

## 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(N)
  (COND
    ((= N 1) 1)
    (> (F (- N 1)) 2) (- N 2))
    (> (F (- N 1)) 1) (F (- N 1)))
    (T (- (F (- N 1)) 1))
  )
)
```

Rewrite the definition in order to avoid the repeated call **(F (- N 1))**. 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 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  $L=[2, 3, 4] \Rightarrow [[],[2],[4],[2,4]]$  (not necessarily in this order).

**C.** 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))).