EE 331 Midterm Examination

October 21, 2002

- 2 Hours
- Open Book
- Two pages

1. 20 Marks (5 marks each)

   (a) Describe the differences between these instruction sequences?

   ```
   mov   R1,#80H
   inc   @R1

   inc   80H
   ```

   (b) Briefly describe the 5 memory spaces provided by the 8751 architecture and explain how you would access data from each of these regions.

   (c) Describe unsigned binary, two's complement numeric representation? What support does the 8751 architecture provide for performing the four basic arithmetic operations on single-byte values in these representations.

   (d) Given that the first byte of each of the following instructions is at location 3F0H, what are the ranges of addresses which could be reached by each of the instructions?

   ```
   sjmp   ALABEL
   ajmp   ALABEL
   ljmp   ALABEL
   ```

2. 20 Marks (4 marks each) What will be the value of the accumulator, the carry bit, and the overflow bit after an 8051 executes each of the following instruction sequences? Note that some values may be indeterminate.

   (a)
   ```
   clr    C
   mov    A,#70H
   subb   A,#0D2H
   ```

   (b)
   ```
   mov    A,#0F2H
   rr     A
   add    A,#0FFH
   ```

   (c)
   ```
   mov    A,#22H
   cjne   A,#24H,100
   ```

   (d)
   ```
   mov    20H,#20H
   setb   1
   mov    A,20H
   ```

   (e)
   ```
   clr    PSW
   mov    0,#1
   djnz   R0,70
   mov    A,R0
   ```

3. 20 Marks
   Draw the schematic of a circuit to add 16 kbytes of external program memory and 8 kbytes of external data memory to an 87C51 system.

- All external memory devices should be 8k×8.
- The addresses must be fully decoded but the only components available are inverters and 3-input NAND gates.
- The external program memory should appear at locations 8000H to BFFFH.
- The external data memory should appear at locations C000H to DFFFH.

4. 30 Marks
   Write a simple 'walking-1' memory-test subroutine for the above system:

   (a) Write 00H to all external data memory locations.

   (b) Write 01H to the first external data memory location.

   (c) Verify that reading the first external data memory location returns 01H and that all other memory locations still contain 00H. If not, your subroutine should return with a value of 0 in the accumulator.

   (d) Write 02H to the first external data memory location.

   (e) Verify that reading the first external data memory location returns 02H and that all other memory locations still contain 00H. If not, your subroutine should return with a value of 0 in the accumulator.

   (f) Repeat until all bits of the first external data memory location have been tested.

   (g) Repeat from step (b) for all external data memory locations.

   If the tests succeed your subroutine should return with a value of 1 in the accu mulator.

   Your program should be adequately commented so that it can be readily understood. The purpose and location of all variables should be described.

   Hint: Write a `testMem` subroutine which takes two arguments – the 16 bit value of the external memory address which should contain the non-zero value, and the 8 bit value which should be at that address.

5. 10 Marks
   Write an 8051 assembly-language subroutine which multiplies two 8-bit, signed (two's complement) values and returns a 16-bit signed result. One argument is passed to the subroutine in the accumulator and other is passed to the subroutine in special function register B. The subroutine should return with the most-significant byte of the product in SFR B and the least-significant byte of the product in the accumulato r.

   Hint: Use the 87C51 `MUL AB` instruction to multiply the absolute value of the arguments then negate the product if required.

   Bonus question (4 marks): Write your subroutine so that it uses no resourc es other than the accumulator, SFR B, and the processor status word.

END