Time: 2 hours.

You should have three sheets of paper.
Write your name and identification number in the **upper right corner** of ALL the sheets, so that it appears at least once per sheet (not per-page).
Write the answers to exercises 1-2, 3-4 and 5-6 on three different sheets of paper.

1. (5 points) Transform the following propositional logic formula into an equivalent formula in Disjunctive Normal Form:

$$((A \to B) \land (C \lor \neg D)) \lor ((B \land \neg C) \to (A \lor D))$$

2. (5 points) Consider the following statement:

> "If the alarm is set, then either the door is locked or the security system is active. If the security system is inactive, then the room is secure if and only if the door is locked. If the door is not locked, then the alarm is not set. If the alarm is not set and the room is secure, then the security system must be active. The security system is inactive."

Formalise this statement and determine (with truth tables or otherwise) whether it is inconsistent.

3. (5 points) Formalize in FOL the following statements:

- Every coach who trains a tennis player respects at least one other player that the player he trains dislike.
- Every scientist who wrote a paper with a co-author admires at least one person who has never collaborated with any of their co-authors.

4. (5 points) Considering the formula F resulting as the formalization of one of the two cases of previous exercise, provide, if possible, an interpretation which satisfies F and an interpretation which does not satisfies F.

5. (6 points) Consider the following Prolog program:

```
q(alpha, X, Y)       :- q(beta,  X, Y), r(Y).
q(beta,   X, f(Z))  :- p(X),      r(Z),     s(Z).
q(alpha, beta, Z)   :- r(Z),      s(Z).
q(gamma, X, g(Z))   :- q(alpha, X, Z), p(Z).


p(c).
p(d).

r(f(a)).
r(g(b)).
r(h(d)).
r(f(f(a))).
r(f(h(d))).

s(g(b)).
```

What is the result of evaluating the query:

```
q(alpha, c, W).
```

Provide all possible solutions for W, if any. Motivate the answer.

6. (6 points) Four room types-Economy, Standard, Deluxe, and Suite,Âî must be assigned nightly rates (in euros) that satisfy the following constraints:

- Economy may cost 100, 200, or 300 €, but must cost more than Deluxe.
- Standard must cost exactly 50 €more than Deluxe, and its rate must be an even number.
- Deluxe cannot exceed 250 €, and its rate must be a multiple of 50 €.