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

Important:

1. Subjects are graded as follows: of - 1p; A – 1.5p; B - 2.5p; C - 2.5p; D - 2.5p.
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)
                ((> (CAR L) 0)
                        (COND
                                ((> (CAR L) (F (CDR L))) (CAR L))
                                (T (F (CDR L)))
                        )
                (T (F (CDR L)))
        )
)
```

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

B. Given a list composed of integer numbers and sublists of integer numbers, write a SWI-Prolog program that verifies if all the elements of the list (including those in sublists) form a symmetrical sequence. For example, for the list [1, 5, [2,4], 7, 11, 25, [11, 7, 4], 2, 5, 1] the result will be true.

C. Write a PROLOG program that generates the list of all subsets of even sum, using the elements of a list. Write the mathematical models and flow models for the predicates used.
For example, for the list L=[2, 3, 4] ⇒ [[],[2],[4],[2,4]] (not necessarily in this order).

D. Write a Lisp function to substitute an element **e** by other element **e1** at all odd levels of a nonlinear list. The superficial level is assumed 1. **A MAP function shall be used.**
Example, for the list (1 d (2 d (d))), **e**=d and **e1**=f the result is (1 f (2 d (f))).