

## 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 subsets of sum **S** given, using the elements of a list, such that the number of even elements from each subset is even. Write the mathematical models and flow models for the predicates used. For example for the list [1, 2, 3, 4, 5, 6, 10] and  $S=10 \Rightarrow [[1,2,3,4], [4,6]]$ .

**C.** An n-ary tree is represented in Lisp as ( node subtree1 subtree2 ...). Write a Lisp program to return the ***height*** of a node of a tree. **A MAP function shall be used.**

**Example** for the tree (a (b (g)) (c (d (e)) (f)))

**a)** nod=e => the height is 0      **b)** nod=v => the height is -1      **c)** nod=c => the height is 2.