Alexandria University
Faculty of Engineering
Electrical Engineering Department
January 2016

جامعة الإسكندرية
كلية الهندسة
قسم الهندسة الكهربية
يناير ٢٠١٦

Course title : Microprocessors-1
Year : 3rd year Communications
Time allowed: 3 hours

اسم المقرر والرقم الكودى له: المعالجات الدقيقة-١
السنة الدراسية : ثالثة- اتصالات
مدة الإمتحان : ٣ ساعات (للجزئين)

The examiners: Dr. Hossam Eldin Mostafa, and Dr. Nayera Sadek.

Part II: Hardware

Answer the following questions:

Question 1: [15 Marks]

a) Design a memory system for 8088 microprocessor. The data memory is designed using 6264 chips and occupies the address range 80000-8FFFF. The code memory is designed using 2816 chips and occupies 8K Byte starting from address F2000. Draw the complete design and write down the memory map for each chip. Use gates and decoder chips for selecting the memories.

b) In a typical minimum mode 8088 microprocessor system, state the direction and function of each of the following pins:
i) **Ready**   ii) ***TEST**   iii) **IO/*M**   iv) **HOLD**   v) ***INTA** (note: * indicates negation)

c) Draw a fully buffered 8086 microprocessor system.

Question 2: [15 Marks]

a) Show how the internal memory of AT89S52 microcontroller is organized.

b) Draw the hardware connection between AT89C52 microcontroller and a 64K of external data memory and a 64K of external code memory. Write an assembly language program to clear memory locations 5000H to 5040H.

c) Write an 8051 assembly language program that generates a square wave of the highest possible frequency on pin P1.0. Assuming 6 MHz crystal, what is the frequency of the generated wave?

Question 3:   [15 Marks]

a) Atmel manufactures the following 8051 based microcontrollers: AT89C52, AT89C4051, AT89S52, AT89C51ED2, and AT89LP214. Compare between those microcontrollers with respect to pin count, flash memory, method of hardware programming, and speed. Describe the software and hardware tools required for developing assembly and C language programs for those microcontrollers.

b) You are asked to design a light control product based on AT89S52 microcontroller. A push button switch is connected with a pull up resistor to pin P2.0 and a 220V AC Bulb is connected to a relay controlled via pin P3.0. Draw the complete design and write a Keil C program that turns on the bulb for 5 minutes after pressing the button then turns it off. You may use Timer 1 in adjusting the delay assuming 12MHz crystal. Discuss how this product can extensively save the electrical consumption.

c) For your lab project, draw the minimum system to start working with ATSTAMP. Write a C Builder program to read the status of 8 DIP switches connected to P0 and output the corresponding hexadecimal number on two multiplexed common anode seven segments displays connected to P1. You may use any pins of P3 to access the displays. Draw the complete design without using extra display decoder ics. You may use transistors and resistors in your design.

Question 4:   [15 Marks]

a) Intel introduced 8051 microcontroller in 1980 and till now, it is used in teaching academic courses and products all over the world. According to the lectures, discuss this statement.

b) Some of the following 8051 instructions are true and others are false. Show what is achieved by the correct statements and correct the false ones.
   i)   CPL P2.2
   ii)   ANL C, 25H
   iii) PUSH A
   iv)   DEC DPTR
   v)   CLR @R3

c) What does the following 8051 program do? Give explanation for your answer assuming that the crystal frequency is 11.0592 MHz.

```
           MOV   TMOD, #10H
again:     MOV   TL1, #34H
           MOV   TH1, #76H
           SETB  TR1
back:      JNB   TF1, back
           CLR   TR1
           CPL   P1.5
           CLR   TF1
           SJMP  again
```

TCON

TF1	TR1	TF0	TR0	IE1	IT1	IE0	IT0

TMOD

Gate	C/T̄	M1	M0	Gate	C/T̄	M1	M0

SCON

SM0	SM1	SM2	REN	TB8	RB8	TI	RI

PCON

SMOD	-	-	-	GF1	GF0	PD	IDL

IP

-	-	PT2	PS	PT1	PX1	PT0	PX0

IE

EA	-	ET2	ES	ET1	EX1	ET0	EX0

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The examiners: Dr. Hassam Eldin Mostafa, and Dr. Nayera Sadek.

Part I: Software

Answer the following questions:

Question 1: [10 Points]

a) Using the values shown in Figure 1, answer the following questions.
  1) What is the physical address of the next instruction be executed?
  2) If the SP is initialized by 0000H, how many words can be pushed to the stack without overwriting?
  3) Using the packed BCD format, what is the 4-digit BCD number stored starting at the address DS:0014?
  4) Using the IEEE-754 short-form, what is the real number pointed by the BP register?
  5) How many interrupt does the 8086 microprocessor support? What is the physical address range of the interrupt vector number 20?

b) Write an instruction that performs each of the following tasks:
  1) Change the content of AX from CFF6 H to 8574 H.
  2) Check if the MSB of CX is 1 or 0.
  3) Check if BX is less or greater than 1234 H.
  4) Divide the signed number stored in DX by 2.
  5) Insert breakpoint in the program.

Question 2: [10 Points]

Trace each of the following programs by constructing a table as shown:

Instruction	Register(s) affected	Flag register	Memory location affected
...	...	...	......

For each program, use the values shown in Figure 1 as initial values.

Program 1	Program 2
LEA BX, [BP+DI]	LES DI, [BP+SI+0FFFC H]
NEG AL	IDIV CL
XLAT	MOV CH,AH
SBB CL, AL	REP STOSB

Program 3	Program 4
XOR AL, AL	CLC
CBW	RCR BP, CL
SAHF	INC BYTE PTR [BP+DI]
IRET	ADD DH, [BP+DI]

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Question 3: [10 points]

Using the values shown in Figure 1 and Program 5, and assume that the logical address of COMPUTE is 8C00: 1000H, Answer the following questions:

1) What are the addressing modes used in lines 2 and 4?

2) Write the content of the register(s) changed after executing line 5.

3) Assume CX = 10 H and the data on the input is 06 H,
   i) Show the contents of the stack after executing line 16.
   ii) What are the contents of AX, CX, SI, DI after executing line 18?
   iii) What is the data on the output port after executing line 6?

   30000

4) If the logical address of AGAIN is CS:01B0 H, what is the machine code of the instruction in line 10?

   31B0

5) What is the function of the code from line 8 to line 10?

6) What are the address and the data size of the input and output ports?

   20

   0000 0000 0010 0000   0000 0000 0001 00   0

Program 5
1. MOV CX, 10 H
2. MOV DX, 0725 H
3. CLD
4. NEXT: IN AL, DX
5. CALL COMPUTE
6. OUT 15H, AL
7. MOV BX, 1000
8. AGAIN: NOP
9. CMP BX, 0
10. JNE AGAIN
11. LOOP NEXT
12. HLT   *8C00 : 1000 H*
13. COMPUTE PROC FAR
14. PUSH CX
15. PUSH SI
16. PUSH DI
17. MOV CX, 10H
18. REPNE SCASB
19. DEC DI
20. MOV SI, DI
21. MOV AL, [SI]
22. POP DI
23. POP SI
24. POP CX
25. RET
26. COMPUTE ENDP

AX = FFF4H, BX = 5E38H, CX = F503H, DX = F920H,
SI = 0000H, DI = 0010H, BP = 0020H, SP = 0020H, IP = 0100H
CS = 1000H, DS = 3000H, SS = 3001H, ES = 3000H, Flag register = 0101H.
Part of memory locations are given as follows (in hexadecimal):

3000:0000	24	15	18	46	57	3F	5A	29	1A	4E	19	30	28	5D	3B	30
3000:0010	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10
3000:0020	F4	A2	25	85	0B	0F	05	08	02	01	06	0C	00	00	03	30
3000:0030	00	40	87	42	A7	06	B5	78	04	05	08	10	0A	08	51	67

Figure 1

The flag register

				O	D	I	T	S	Z		A		P		C

Figure 2

The conditional jump instructions

JNE/JNZ	ZF=0		Jumps not equal/Jumps not zero

Figure 3

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Explanation

Code	Explanation
00	Memory mode, no displacement
01	Memory mode, 8-bit displacement
10	Memory mode, 16-bit displacement
11	Register mode, no displacement

*Except when R/M=110, then 16 bit displacement

Mode = 11

R/M	W=0	W=1
000	AL	AX
001	CL	CX
010	DL	DX
011	BL	BX
100	AH	SP
101	CH	BP
110	DH	SI
111	BH	DI

Effective address Calculation

R/M	Mode=00	Mode=01	Mode=10
000	[BX]+[SI]	[BX]+[SI]+D8	[BX]+[SI]+D16
001	[BX]+[DI]	[BX]+[DI]+D8	[BX]+[DI]+D16
010	[BP]+[SI]	[BP]+[SI]+D8	[BP]+[SI]+D16
011	[BP]+[DI]	[BP]+[DI]+D8	[BP]+[DI]+D16
100	[SI]	[SI]+D8	[SI]+D16
101	[DI]	[DI]+D8	[DI]+D16
110	Direct address	[BP]+D8	[BP]+D16
111	[BX]	[BX]+D8	[BX]+D16

MOV=Move:

Register/memory to/from register	100010dw	Mod Reg R/M	Disp-lo	Disp-hi		
Immediate to register/memory	1100011w	Mod 000 R/M	Disp-lo	Disp-hi	Data	Data w=1
Immediate to register	1011 w Reg	Data	Data w = 1			
Memory to accumulator	1010000w	Addr-lo	Addr-hi			
Accumulator to memory	1010001w	Addr-lo	Addr-hi			
Register/memory to seg. register	10001110	Mod 0 SR R/M	Disp-lo	Disp-hi		
Seg. register to register/memory	10001100	Mod 0 SR R/M	Disp-lo	Disp-hi		

NOP	1001 0000	
JNE	0111 0101	disp

CMP:Compare

Register/Memory and Register	001110d w	Mod Reg R/M		
Immediate with Register/Memory	100000 s w	Mod 111 R/M	Data	Data sw=01
Immediate with Accumulator	0011110 w	Data	Data w=1	

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