INTRODUCTION TO MICROCOMPLITERS SECOND EXAM
(Summer School - 2009)

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#1)

```
        ORG     0000h.
        LXI     SP, OFFFFh
        MVI     A, OFFh.
TOP     MVI     B, 08h.
        MVI     C, 00h
BB!     RRC
        JNC     AA
        INR     C
AA!     DEC     B
        JNZ     BB
        CALL    SALIH
        NOP
        DCR     A
        JNZ     TOP
        HLT
        NOP
        NOP
        ORG     0100h
SALIH   NOP
        PUSH    B
        MVI     C, 10h.
DD!     CALL    FADIL
        NOP
        DCR     C
        JNZ     DD
        POP     B
        RET
FADIL!  NOP
        PUSH    B
        MVI     C, 20h
EE:     NOP
        NOP
        DCR     C
        JNZ     EE
WW:     NOP
        POP     B
        RET.
```

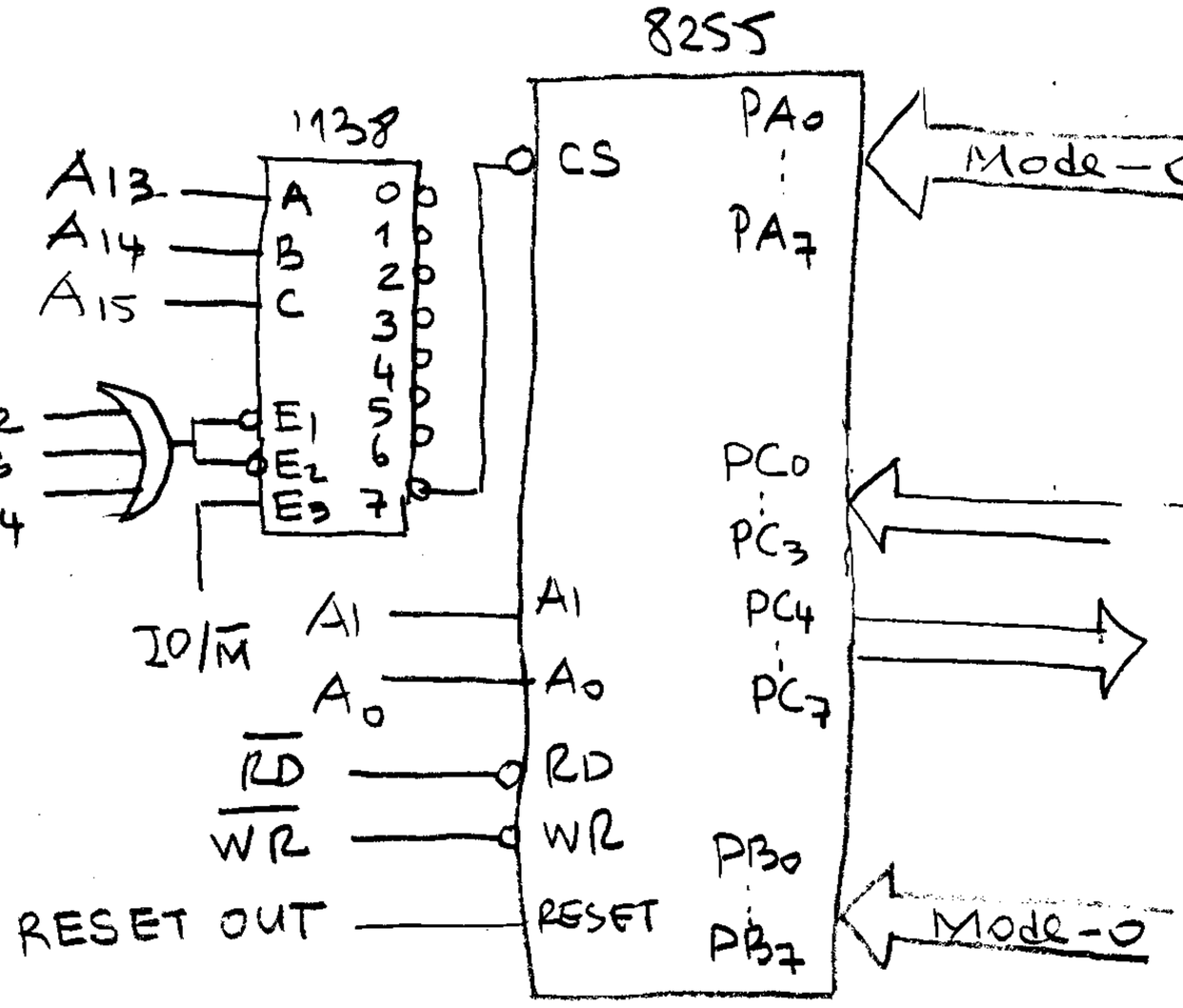
Consider the assembly program that will be run on an 8085 based microprocesser system. The 8085 has 2 MHz cyristal.

a) Calculate the execution time for SALIH subroutine when it is called fourth time from the main program.

b) Determine the content of the stack when the program reaches the point labeled as WW in the program <u>first time</u>.

see back →

#2)



a) Consider the system shown in the above figure and write the necessary instructions to program the 8255 as shown in the program.

b)

```
SUB:  MVI   A, 00h
      OUT   PORTC
      IN    PORTC
      ANI   00001111b
      JNZ   ONES
      JMP   ZEROS
      NOP
      NOP
      NOP

ONES: MVI   B, 08h
      MVI   C, 00
      IN    PORTA
LL:   RRC
      JNC   KK
      INR   C
KK:   DCR   B
      JNZ   LL

      MVI   B, 08h
      IN    PORTB
MM:   RRC
      JNC   TT
      INR   C
TT:   DCR   B
      JNZ   MM
      MOV   A, C
      OUT   PORTC
      JMP   SON

ZEROS: MVI  B, 08h
       MVI  C, 00h
       IN   PORTA
XX:    RRC
       JC   NN
       INR  C
NN     DCR  B
```

(RRC RRC RRC RRC) ↑ added after the exam.

```
        JNZ   XX
        MVI   B, 08h
        IN    PORTB
YY:     RRC
        JC    SS
        INR   C
SS:     DCR   B
        JNZ   YY
        MOV   A, C  <-- { RRC, RRC, RRC, RRC }  added after the exam
        OUT   PORTC
SON:    NOP
        RET
```

i) Explain the function of the above subroutine shortly (not line by line) and fill in the following table also.

Data read from port A	Data read from port B	Data read from port C_L	Data output from port Cu
AAh	55h	1h	?
00h	00h	0h	?
FFh	FFh	0h	?

ii) Determine the values of PORTA, PORTB and PORTC

see back →

#3)

```
        ORG   0000h
        LXI   SP, OFFFFh
        MUI   A, 08h
        MOV   B, A
        SIIM
        EI
DONGU:  NOP
        NOP
AA:     NOP
        NOP
CC:     NOP
        NOP
KK:     NOP
        JMP   DONGU
        NOP
        NOP
        ORG   002Ch
        JMP   ONE
        ORG   0034h
        JMP   TWO
        ORG   003Ch
        JMP   THREE
ONE:    MUI   A, 55h
        CMA
        ADI   01h
        MOV   B, A
BB:     NOP
        RIM
        ANI   00100000
        JNZ   TWO
YY:     EI
        RET
TWO:    MVI   A, 65h
        CMA
        ADI   01h
        MOV   B,A
        NOP
        RIM
        ANI   01000000b
        JNZ   THREE
        EI
        RET
THREE:  MVI   A, 75h
        CMA
        ADI   01h
        MOV   B,A
        MVI   A, OFh
        SIIM
        EI
        RET
```

Consider the above assembly program written for a 8085 microprocessor based system. Assume that the following events occur saperately after the system is powered up. For each case, explain your answer shortly (No grade is going to be given to answers with no explanations...!)

a) If a RST5.5 hardware interrupt signal arrives at 8085 at point labeled as AA, what is the content of register B at point KK.

see back

b) If RST 5.5 hardware interrupt signal arrives at 8085 at point labeled as AA and just after that a RST 6.5 hardware interrupt signal arrives at point labeled as BB, what is the content of B at point KK.

c) If an RST 7.5 interrupt signal arrives at 8085 at point AA, just after that an RST 6.5 arrives at point CC, what is the content of B at point KK.

d) Assume that EI instruction at point YY is removed from the program. Under this assumption, an RST 5.5 interrupt signal arrives at 8085 at point AA, just after that an RST 6.5 interrupt signal arrives at 8085 at point CC, what is the content of B, at point KK.

e) Answer the question asked in part d, if EI instruction at point YY remains at its place.

INTRODUCTION TO MICROCOMPUTERS SECOND EXAM

SOLUTION MANUAL

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#1)

```
                ORG 0100h ; # of T-states     # of bytes     starting addr
SALIH:          NOP       ; 4                 1             0100h
                PUSH  B   ; 12                1             0101h
                MVI   C, 10h ; 7              2             0102h
DD:             CALL  FADIL ; 18              3             0104h
                NOP       ; 4                 1             0106h
                DCR   C   ; 4
                JNZ   DD  ; 10/7
                POB   B   ; 10
                RET.      ; 10
FADIL:          NOP       ; 4
                PUSH  B   ; 12
                MVI   C, 20h ; 7
EE:             NOP       ; 4
                NOP       ; 4
                DCR   C   ; 4
                JNZ   EE  ; 10/7
WW:             NOP       ; 4
                POP   B   ; 10
                RET       ; 10
```

Subroutine SALIH takes the same time to execute whenever it is called!

# of T-states in FADIL subroutine;

$$\underbrace{(4+12+7)}_{23} + \overbrace{(4+4+4+10)}^{22} \times 31 + 19 + 4 + 10 + 10 =$$

$$\hookrightarrow 23 + 22 \times 31 + 19 + 24 = 748$$

# of T-states in SALIH subroutine;

$$4+12+7+(\underbrace{18+748+4+4+10}_{784})\times 15 + 781 + 20 = 12584$$

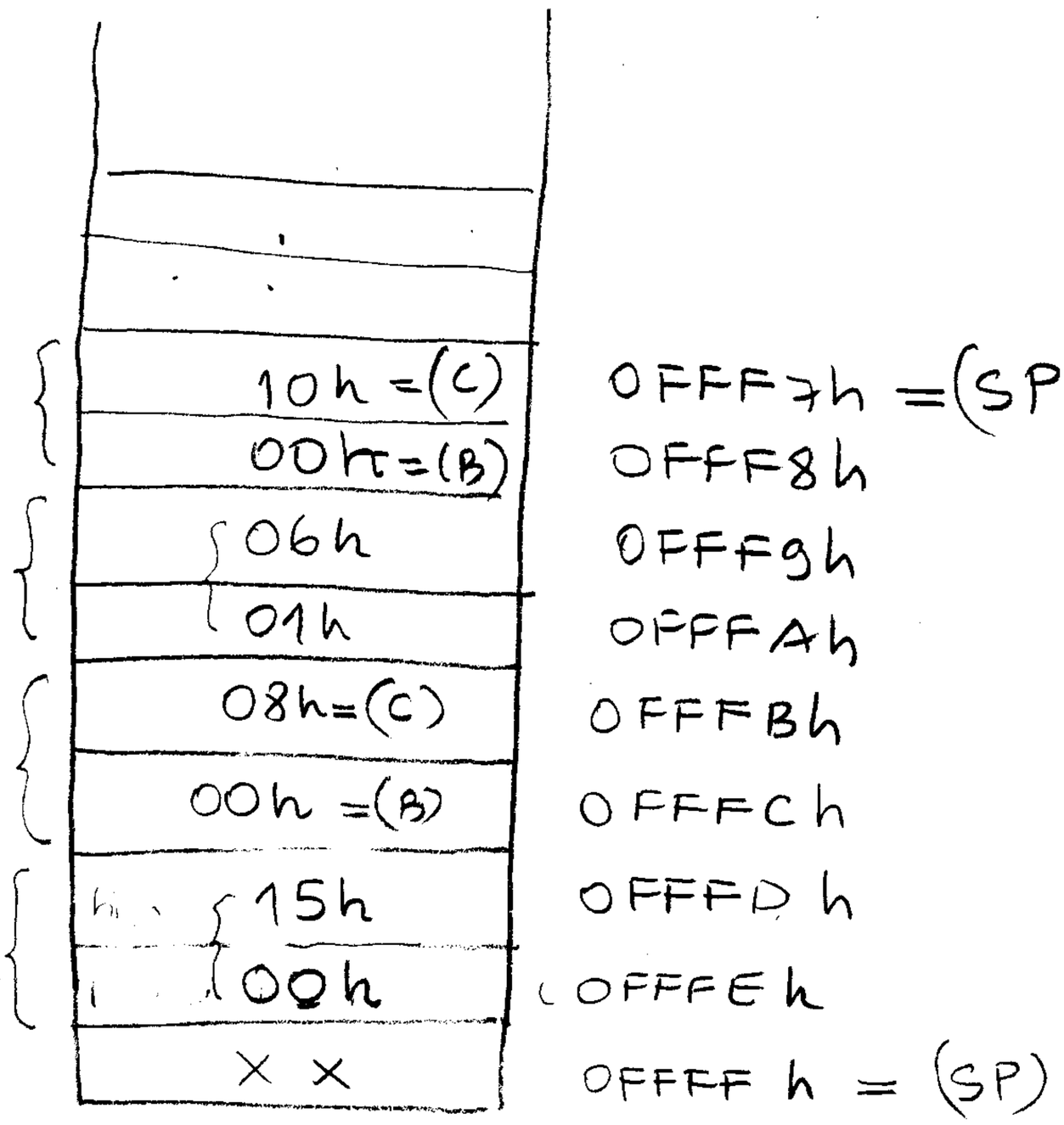
$$\text{execution time} = \frac{1}{(2/2)\,10^6} \times 12584 = 12584\ \mu s.$$
$$= 12{,}584\ ms.$$

b)

			# of bytes	starting addr
	ORG	0000h		
	LXI	SP, 0FFFFh	3	0000h
	MVI	A, 0FFh	2	0003h
TOP:	MVI	B, 08h	2	0005h
	MVI	C, 00h	2	0007h
BB:	RRC		1	0009h
	JNC	AA	3	000Ah
	INR	C	1	000Dh
AA:	DCR	B	1	000Eh
	JNZ	BB	3	000Fh
	CALL	SALIH	3	0012h
	NOP		1	0015h

22 Bytes

b)



Content of the stack when the execution of the program reaches point labeled as WW.

#2) a) The system has isolated I/O decoder since $E_3 = 1$ when $IO/\bar{M} = 1$.

A_{15} A_{14} A_{13} A_{12} A_{11} A_{10} A_9 A_3 or A_7 A_6 A_5 A_4 A_3 A_2	A_1 A_0	
1 1 1 0 0 0	0 0 = E0h	addr. of port A
- ||-	0 1 = E1h	" " port B
	1 0 = E2h	" " port C
	1 1 = E3h	" " control reg.

Control word

7	6	5	4	3	2	1	0	
1	0	0	1	0	0	1	1	= 93h

```
MVI   A,93h
OUT   0E3h
```

b)

i) In SUB subroutine, PC_u is cleared first. Later data from PC_L is rezd, If the data rezd is zero, the number of zeros in data rezd from port-A and port-B is counted and kept in register C. If the data rezd from PC_L is nonzero, this time the number of ones is counted and kept in register C, after that this number is output from PC_u.

There is a mistake in the given program. Before outputting the content of (C) = (A), four RRC instructions should be added just to see the number of zeros or ones from PCu.

Data rezd from port A	Data rezd from port B	Data rezd from port C_L	Data output from PC_u
AAh = 1010 1010b	55h = 0101 0101b	0001b	1000b
00h = 0000 0000b	00h = 0000 0000b	0000b	(1)0000b
FFh = 1111 1111b	FFh = 1111 1111b	0000b	0000b

(1) ↗ not seen.

ii) PORTA = 0E0h addr. of port A
PORTB = 0E1h addr. of port B
PORTC = 0E2h addr of port C

#3) a) At the beging of the program all masks are removed and interrupts are enzbled. Because of it, when RST5.5 arrives at 8085 at point AA, it finishes NOP instruction, write the return address to the stack and jump to 002Ch. From there it jumps to subroutine ONE.

In Subroutine ONE

2's complement

(A) = 0101 0101 → 1010 1011 = ABh (B) = ABh

At point KK, (B) = ABh

b) The story is same as the one given part a here. Since RST6.5 signal arrives at 8085 at point BB just after the RST5.5 signal, the program jumps to subroutine TWO because of the following instructions

pending bit of RST 6.5

RIM
ANI 0010 0000
JNZ TWO

In subroutine TWO

2's complement

(A) = 0110 0101 → 1001 1011 = 9Bh (B) = 9Bh

At point KK, (B) = 9Bh

c) When an RST7.5 signal arrives at 8085 at point AA, it jumps to 003Ch, from there it jumps to subroutine THREE. Inside subroutine THREE

(A) = 0111 0101 → 1000 1011 = 8Bh (B) = 8Bh

2's complement

After that, all masks are put in place. The program returns to NOP instruction just after label AA.

If an RST 6.5 arrives at point CC just after that, it is ignored by the 8085 since its mask is in place. As a result

At point KK, (B) = 8Bh

d) The story here is the same that is given in part a upto the returning of the NOP instruction just after labeled as AA. At this point (B) = ABh. Since interrupts are not enabled in leaving subroutine ONE, RST 6.5 interrupt signal is not going to be recognized by the 8085. As a result

At point KK, (B) = ABh

e) If EI instruction at point YY remains at its place, RST 6.5 interrupt request ↓ at CC will be recognized by the 8085, and (B) = 9Bh at the point just after the point CC. As a result

At point KK, (B) = 9Bh