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(N)
       (COND
              ((= N 0) 0)
              (> (F (- N 1)) 1) (- N 2))
              (T (+ (F (- N 1)) 1))
       )
)
```

Rewrite the definition in order to avoid the double recursive call **(F (- N 1))**. Do NOT redefine the function. Do NOT use SET, SETQ, SETF. Justify your answer.

B. Given a binary tree in which the nodes contain numerical information and given that the binary tree is represented as a list in which each node is followed by a number (0,1 or 2) that represents the number of children of that node, write a SWI-Prolog program that computes the sum of the first element on each level. For example, for the list [13, 2, 9, 2, 5, 0, 3, 2, 11, 0, 6, 1, 3, 0, 2, 1, 7, 1, 9, 1, 8, 2, 4, 0, 2, 1, 10, 0] the result will be 55.

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. An n-ary tree is represented in Lisp as (node subtree1 subtree2 ...). Write a Lisp function to determine the number of nodes on level **k**. The root level is assumed zero. **A MAP function shall be used.** _**Example**_ for the tree (a (b (g)) (c (d (e)) (f)))
a) k=2 => nr=3 (g d f)   **b)** k=4 => nr=0 ()