

24.5/31

- LDA B6
- STA B7
- LD B8
- ST B8
- LD B9
- ST B9
- LD BA
- ST BA
- LD BB
- ST BB
- LD BC
- ST BC
- LD BD
- ST BD
- LD BE
- ST BE
- LD BF
- ST BF

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**University of Saskatchewan
Department of Electrical Engineering
EE 331 - Microprocessor Hardware and Software
Mid-term Examination**

Instructor: Seok-Bum Ko
Duration: 2 hours

October 27, 2003

- No materials are allowed.

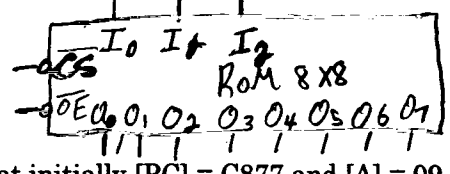
* A particular microcomputer can store an 8-bit number in each memory location. If the memory addresses range from 0000_{16} to $FFFF_{16}$, how many memory locations are there? (1)

64K ✓

* t_s (setup time) is the time interval immediately preceding the active transition of the CLK signal, during which the synchronous input has to be maintained at the proper level. (1)

* Design a combinational circuit using a ROM. The circuit accepts a 3-bit number and generates an output binary number equal to the square of the input number. Provide the simple block diagram and ROM truth table. (2)

Assume
 $O_0 = \text{MSB}$
 $O_7 = \text{LSB}$
 $I_1 = \text{MSB}$
 $I_2 = \text{LSB}$



I_2	I_1	I_0	O_0	O_1	O_2	O_3	O_4	O_5	O_6	O_7
0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	1	0	0	0	0	0
0	0	1	1	0	1	1	0	0	0	0
0	1	0	0	0	0	0	1	0	0	0
0	1	0	1	0	0	1	1	0	0	0
0	1	1	0	0	1	1	1	0	0	0
0	1	1	1	0	1	1	1	1	0	0
1	0	0	0	0	0	0	0	0	1	0
1	0	1	0	0	0	0	0	0	1	1
1	1	0	0	0	0	0	0	0	1	1
1	1	1	0	0	0	0	0	0	1	1

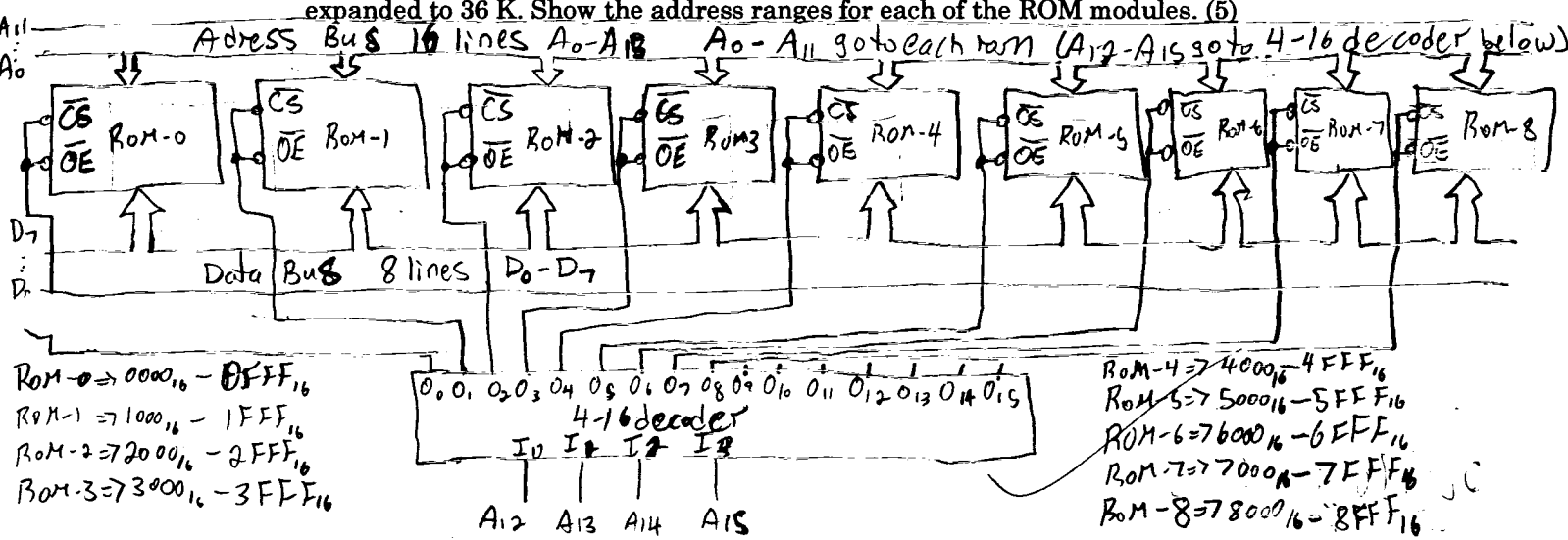
* Assume that initially $[PC] = C877$ and $[A] = 09$. Also assume that the content of memory location $C457$ is 03 .

- (1) At the completion of this instruction, $[pc] = C87A$, $[A] = 0C$, and $[C457] = 03$ (3)
- (2) Add an instruction to follow the instruction of Problem 4 so that the MPU stores the result in address $C457$. STAA #C457 B7C457 (1)
 $[PC] = C87D$, $[A] = 0C$, and $[C457] = 0C$ (3)

Memory address	Memory word
C877	BB
C878	C4
C879	57

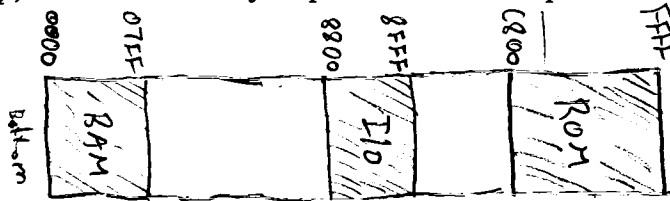
C87A B7
C87B C4
C87C 57

* Assume that we have a ROM of $4K \times 8$ size. Show how the ROM capacity can be expanded to $36K$. Show the address ranges for each of the ROM modules. (5)



X A certain microcomputer allocates addresses 0000 to 7FFF to RAM, 8800 to 8FFF to I/O, and C800 to FFFF to ROM. (4)

(1) Draw the memory map for this microcomputer.



(2) Determine the total RAM capacity. How many "pages"? How many "4K pages"? 8 pages & 1/2 of a 4K page

(3) Determine the total ROM capacity. How many "pages"? How many "4K pages"? 56 pages & 3 1/2 4K pages.

(4) How many different I/O devices can this microcomputer accommodate? 2K or 2048 devices.

X Consider the following program and assume that the stack pointer register is initially loaded with 6200₁₆. Show the contents of the stack after each instruction. What are the contents of the stack pointer register at the end of the execution? 61FD₁₆ (3).
Add the instructions so that the MPU pull all the contents off the stack.

PULB PULX PULA (in that order since stack is LIFO)

What are the contents of the stack pointer register at the end of the execution?

6200₁₆ (3)

PSHA — 61FF₁₆
PSHX — 61FE₁₆
PSHB — 61FD₁₆

X The function of this program is to add two 8-bit numbers (X and Y) that are stored in memory locations C100 and C101, respectively. The sum is then stored in address C102. Provide the followings for this program. (4)

- Memory address (hex), memory word (hex), Mnemonic, and brief description.

Memory address	Memory Word	Mnemonic	brief description
C800	86	LDA A	loads [A] with value stored at memory location C100 (X)
C801	C1		
C802	00		
C803	BB	ADD A	Adds contents of memory location C101 (Y) to the contents of [A] and puts result in [A] (X+Y)
C804	C1		
C805	01		
C806	B7	STA A	stores the contents of [A] (X+Y) in memory location C102 (X+Y)
C807	C1		
C808	02		

The END

C100 = X
C101 = Y
C102 = X + Y