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. Let **G** be LISP function and given the following definition

```
(DEFUN F(L)
        (COND
                ((NULL L) 0)
                (> (G L) 2) (+(G L) (F (CDR L))))
                (T (G L))
        )
)
```

Rewrite the definition in order to avoid the repeated call **(G L)**. Do NOT redefine the function. Do NOT use SET, SETQ, SETF.Justify your answer.

B. Given a heterogeneous list made of numbers and nonempty numeric lists, write a SWI-PROLOG program that verifies if all numbers (including those in sublists) form an increasing sequence of numbers. For example, for the list [2,4,6, [10, 12, 19], 30, 201, [1000, 1003, 1006, 2003], 2020] the result will be true, but for the list [2,4,6, [10, 12, 11], 30, 201, [1000, 1003, 1006, 2003], 2020] the result will be false.

C. Write a PROLOG program that generates the list of all subsets of k elements (all elements being odd numbers) 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 ⇒ [[1,5,9],[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))).