EE 3724 Test #4 Solutions- Fall '00 – Reese

1. (5 pts) Convert the following number in single precision floating point format to its decimal value (no exponents allowed in the final decimal value).

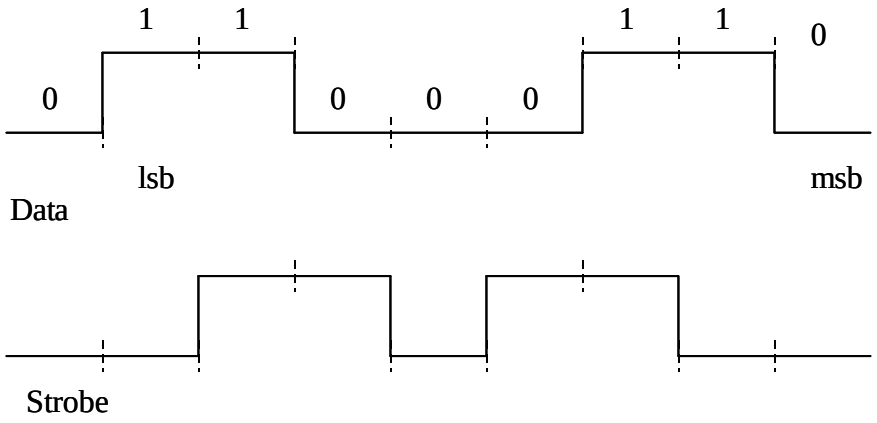
Sign bit: 1
Exponent field: 10000011
Significand Field: 1110 0000 0000?

Exponent = Exponent field - 127 = 83h - 127 = 131 -127 = 4
Number = - 1.significand x 2^4 = -1.111 x 2^4 = -11110b = - 1Eh = -30.0

2. (5 pts) The MMX instructions support an addition mode called saturating addition. Give an example of an 8-bit addition that will yield different answers in SIGNED saturating mode and SIGNED non-saturating mode (use the same operands for both questions).

   a. Saturating mode addition 7Fh + 01h = 7Fh (max positive number)
   b. Non-saturating mode addition: 7F + 01h = 80h (overflow, negative number)

3. (5 pts) Draw the waveform for sending an 8 bit value of 63h using **DATA STROBE** encoding. Assume the initial values of both data and strobe are '0'. Show the signaling for the 8-data bits only (no framing bits such as start/stop)..



4. (5 pts) What is 'bit-stuffing' on the USB and why is it used?
   NRZI encoding is used that guarantees a signal transition for every '0'. If 6 consecutive '1's are sent, a '0' is inserted to ensure a signal transition. These keeps the receiving clock synchronized to the bitstream.

5. (5pts) What is rotational latency in a fixed disk? *The time it takes for the correct sector to rotate under the read/write head once the head is positioned over the correct track.*

6. (5 pts) The PCI supports bus mastering and requires arbitration logic to determine which requesting device controls the bus. Does the USB support bus mastering? Explain why or why not.
   Bus mastering allows any device to assume ownership of the bus at any time, and there is no other device needed to control the transfer. USB does not support true bus mastering. In USB, the root device is involved in every transfer, and the ROOT initiates every transfer except for scheduled 'interrupt' transfers which has been setup by the Root hub during device configuration.

7. (5 pts) Why is the USB physical signaling method good at rejecting common node noise? Explain.
   D+, D- differential signals are used. These signals are subtracted from each other at the receiver. If common node noise is injected on both D+ and D-, then the operation (D+ + Noise) - (D- + Noise) results in the Noise subtracting out and only D+ - D- is left.

8. What are the SIMD Floating point extensions to the Pentium III? Give an example of how they work.
   128 bit registers were added, each register can be divided into 4 32-bit fields (four single precision floating point numbers). Operations on two registers can be performed, in which each 32-bit field is treated as a separate number. This allows the same operation to be performed on 4 pairs of numbers in one instruction.

9. (5 pts) Convert the number -13.5 to single precision floating point format:

Sign bit: 1 (negative number)
Exponent field: 82h = 1000 0010 (8 bits)
Significand field: 10110000…0 (23 bits)

13 = 1101, 0.5 = 0.1 - 1101.1 = **-1 . 1011** x 2^{3}
Exponent field = 3 + 127 = 130 = 82h.

10. (5 pts) The PCI is called a 'bus'. The USB is called a 'bus'. Both of these are extremely different in terms of number of signals used, physical interconnect, etc. Why is the general term 'bus' applied to both of these?

    A bus allows multiple devices to communicate with each other. When one device talks, the other devices all listen.

11. (5 pts) On the USB, data is transferred in packets. What is the address field of the packet used for? What is the ID field of the packet used for?

    Address field: specifies device the packet is for
    ID field: specifies type of packet

12. How does the DATA/STROBE signaling method used by Firewire allow peripherals to maintain data synchronization? Explain.

Every bit time, either the DATA or STROBE line changes values. If you XOR these two lines together, you get a clock signal that can be used to clock the incoming data.

13. (20 pts) Write a subroutine that will count the number of capital letters in a string. The starting address of the string is passed in BX. The string is terminated by a zero data byte (00h). The number of capital letters found is returned in AX (string maximum length can be greater than 255). A zero-length string can be passed to the subroutine (zero-length means first character is the zero data byte).

```
        xor     ax,ax
loop:   mov     cl,[bx]         ;read char
        cmp     cl,0            ;end of string?
        Jz      exit            ; exit if end
        Cmp     cl, 41h         ;'A'
        Jb      next            ;if lower, inc to next char
        Cmp     cl,5Fh          'Z'
        Ja      next            if higher, inc to next char
        Inc     ax              ;found capital letter
Next    inc     bx              ;increment to next letter
        Jmp     loop

Exit    ret                     ;answer in AX
```

14. (20 pts) Write a subroutine that will convert a 2 digit BCD number passed in AL to its hex value. The hex value should return in AL. Examples would be:
    INPUT AL= 14 h (14 bcd) OUTPUT: 0Eh
    INPUT AL = 99h (99 bcd) OUTPUT 63h
    INPUT AL = 25h (25 bcd) OUTPUT: 19h

(Old Hint: One of the steps in your algorithm is a multiplication by 10).
(Hint should have been: Take upper 4 bits, multiply by 10, add to lower 4 bits).

```
Mov   bl,al       ;save value
Lsr   al,4        ;move high 4 bits (high digit) into lower 4 bits
Mov   cl,0a       ;get 10 (decimal) into cl
Mul   cl          ;multiply upper digit by 10, result is in AX
And   bl,0Fh      ;zero upper digit of original number
Add   al,bl       ;add in lower digit, AL has final value
Ret
```