**T-79.1002 Introduction to Theoretical Computer Science Y (2 ECTS)**
**Exam Wed 14 Dec 2005, 1–4 p.m.**

Write down on each answer sheet:
- Your name, department, and student id
- The text: "T-79.1002 Introduction to Theoretical Computer Science Y 14.12.2005"
- The total number of answer sheets you are submitting for grading

**Note that you CANNOT use this exam to compensate for course T-79.148 in the pre-2005 study requirements!!! If you want to take an exam for this course, or the post-2005 two-period course T-79.1001, please ask for another exam sheet!!!**

1. Which of the following claims are true (T) and which false (F):

    (a) All languages described by regular expressions can be recognised (decided) by deterministic finite automata. *2p.*

    (b) All languages described by context-free grammars can be recognised (decided) by nondeterministic finite automata. *2p.*

    (c) The union of two regular languages is regular. *2p.*

    (d) The intersection of a regular language and a context-free language is regular. *2p.*

2. (a) Give a regular expression that describes the language

    $$\{w \in \{0,1\}^* \mid w \text{ contains an odd number of 0's or an odd number of 1's (or both).}\}$$

    *5p.*

    (b) Design a nondeterministic finite automaton with no $\varepsilon$-transitions that recognises the language in part (a). *5p.*

    (c) Design a deterministic finite automaton that recognises the language in part (a). *5p.*

3. (a) Design a context-free grammar for the language

    $$L = \{a^i b^j c^k \mid i = j \text{ or } j = k \text{ (or both)}\}.$$

    *5 p.*

    (b) Show that the grammar you gave in part (a) is ambiguous. *5 p.*

4. (a) Justify the claim: if languages $A$ and $B$ over the alphabet $\Sigma = \{0,1\}$ are regular, then so is the language $A \cap B$. *4p.*

    (b) Based on part (a), justify the claim: if a language $L \subseteq \{0,1\}^*$ is regular, then so is the language $L' = \{w \in L \mid |w| \text{ even}\}$. *3p.*

    *Total 40p.*