

Cp Eng 213 – Digital Systems Design

Exam #1 (100pts) – Tuesday, Feb. 25, 2003

Closed book and notes. One crib sheet/calculator allowed.

Show your work/derivation for full credit!

Name:

Student ID:

1. Suppose that a microcontroller which has a 16 bit address port (from A0 to A15) controls three external memory devices: one 8K X 8 RAM, one 1K X 8 ROM and one 8 bit register. The given microcontroller's A15, A14 and A13 pins are used to select RAM, ROM and register, respectively, and the other address pins (from A12 to A0) are used to address individual external memory device. (10pts)

a) For each external memory device, find the address space (Remark: 16-bit starting address and 16-bit ending address must be shown).

b) For the given RAM and ROM, specify the used range of memory space and unused range of memory space (Remark: 16-bit starting address and 16-bit ending address must be shown).

2. Given the values of registers and memory shown below, for the following instructions (or sequence of instructions), predict which registers will be modified and give their new values. For each question, assume that the shown registers and memory locations are initialized by the values shown in the table. (Hint: PSW.7=Carry Flag, PSW.6=Aux. Carry Flag, PSW.5=General purpose flag, PSW.4,3=Register Select Bits, PSW.2=Overflow Flag, PSW.1=Not used, PSW.0=Parity flag) (20pts)

Registers		Internal Memory		External Memory	
		Address	Content	Address	Content
A	32H	35H	78H	20DDH	02H
DPTR	142AH	36H	80H	2100H	03H
PSW	81H	0AH	1AH		
R0	35H				
R1	36H				
R2	15H				
R3	5CH				

a) ADDC A, #E7H

b) MOV A, @R0

c) MOV 82H, #00H
 MOV 83H, #21H
 MOVX A, @DPTR

d) MOV A, R1
 ADD A, #0FFH
 MOV R1, A
 MOV A, @R1

3. Implement an 8051 assembly instruction sequence to add contents of R3 in Bank3 and R2 of Bank2 and R1 of Bank1, and then store the result back to R0 of Bank0. Use direct addressing scheme to access these registers. (10pts)

4. Suppose that the WIMP51 is executing “MOV A, R0” instruction. Determine the contents of each register shown below at the end of each clock cycle. (10pts)

Register	Initial contents	Clock1	Clock2	Clock3
IR	42H			
Acc	2AH			
AUX	00H			
PC	F0H			
R0	07H			

5. Suppose that PSW=1000 0000B, initially. What is PSW in binary number after executing:

```
MOV A, #9DH  
ADDC A, #B5H
```

Please give brief justification for each PSW bit as well. (Hint: PSW.7=Carry Flag, PSW.6=Aux. Carry Flag, PSW.5=General purpose flag, PSW.4,3=Register Select Bits, PSW.2=Overflow Flag, PSW.1=Not used, PSW.0=Parity flag) (10pts)

6. Consider the following WIMP51 assembly program.

```
    MOV A, #42H
    MOV R0, A
    MOV A, #2AH
Loop: XRL A, R0
      MOV R0, A
      JZ Stop
      SJMP Loop
Stop: SJMP Stop
```

a) Write down the machine code in binary code, and then hex code for this program. For each machine code instruction, determine its address as well. Assume that the beginning address of the program is 00H. (20pts)

b) How long does it take to execute this program in clock cycles? (5pts)

c) List all registers that are used by this program (PC, Acc, Z and R0) and list their contents after each instruction is executed. (15pts)