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 Fct(F L)

 (COND

 ((NULL L) NIL)

 ((FUNCALL F (CAR L)) (CONS (FUNCALL F (CAR L)) (Fct F (CDR L))))

 (T NIL)

)

Rewrite the definition in order to avoid the double recursive call **(FUNCALL 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 or all arrangements of **k** elements from a list of integer numbers, for which the product of the elements is less than a value **V** given. Write the mathematical models and flow models for the predicates used. For example, for the list [1, 2, 3], **k**=2 and **V**=7 \Rightarrow [[1,2],[2,1],[1,3],[3,1],[2,3],[3,2]] (not necessarily in this order).

D. Given a nonlinear list, write a Lisp function to return the list with all atoms on even levels replaced by zero. 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 (0 (2 b)) (0 (d))).