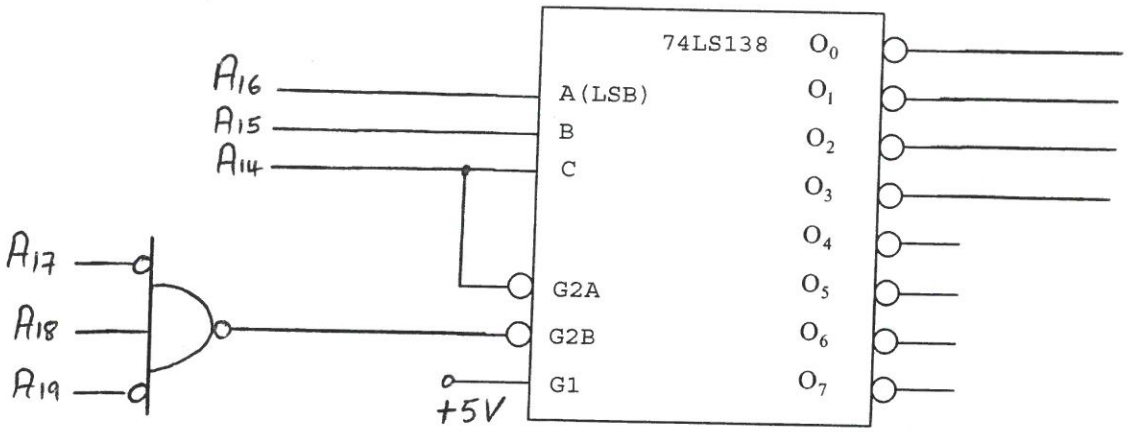
93000 - 93FFF

96000 - FFFFF

$\Rightarrow$ 1024 - 16 = 1008KB

Q4) [14 *points*]

Consider the following address decoding circuit.



a) *[12 points]* Determine the address range (in Hexadecimal) and size (in KB) for the outputs O_0, O_1, O_2 and O_3 of the 74LS138 decoder.

A_{19}	A_{18}	A_{17}	A_{16}	A_{15}	A_{14}	A_{13}	A_{12}	A_{11}	A_{10}	.....	A_0	Range (in H)
0	1	0	0	0	0	0	0	0	0	.....	0	40000 - 43FFF → O_0 (16K)
0	1	0	0	0	0	1	1	1	1	.....	1	
0	1	0	1	0	0	0	0	0	0	.....	0	50000 - 53FFF → O_1 (16K)
0	1	0	1	0	0	1	1	1	1	.....	1	
0	1	0	0	1	0	0	0	0	0	.....	0	48000 - 4BFFF → O_2 (16K)
0	1	0	0	1	0	1	1	1	1	.....	0	
0	1	0	1	1	0	0	0	0	0	.....	0	58000 - 5BFFF → O_3 (16K)
0	1	0	1	1	0	1	1	1	1	.....	1	

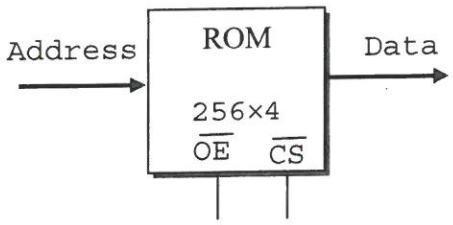
b) *[2 points]* What is the total size (capacity) of memory chip that can be connected to the other outputs of the decoder?

Since A_{14} is connected to G2A, then the decoder is never enabled when $A_{14} = 1$.

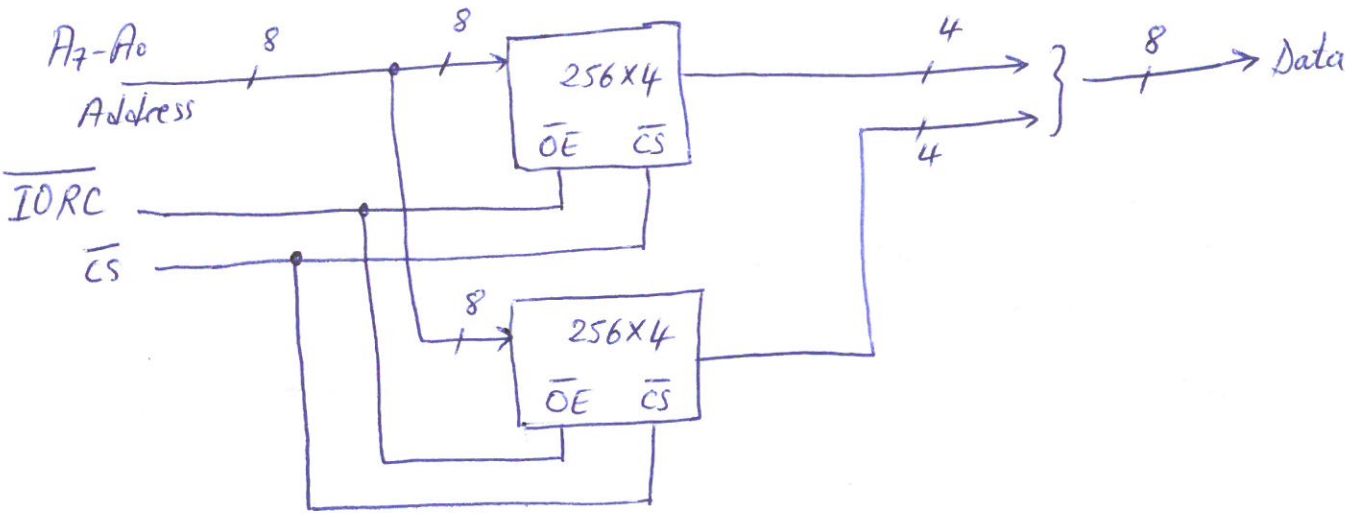
Therefore, the outputs O_4, O_5, O_6, and O_7 cannot be connected to the memory chips. If they are connected to the memory chips, these chips will not be selected which results in 0KB.

Q5) [14 *points*]

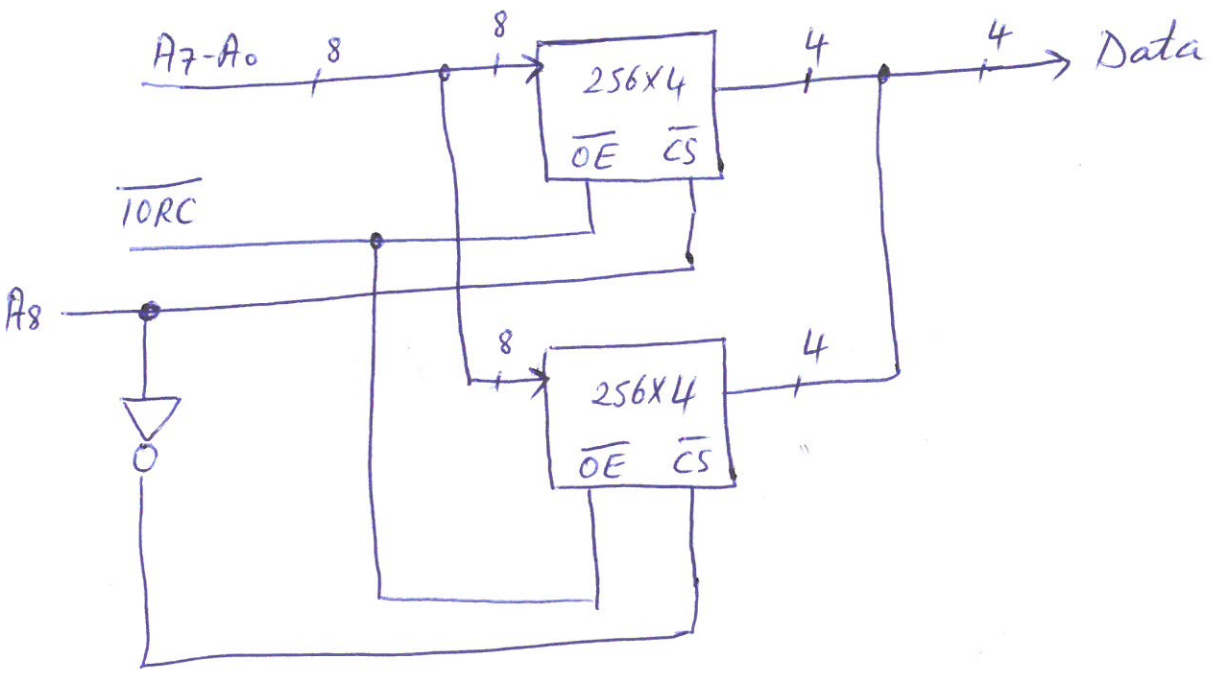
Consider the following block diagram of a ROM chip.



a) *[7 points]* Using the ROM chip shown above, design a 256x8 ROM.

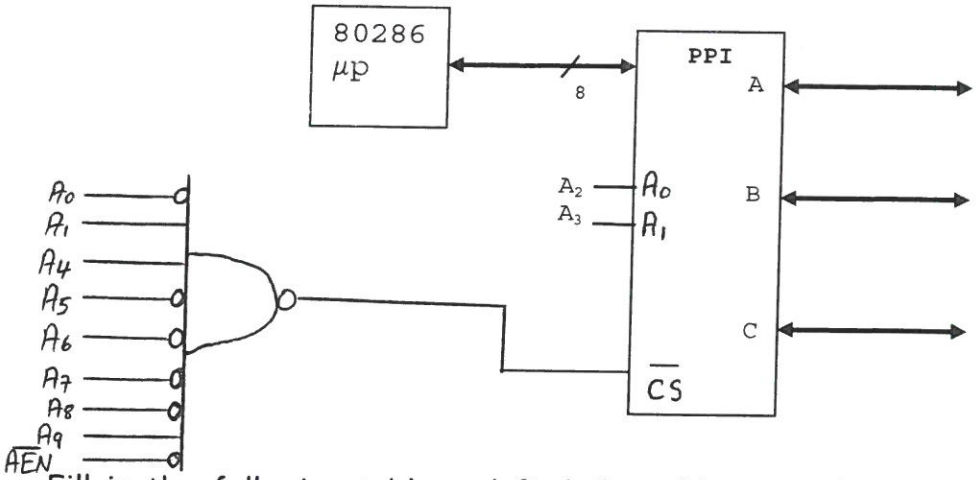


b) *[7 points]* Using the ROM chip shown above, design a 512x4 ROM.



Q6) [16 *points*]

Consider the following PPI register addressing circuit.



Fill in the following table and find the addresses of ports A, B, and C and the command register and record them into the table.

$\overline{AEN}$	A_9	A_8	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	Port Name or C. Register	Address (in Hex)
0	1	0	0	0	0	1	0	0	1	0	Port A	212
0	1	0	0	0	0	1	0	1	1	0	Port B	216
0	1	0	0	0	0	1	1	0	1	0	Port C	21A
0	1	0	0	0	0	1	1	1	1	0	Command Reg	21E