ECE3710 Exam 1 Spring 2013. Name (4 pts) Key

4 pages. Open Book. Open Notes. Closed Internet. Cheating will result in a score of 0.

1. (2 pts) Name the architecture that is characterized by a shared program and data memory Von Neuman.
2. (3 pts) Name three different 8-bit microcontroller families.
   (a) Intel 8051 Zilog Z8
   (b) Microchip PIC 16 Motorola 68HC11
   (c) TI MSP 430 Microchip ATmega 8
3. (5 pts) Name 10 criteria that you might use to select a microcontroller (we discussed about 13 in class).
   (a) Performance
   (b) Power Consumption
   (c) Package Size
   (d) Sufficient Memory
   (e) Sufficient I/O
   (f) Multiple Sources
   (g) Has an upgrade path
   (h) Cost per unit
   (i) Cost of tools & licenses
   (j) Availability & quality of tools

   familiarity / learning curve
   documentation / app notes
   Technical Support
4. (3 pts) On the 8051, how wide (in bits) are the following:
   (a) The accumulator 8
   (b) The program status word 8
   (c) The program counter 16
5. (2 pt) How much (internal) RAM is available on the original 8051? 128 bytes
6. (6 pts) Other than RAM and ROM, the original 8051 has three types of peripheral devices. Name them, and tell how many there are of each.
   (a) Timers number of them: 2
   (b) Parallel ports number of them: 4
   (c) Serial Port number of them: 1
7. (2 pts) What is the address of the first instruction executed immediately after reset?
   0000
8. (3 pts) What is the difference between `MOV A,#42H` and `MOV A,42H`?
   MOV A,#42H loads 42H into the accumulator. MOV A,42H moves the contents of RAM location 42H into the accumulator
9. (2 pts) What assembly statement would you use if you want the symbol `count` to be synonymous with 3?
   Count equ 3
10. (2 pts) The instruction MUL AB multiplies registers A and B.
    (a) Is the multiplication signed, unsigned or both? unsigned
    (b) In which register is the least significant byte of the result stored? A.

11. (2 pts) What does the following sequence of assembly statements do?

```
        cseg
        ...
frogs:  db      2
```

(a) Allocates 2 bytes from code memory and names them frogs
(b) Allocates 1 byte from the code memory, names it frogs and initializes it to 2.
(c) Allocates 2 bytes from internal RAM and names them frogs.
(d) Allocates 1 byte from internal RAM, names it frogs and initializes it to 2.
(e) None of the above

12. (4 pts) Assume the following instructions are executed right after a reset:

```
        MOV     PSW,#98H
        MOV     R2,sp
```

What value will be stored? 7 To what address? 1AH

13. (2 pts) After the instructions in problem 12 are executed, what is the value of:
(a) the carry flag (C)? 1
(b) the auxiliary carry flag (AC)? 0

14. (4 pts) Consider the following instructions:

```
        MOV     A,#87H
        ADD     A,#79H
```

After these instructions have executed,
(a) What is the value of A? 00
(b) What is the value of C? 1
(c) What is the value of AC? 1
(d) What is the value of OV? 0

15. (2 pts) Assume the accumulator is 091_{16}, C=0, AC = 1. What will the accumulator hold after the instruction `DA A` is executed? 97

16. (4 pts) Consider the following assembly code.

```
        CLR     A               1x
        MOV     R7,#3           1x
LOOP1:  MOV     B,#4            3x
LOOP2:  INC     A               12x
        DJNZ    B,LOOP2         12x
        INC     R7              3x
        CJNE    R7,#6,LOOP1     R7=3,4,5
```

What will the values of A, B, R7 and C be when this code has finished executing?
A = 0C
B = 00
R7 = 06
C = 0

17. (2 pts) What is the fundamental difference between a call and a jump instruction?
(a) the destination address of the jump is pushed onto the stack
(b) the destination address of the jump is popped from the stack
(c) the address of the CALL instruction is pushed onto the stack
(d) the address of the instruction that follows the CALL is pushed onto the stack

18. (3 pts) Match the jump instructions to their descriptions:
    (a) LJMP ___b___ Jump to a location in the range (PC-128..PC+127)
    (b) SJMP ___a___ Jump anywhere in program memory
    (c) AJMP ___c___ Jump to a location in a 2K block of program memory

19. (3 pts) Consider the following 2 assembly code fragments:

Fragment 1		Fragment 2	
ANL	A,P3	ANL	P3,A
MOV	P3,A	MOV	A,P3

In what way do these fragments behave differently? (Hint: Don't forget about the port latch.)

Both clear those bits on the port corresponding to the zeros in ACC, but fragment 1 will also clear those inputs that happen to be low (changing the pin to an output & causing contention)

20. (6 pts) Write a single instruction to:
    (a) toggle pins P1.0 – P1.1 ___xrl P1, #3___
    (b) select register bank 3 ___orl PSW, #18H___
    (c) complement (toggle) the overflow flag ___cpl OV___

21. (4 pts) An original 8051 has a 6 MHz crystal.
    (a) What is the period of a machine cycle? ___2 μs___
    (b) How long will it take to execute the delay loop, below? ___1.6ms___

```
        MOV     R2,#2       1 x 1
        MOV     R3,#141     1 x 1
LOOP:   DJNZ    R3,LOOP     (141+256) x 2
        DJNZ    R2,LOOP     2 x 2
```

800 cycles x 2 μs = 1.6ms

22. (5 pts) Analyze the following subroutine (Hint: assume the input is a signed number):

```
;       Subroutine foo
;       description: left as an exercise for the student
;       input: A
;       output: A
foo:    JNB     ACC.7, done
        CPL     A
        INC     A
done:   RET
```

Describe what this function does and suggest a better name for it.

This subroutine takes the absolute value of the accumulator, so "abs" may be a better name

23. (3 pts) Which bit address is used for the following instructions?
    (a) SETB P1.1 Bit address = ___91H___
    (a) CLR ACC.7 Bit address = ___E7H___
    (a) CPL PSW.3 Bit address = ___D3H___

24. (6 pts) A listing file contains the line shown below.

```
(address) (code)
167E B414F6      CJNE    A,#20,foo
```

Assume the accumulator contains 10H when this instruction is executed.

(a) Will the branch be taken or not?

yes - taken

(b) What will the carry flag be after the instruction is executed?

1

(c) What is the address (in code memory space) of `foo`?

1677

```
1681
+FFF6
1677
```

25. (6 pts) Write a code fragment to subtract the 16-bit value {R5,R4} from {R7,R6}, leaving the result in {R3,R2} and setting the carry flag if a borrow occurs. (7 instructions)

```
Clr  C
mov  A, R6
subb A, R4
mov  R2, A
mov  A, R7
subb A, R5
mov  R3, A
```

26. (4 pts) The code below purports to convert a 3-bit number (in the accumulator) into a bit mask (e.g. 0 → 00000001, 1 → 00000010, 7 → 10000000), but there is a problem. Find it and show the correction(s) below. Do not use DPTR.

```
get_mask:
        ADD     A, # bit_table - pc_val
        MOVC    A,@A+PC
pc_val:
        RET

bit_table:
        db 01H, 02H, 04H, 08H, 10H, 20H, 40H, 80H
```

Error is that index to lookup table was off by 1.

27. (6 pts) Write a code fragment to divide a 16-bit unsigned value in {R3,R2} by 2. (Hint: shift the value right except for its sign bit, which should be loaded with 0). (7 instructions)

```
MOV  A, R3
CLR  C
RRC  A
MOV  R3, A
MOV  A, R2
RRC  A
MOV  R2, A
```

if this were a signed division replace this with MOV C, ACC.7

Extra Credit. (3 pts)

Write code to jump to the address in registers {B,A} without using DPTR.

```
PUSH  B
PUSH  ACC
RET
```