

## 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.** Given the following PROLOG predicate definition **f(integer, integer)**, with the flow model (i, o):

f(20, -1):-!.

f(I,Y):-J is I+1, **f(J,V)**, V>0, !, K is J, Y is K.

f(I,Y):-J is I+1, **f(J,V)**, Y is V-1.

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

**B.** Write a PROLOG program that generates the list of all subsets with at least  $N$  elements such that the value of sum of all elements from each subset is divisible with 3, from a list of integers. Write the mathematical models and flow models for the predicates used. For example, for the list  $L=[2,3,4]$  and  $N=1 \Rightarrow [[3],[2,4],[2,3,4]]$  (not necessarily in this order).

**C.** Given a nonlinear list, write a Lisp function to return the list with all non-numerical atoms on even levels removed. The superficial level is assumed 1. **A MAP function shall be used.**

**Example** for the list (a (1 (2 b)) (c (d))) the result is (a (1 (2 b)) ((d)))