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
              ((ATOM L) -1)
              ((> (F (CAR L)) 0) (+ (CAR L) (F (CAR L)) (F (CDR L))))
              (T (F (CDR 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. Given a heterogeneous list composed of numbers and nonempty numerical linear lists, write a SWI-Prolog program that builds a list with the minimum values from those sublists for which the sum of the elements is a prime number. The resulted list will contain elements in reverse order of the initial input list. For example, for the list [[4, 1, 18], 7, 2, -3, [6, 9, 11, 3], 4, [5, 9, 19]], the result will be [3, 1].

C. Write a PROLOG program that generates the list of all subsets of k elements in arithmetic progression. Write the mathematical models and flow models for the predicates used. For example, for L=[1,5,2,9,3] and k=3 ⇒ [[1,2,3],[1,5,9],[1,3,5]] (not necessarily in this order).

D. Write a Lisp function to substitute all numerical values at any level of a given nonlinear list with a given value **e. A MAP function shall be used.**
Example, for the list (1 d (2 f (3))), **e**=0 the result is (0 d (0 f (0))).