Functional and logic programming
- **written exam -**

Important:

1. Subjects are graded as follows: By default - 1p; A – 2p; B - 4p; C - 3p.
2. Prolog problems will be resolved using SWI Prolog. The following are required: (1) explanation of the code and of the reasoning behind it; (2) recursive model that solves the problem, for all the predicates used; (3) specification of every predicate (parameters and their meaning, flow model, type of the predicate - deterministic/non-deterministic).
3. Lisp problems will be resolved using Common Lisp. The following are required: (1) explanation of the code and of the reasoning behind it; (2) recursive model that solves the problem, for each function used; (3) specification of every function (parameters and their meaning).

A. The following function definition in LISP is given

```
(DEFUN F(L)
      (COND
            ((NULL L) 0)
            ((> (F (CAR L)) 2) (+ (CAR L) (F (CDR L))))
            (T (F (CAR L)))
      )
)
```

Rewrite the definition in order to avoid the double recursive call **(F (CAR L))**. Do NOT redefine the function. Do NOT use SET, SETQ, SETF. Justify your answer.

B. Write a PROLOG program that generates the list of all combinations of k elements with numbers from 1 to N, with the property that difference between two consecutive numbers from a combination has an even value. Write the mathematical models and flow models for the predicates used. For example, for the **N**=4, **k**=2 ⇒ [[1,3],[2,4]] (not necessarily in this order).

C. Given a nonlinear list, write a Lisp function to return the list with all atoms on the level **k** replaced by 0. The superficial level is assumed 1. **A MAP function shall be used.**
Example for the list (a (1 (2 b)) (c (d)))   **a)** k=2 => (a (0 (2 b)) (0 (d)))
b) k=1 => (0 (1 (2 b)) (c (d)))   **c)** k=4 => the list does not change