CmpE213 – Digital Systems Design

Homework 4

The 8051 - internal and external memory

1. CLRC is a 1 byte instruction for the 8051 (an instruction using 1-byte of code-space) which requires 12 clock cycles. CLR 92H is a 2 byte instruction which also requires 12 clock cycles. Explain how these instructions can both be executed in 12 clock cycles while the number of bytes used to store each instruction is different.

2. Normally external code and data are stored on separate chips... code in ROM and data in RAM. However, this doesn't have to be the case. Adding simple logic gates (AND, OR, NOT, etc), show a circuit diagram with the 8051, an external RAM chip (the 6164 8k x 8 RAM), and an address latch, which reads both code and data from external RAM. Hint: the trick is in the control signals. Assume that CODE and DATA space are kept separate in *software*.

3. Suppose the 8051 performs the following instruction sequence:

Instruction	Meaning
MOV 2AH, #42H	Move the number #42H into internal mem location 2AH
SETB 54H	Set the bit at bit-mem location 54H
MOV A, 2AH	Move value in internal MEM(2AH) into Accumulator

   What value is in the accumulator (i.e. at memory location 2AH)?

4. Assume PSW = 0x15 before the following instruction sequence is executed

Instruction	Meaning
MOV A, #2AH	#2AH -> Acc
ADD A, #E0H	Acc + #E0H -> Acc

   What is the value of PSW after execution? (Show your work).

5. The external signals needed to implement the instruction MOVX A, @DPTR and MOVX @DPTR, A (read and write an external memory location, respectively) are shown on pg 38 of your textbook. The following figure shows the 8051 hooked to external data memory and shows that the DPTR contains a value of 14A0H, the ACC contains a value of 2AH, and shows some locations inside of the external data memory. Drawing arrows on the figure, show the steps that are taken to perform the instruction MOVX @DPTR,A, showing the values that are on or in each line/bus/register/memory location for each step (like we did in class for the code read instruction).

6. For the following timing diagram, find

   (a) What instructions were executed

   (b) For each instruction, where it was stored in memory

   (c) What data was read/written to memory, giving: a) its address, b) its value, c) whether it was READ or WRITTEN.

   (d) Explain, briefly, how you know when a value is read or written from memory and how you know if the 8051 is communicating with CODE or DATA memory.