# OLLSCOIL NA hÉIREANN, CORCAIGH
THE NATIONAL UNIVERSITY OF IRELAND, CORK

## COLÁISTE NA hOLLSCOILE, CORCAIGH
UNIVERSITY COLLEGE, CORK

AUTUMN EXAMINATION 2006

**CS1101: Systems Organisation**

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**Instructions**

Answer all questions.

All questions carry equal marks (i.e. 40 per question).
This examination is worth 160 marks.
Coursework submitted during term is worth 40 marks.

Calculators may be used.
Please indicate the make and model of your calculator at the start of your exam script.

**Duration**

3 Hours

1.  a) Explain any 3 of the following, making use of suitable examples:

    i. Given a hexadecimal number, explain one method to convert it to octal.

    ii. Explain two approaches to instruction-level parallelism in CPU design.

    iii. Explain the architecture of the PCI bus.

    iv. Given a binary number in excess-128 format, explain how to convert it to its equivalent in decimal. (*10 marks*)

    b) Answer all of the following:

    i. Convert the following numbers to binary using both the *successive halving method* and the *powers of two method*:

    - 21
    - 7

    ii. Convert both of the above numbers into octal and hexadecimal.

    iii. Convert the following numbers into 8-bit *signed-magnitude*, *one's complement*, *two's complement* and *excess notation*:

    - -21
    - -7

    iv. Show how the following calculations are performed in both 8-bit ones-complement and twos-complement, showing that your answer has the correct decimal value in each case: $21 - 7, -21 - 7$. (*20 marks*)

    c) In decimal, $21 + 7 = 28$ and $21 - 7 = 14$. Show that by performing the corresponding calculations in both octal and hexadecimal that you arrive at the same answers. Specifically, perform the above calculations on the octal and hexadecimal representations of these numbers, showing the details of the calculation, and showing that converting the result into decimal gives the answer one expects. (*10 marks*)


2.  a) Explain any 3 of the following, making use of suitable examples:

    i. Explain the difference between a Half-Adder and a Full-Adder.

    ii. Give the symbol and truth table for the following digital logic gates: AND, OR, NOT, XOR, NAND, NOR. Where appropriate assume that gates have at most two inputs.

    iii. Name the digital logic circuits that perform the following functions: (a) select one input from amongst a set of possibilities; (b) selects one output from amongst a set of possibilities and (c) compares two n-bit words for equivalence.

    iv. Give a circuit diagram representing the following: $\overline{A.B}$; $\overline{A}.\overline{B}$; $\overline{A + B}$; and $\overline{A} + \overline{B}$. (*10 marks*)

b) Consider the following truth-table having 3 inputs $(A, B, C)$ and 1 output $F$.

| A | B | C | F |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 |

    i. Derive a Sum-of-Products expression for each output in the truth-table; (*10 marks*)

    ii. Draw a logic circuit of the Sum-of-Products expression you have derived. You do not need to simplify your circuit in any way. (*10 marks*)

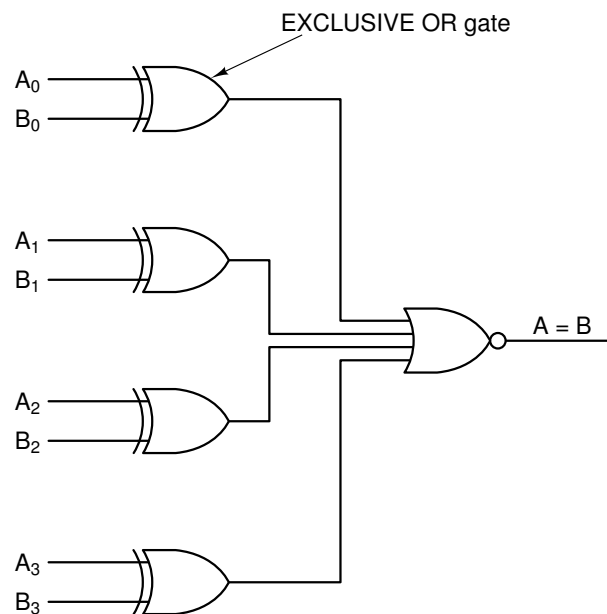c) A simple comparator circuit is shown in Figure 1. Explain how it works.



Figure 1: A comparator circuit.

(*10 marks*)

3.    a) Explain any 3 of the following, making use of suitable examples:

    i. What is an instruction set?

    ii. Explain how, in the IEEE 754 Floating Point standard, denormalised numbers can be used to present very small positive and negative numbers.

    iii. Explain why the IEEE 754 Floating Point standard only gives us an approximation of the real number line. How do relative versus absolute errors change over the range of expressible numbers?

    iv. Compare *procedures* and *coroutines*.

(*10 marks*)

b)   i. Convert the following decimal numbers into IEEE 754 format single precision numbers. Give your answer in hexadecimal.
- 4.125
- -1.25

*(10 marks)*

  ii. Convert the following IEEE 754 format single precision numbers into decimal.
- 40FC0000
- C0200000

*(10 marks)*

c) Using a simple example, show how the size of the fraction and the exponent in scientific notation affects the range and precision of the numbers that can be expressed in this representation.

*(10 marks)*

4.   a) Explain what is meant by the term *paging*. Discuss how it could be implemented. A diagram should be used to illustrate your explanation. *(10 marks)*

b) Explain *precisely* the effects of the following UNIX commands. Note that `<return>` means pressing the Return or Enter key on the keyboard; `file1` and `file2` are files; `www` and `var` are directories;

  i. `mkdir ./www <return>`
  ii. `cd ../../.. <return>`
  iii. `cp ~john/file1 ./file2<return>`
  iv. `chmod ugo=r file1 <return>`
  v. `chmod go-wx file1 <return>`            *(10 marks)*

c) In the context of the assembly process, explain the processes *linking* and *loading*. *(10 marks)*

d) In the context of assembly languages, briefly explain the following terms:
  i. pseudo-instruction;
  ii. macro and macro-expansion;
  iii. two pass assembly process;
  iv. machine code.            *(10 marks)*