CmpE213 – Digital Systems Design

Homework 4
Machine instructions for the 8051

1. Ch3, Question 2. Don't worry about simulating your results for now. Assume the starting conditions shown in problem 1 exist *for each instruction*. For example, the first instruction is MOV A,0AH, the second is MOV SP,#7. The starting value for A, when executing MOV SP,#7, is 23H, not 19H. Be sure you include <u>any</u> register or memory location changed (like PSW). You may skip the following instructions, if you like: MOV A,#0AH; MOV R3,0AH; MOV @R1,#0AH; MOV @R1,0AH.

2. Ch3, Question 3. Follow recommendations in 1, above. You may skip the following instructions, if you like: SUBB A, 08H; SUBB A,#92; XCHD A, @R1; ORL B,#20H. (NOTE: The questions like ADDC A, 03H are do-able as they stand – think about how memory is laid out in the 8051).

3. Ch3, Question 4. Follow recommendations in 1, above. Since you're not simulating your code yet, placing a JMP 0030H instruction at 2080H isn't so important. To make this question do-able, assume the instructions given are located at address 2048H. For example, the instruction "SJMP 2020H" would have an opcode of 0x80D6 (80 means SJMP, D6 corresponds to the relative address -2AH). The PC would begin with a value of 2048H. After loading the SJMP instruction, it would be at 2048+2 = 204AH since SJMP is a 2-byte instruction. The 8051 always performs the SJMP, therefore, PC would be loaded with PC= PC + (-2AH) = 204AH - 2AH = 2020H, which is the address of the next instruction.

4. Different addressing modes can be used to accomplish the same result. a) For each addressing mode (direct, indirect, immediate, register), write an instruction which loads the accumulator with the value #42H. For each instruction, list precisely which addressing modes are used. For instance, MOV 2AH, #42 uses direct and immediate. b) List the advantages and disadvantages of each addressing mode.

5. Assume you are to write a jump instruction which will be at address 5280H in code space. Show a jump instruction for each addressing mode (relative, absolute, long) which jumps to code memory location 522AH. Give the opcode for each instruction.

6. For the following code,

```
start: MOV 2AH, #5
       MOV R0, #80H
       CLR A
loop:  MOV @R0, A
       INC R0
       DJNZ 2AH, loop
stop:  JMP stop
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a) Find the final value of any registers or memory changed by executing this code segment.

b) Find the number of bytes in code memory this instruction sequence occupies.

c) Find the number of instruction cycles, machine cycles, clock cycles and total amount of time this code takes to complete (Assume it's complete when it hits JMP stop). Assume the clock is running at 12MHz.

d) Explain why this code does not change the value of special function registers P0, SP, DPL, etc., located at internal memory locations 80H, 81H, etc.

e) Write the machine code and corresponding code memory locations for the above code segment (use a table). Assume that code memory starts at 0000H.