UCT CSC116 2005 :: Number Systems :: Supp [20 marks]

Question 1: Number Systems [15]

Show all calculation for the following questions.

1. Convert 1011011.101_2 to decimal. [2]

$1011011.101 = 1x2^6 + 1x2^4 + 1x2^3 + 1x2^1 + 1x2^0 + 1x2^{-1} + 1x2^{-3}$

= 64 + 16 + 8 + 2 + 1 + 0.5 + 0.125

$= 91.625_{10}$ [1 mark for whole and 1 for fraction]

2. Convert $AB23_{16}$ to base 8. [2]

$AB23_{16} = (1010)(1011)(0010)(0011)_2$ [1]

$= (001)(010)(101)(100)(100)(011)_2 = 125443_8$ [1]

3. Use 4-bit 1's complement addition to calculate $-6_{10} - 1_{10}$. [3]

$-6_{10} - 1_{10}$

= 1comp(0110) + 1comp(0001)

= 1001 + 1110 [1]

= 0111 carry 1 - add [1]

= 1000

= 1comp(0111)

$= -7_{10}$ [1]

4. How do we test for an overflow in 1's complement addition? [1]

if both numbers have the same sign and the sign of the sum is different, then it is an overflow.

5. Represent the floating point number 17.25_{10} in single-precision IEEE 754 format. [3]

sign is positive, so s=0

significand: $17.25_{10} = 10001.01_2 = 1.000101 \times 2^4$

actual exponent = 4

biased exponent = 4 + 127 = 131 = 10000011_2

answer: 0 10000011 00010100000000000000000

6. In IEEE 754 format, it is not necessary to store the leading digit before the point. Why? [2]

after normalisation the leading digit is always a 1 so this can be assumed.

7. During conversion to IEEE 754 format, an exponent cannot have an actual value of 128. Why? [2]

128 would have a biased value of 255, but this is used to represent infinity and not-a-number cases.

Question 2: Boolean Algebra and Logic [5]

1. 1. If A=1, B=1 and C=0, what is the value of

$$F = (A + C) \cdot (B + C) \quad [1]$$

F = (1+0)(1+0) = 1

2. Using a truth table, prove De Morgan's Law: $\overline{A \cdot B} = \overline{A} + \overline{B}$ [4]

A	*B*	*^A*	*^B*	*^A+^B*	*A.B*	*^(A.B)*
0	*0*	*1*	*1*	*1*	*0*	*1*
0	*1*	*1*	*0*	*1*	*0*	*1*
1	*0*	*0*	*1*	*1*	*0*	*1*
1	*1*	*0*	*0*	*0*	*1*	*0*

[1 mark per line … it is not necessary to show every column as long as LHS/RHS are there]