EASTERN MEDITERRANEAN UNIVERSITY

Faculty of Engineering

Department of Computer Engineering

CMPE 323: Microprocessors

Final Exam

Date: 30 / 05 / 2017

Lecturer: Hasan Kömürcügil

Time Allowed: 110 minutes

Name and Surname: ......SOLUTION......

Student Number: ....

- There are <u>5</u> 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 *(24 points)*	
Q3 *(16 points)*	
Q4 *(20 points)*	
Q5 *(16 points)*	
Total	

Q1) [24 *points*]

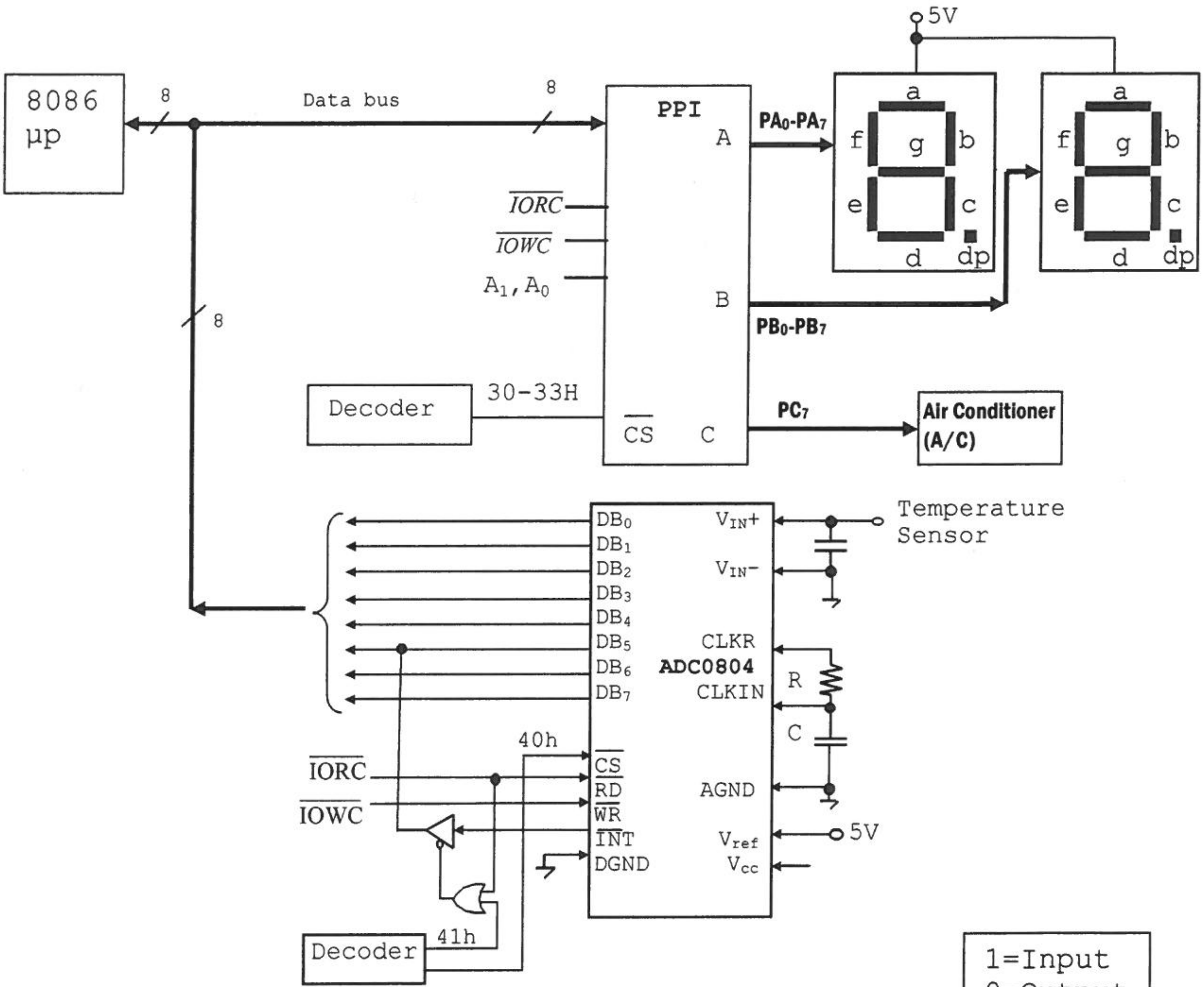
Consider the following system. It is required to display "ON" or "OF" on the common anode 7-segment display units based on the actual temperature (temp) value which is sensed by the temperature sensor and digitized by the ADC as shown below.

When the temp>22° C → display "On" and send a signal (C_7=1) to A/C.

When the temp<22° C → display "OF" and send a signal (C_7=0) to A/C.

When the temp=22° C → display nothing and send a signal (C_7=0) to A/C.

Note that 8-bit <u>binary representation</u> of 22° C in the ADC is 1000001. Write down an assembly program to fulfil this task.



1=Input
0=Output

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

Note 2: The 7-segmet display format for A and B is :

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

```
        Dosseg
        .Model small
        .Code
        Mov al, 80h
        Out 33h, al
Start:  Out 40h, al
Notrdy: In al, 41h
        Test al, 20h
        Jnz Notrdy
        In al, 40h
        Cmp al, 81h
        Je Dark
        Ja On
Off:    Mov al, 11000000b   ; display O
        Out 30h, al
        Mov al, 10001110b   ; display F
        Out 31h, al
        Mov al, 0
        Out 32h, al
        Jmp Start
On:     Mov al, 11000000b   ; display O
        Out 30h, al
        Mov al, 11001000b   ; display n
        Out 31h, al
        mov al, 80h
        Out 32h, al
        Jmp Start
Dark:   Mov al, 0FFh        ; dark display
        Out 30h, al
        Out 31h, al
        Mov al, 0
        Out 32h, al
        Jmp Start
```

Q2) [24 pts]

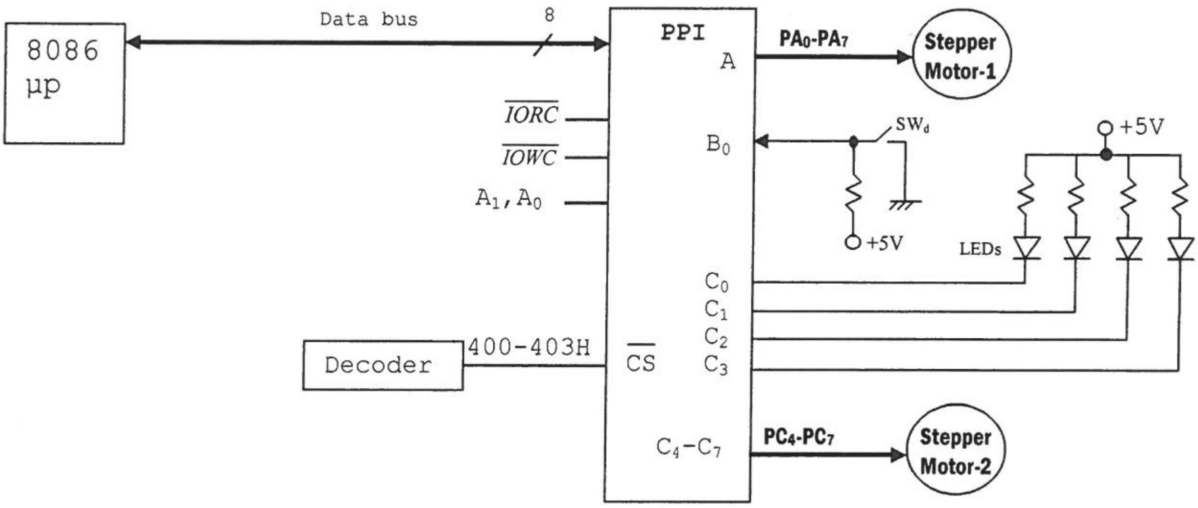
Consider the following system. It is required to control the stepper motors as follows:

i) The direction of rotation is determined by the position of SW_d (**Closed**:clockwise, **Open**:anti-clockwise).

ii) Each motor is supposed to make 20 rotations. The time between each rotation for stepper motor-1 and stepper motor-2 are 2*μs* and 4*μs*, respectively. This means that the stepper motor-1 is twice faster than the stepper motor-2.

iii) The LEDs are turned ON or OFF with the same 4-bit data used to rotate the motors.

Complete the following an assembly program to accomplish the above task.



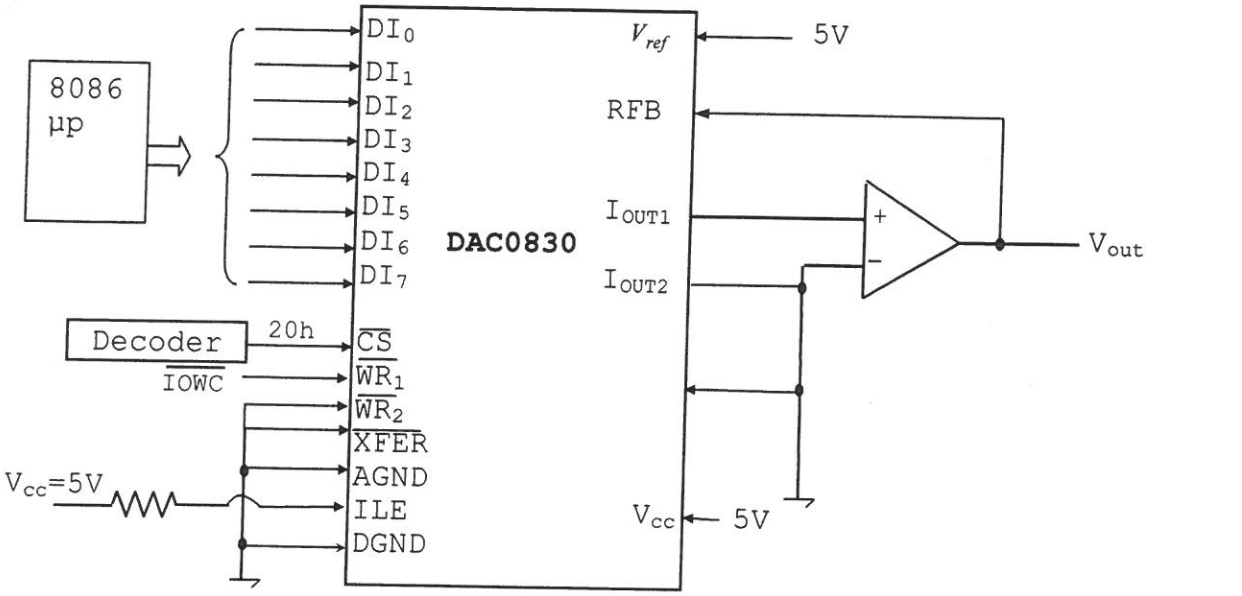

```
        Dosseg
        .Model small
        .Code
        [Mov al, 82h]
        Mov dx,403h
        Out dx,al
        Mov cx,20
        [Mov bl, 11001100b]
Start:  Mov dx,401h
        [In al, dx]
        And al,00000001b
        Cmp al,01h
        [Je Ccw]
        Mov al, bl
Cw:     Mov dx,400h
        [Ror al, 1]
        [Out dx,al]
        Call delay
        Mov dx,402h
        Out dx,al
        Call delay
        Call delay
        [Loop Cw]
        Mov bl, al
        [Jmp Start]
Ccw:    Mov al, bl
Ccw1:   Mov dx,400h
        [Rol al, 1]
        Out dx,al
        Call delay
        [Mov dx, 402h]
        Out dx,al
        [Call delay]
        Call delay
        Loop Ccw1
        [Mov bl, al]
        Jmp Start

Delay:  .....  2μs
        .....
        .....
        ret
```

Q3) [16 *points*]

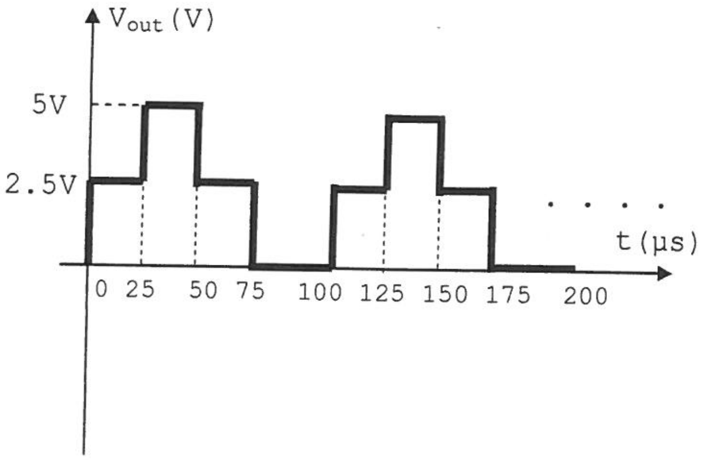
Consider the following DAC0830 interfaced to an 8086 microprocessor. It is required to produce an analog waveform (V_{out}) at the output of DAC.

(a) *[12 points]* Assuming that the hexadecimal numbers 00h and FFh correspond to 0V and 5V, respectively, write an assembly program to produce V_{out}.




```
.Code
Start: Mov cx, 25
       mov al, 127
T1:    Out 20h, al
       call delay
       Loop T1
       mov cx, 25
       mov al, 255
T2:    Out 20h, al
       call delay
       Loop T2
       mov cx, 25
       mov al, 127
T3:    out 20h,al
       call delay
       Loop T3
       mov cx, 25
       mov al, 0
       out 20h, al
       call delay
       jmp start

Delay:       ....1µs
             ....
             ret
```



(b) *[4 points]* Find the approximate <u>period</u> and <u>frequency</u> of V_{out}.

Period, $T = 100\mu s$

Frequency, $f = \frac{1}{T} = \frac{1}{100 \times 10^{-6}} = 10kHz$

Q4) [20 pts]

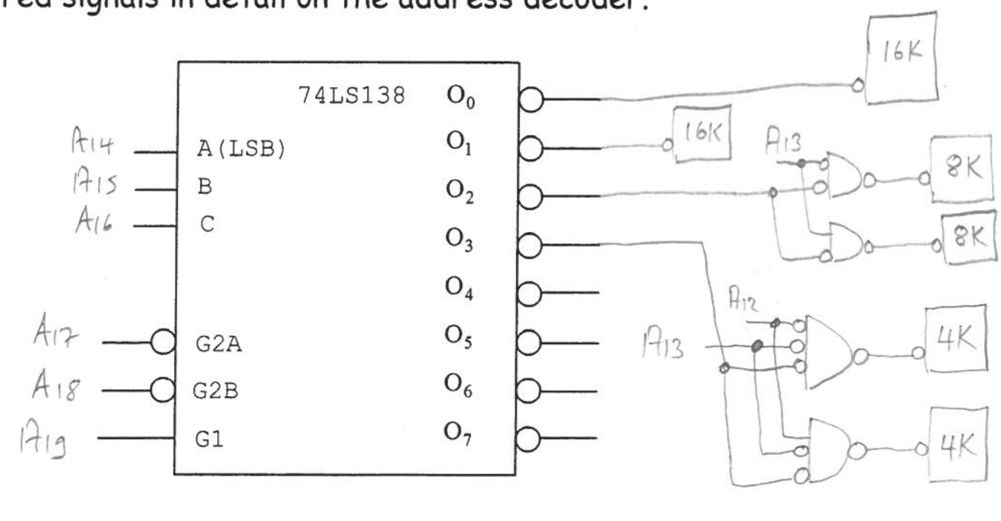
It is required to interface the following memory chips to an 80386 microprocessor based system which has 20-bit address and 8-bit data buses in the following address ranges:

- 2 (16Kx8) RAM chips to decode 80000h-87FFFh
- 2 (8Kx8) RAM chip to decode 88000h-8BFFFh
- 2 (4Kx8) RAM chip to decode 8C000h-8DFFFh

a) *[3 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
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80000
1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	83FFF
1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84000-
1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	87FFF
1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	88000-
1	0	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	89FFF
1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	8A000-
1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	8BFFF
1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8C000-
1	0	0	0	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	8CFFF
1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	8D000-
1	0	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	8DFFF

b) *[14 points]* Using 74LS138 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.



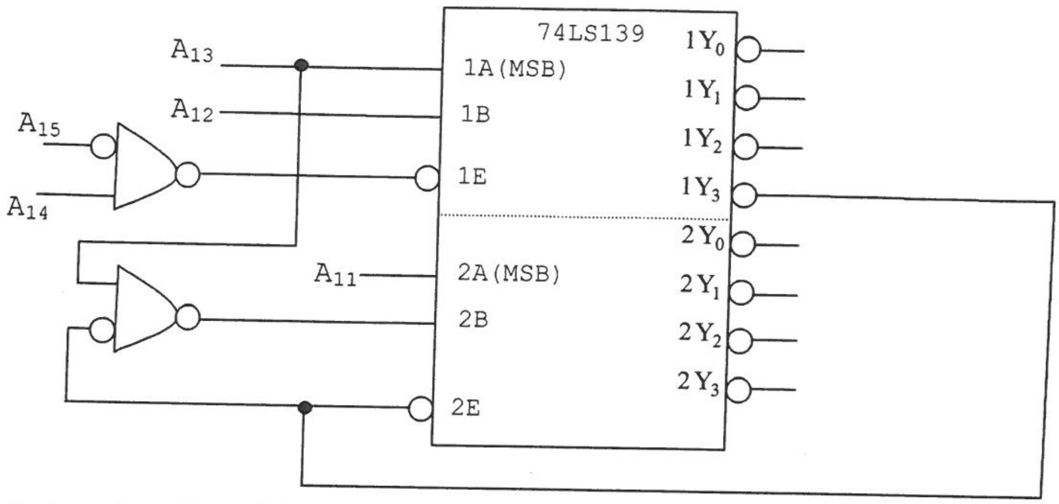
c) *[3 points]* How much memory is available in the memory map for an additional memory chip? Give size and range.

Available Ranges: 00000 – 7FFFF
8E000 – FFFFF

Availabe Size = 1024 – (32+16+8) = 968 KB

Q5) [16 *points*]

Consider the following address decoding circuit.



Determine the address range (in Hexadecimal) and size (in KB) for the RAM chips and record them into the following table.

	Decoded address range (in hex)	Decoded size (in KB)
$1Y_0$	4000 – 4FFF	4K
$1Y_1$	5000 – 5FFF	4K
$1Y_2$	6000 – 6FFF	4K
$1Y_3$	7000 – 7FFF	4K
$2Y_0$	7000 – 77FF	2K
$2Y_1$	Does not exist	—
$2Y_2$	7800 – 7FFF	2K
$2Y_3$	Does not exist	—

A_{15}	A_{14}	A_{13}	A_{12}	A_{11}	A_{10}	- - - - - -	A_0	
0	1	0	0	0	0	- - - - - -	0	) $1Y_0$: 4000 - 4FFF (4K)
0	1	0	0	1	1	- - - - - -	1	
0	1	0	1	0	0	- - - - - -	0	) $1Y_1$: 5000 - 5FFF (4K)
0	1	0	1	1	1	- - - - - -	1	
0	1	1	0	0	0	- - - - - -	0	) $1Y_2$: 6000 - 6FFF (4K)
0	1	1	0	1	1	- - - - - -	1	
0	1	1	1	0	0	- - - - - -	0	) $1Y_3$: 7000 - 7FFF (4K)
0	1	1	1	1	1	- - - - - -	1	
0	1	1	1	0	0	- - - - - -	0	) $2Y_0$: 7000 - 77FF (2K)
0	1	1	1	0	1	- - - - - -	1	
0	1	1	1	1	0	- - - - - -	0	) $2Y_2$: 7800 - 7FFF (2K)
0	1	1	1	1	1	- - - - - -	1	