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. Let L be a list of numbers and given the following PROLOG predicate definition with flow model (i, o):

```
f([],-1).
f([H|T],S):-f(T,S1), S1<1, S is S1-H, !.
f([_|T],S):-f(T,S).
```

Rewrite the definition in order to avoid the recursive call **f(T,S)** in both clauses. Do NOT redefine the predicate. Justify your answer.

B. Write a PROLOG program that generates the list of all combinations of k elements with numbers from 1 to N, with the property that difference between two consecutive numbers from a combination has an even value. Write the mathematical models and flow models for the predicates used. For example, for the **N**=4, **k**=2 ⇒ [[1,3],[2,4]] (not necessarily in this order).

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.