

NIE-MPI – EXAM				JANUARY 10, 2023	
Name	Q1–6	Q7	Q8	Q9	Σ

Multiple choice question answer table					
Q1	Q2	Q3	Q4	Q5	Q6

Instructions: Questions 1 to 6 have possible answers labelled A–E. There is always exactly one correct answer. Please, use the table above to mark your answer. If you make a mistake, correct your answer in the table (in a readable manner).

Other questions serve as a preparation for the oral part of the exam (nevertheless, your written preparation should be understandable). Don't forget to sign this sheet and all the sheets that you will hand in.

*You can use only paper, pen and **your** brain! Good luck!*

Question 1 (5 points). What is the value of the second derivative with respect to x of the function $f(x, y) = \sqrt{x} - x^2y + \ln y$ at the point $(1, 2)$?

- (A) 3.
- (B) -2 .
- (C) 0.
- (D) $-\frac{1}{2}$.
- (E) None of the above values.

Question 2 (5 points). Let us consider as domain D the finite region delimited by the graph $y = 2x - x^2$ and the x -axis. Select the value of the double integral

$$\iint_D x - y \, dx dy.$$

- (A) $\frac{7}{4}$
- (B) $\frac{4}{5}$
- (C) -4
- (D) 0
- (E) None of the above values.

Question 3 (5 points). How many generators has the group \mathbb{Z}_{20}^+ ?

- (A) 7.
 - (B) 19.
 - (C) 8.
 - (D) 20.
 - (E) 10.
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Question 4 (5 points). Let A and B be two fuzzy sets (over a universe U) having membership functions μ_A and μ_B respectively. Using the Łukasiewicz t-norm for intersection, give the formula of the membership function of $A \cup B$.

- (A) $\mu_{A \cup B}(x) = -(\max\{-\mu_A(x) - \mu_B(x) + 1, 0\} - 1)$
 - (B) $\mu_{A \cup B}(x) = \max\{\mu_A(x), \mu_B(x)\} + 1$
 - (C) $\mu_{A \cup B}(x) = 1 - \mu_A(x)\mu_B(x)$
 - (D) $\mu_{A \cup B}(x) = \mu_A(x) - \mu_B(x)$
 - (E) None of the above options is true.
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Question 5 (5 points). In the field $GF(5^2)$ with multiplication modulo $x^2 + 4x + 1$, find the inverse of 13.

- (A) 33
 - (B) 02
 - (C) 112
 - (D) 51
 - (E) None of the above option.
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Question 6 (5 points). Let us consider the permutation $f = (4253176) \in S_7$. The permutation f^{22} is

- (A) (3215467)
- (B) (4253176)
- (C) (3541672)
- (D) (5142763).
- (E) None of the above permutations.

*** ORAL PART PREPARATION ***

Question 7. (10 points)

1. Write down the definition of monoid, semigroup and group.
 2. Is it possible to construct a cyclic group of any order? Justify your answer.
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Question 8. (10 points) Let $f, g : \mathbb{R}^2 \rightarrow \mathbb{R}$. List sufficient conditions for a point $(x, y) \in \mathbb{R}^2$ to be

- (a) a point of local strict minimum of f subject to g ;
 - (b) a point of local strict maximum of f subject to g ;
 - (c) a saddle point of f subject to g .
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Question 9. (10 points) Describe the single precision floating point number representation system.