

NIE-MPI – EXAM				FEBRUARY 8, 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 mixed derivative of the function $f(x, y) = \sqrt{x} - x^2y + \ln y$ at the point $(2, 1)$?

- (A) 2;
- (B) -4 ;
- (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 $y = 2x - x^2$, the x -axis and the line $x = 1$. Select the value of the double integral

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

- (A) $\frac{3}{20}$;
- (B) $\frac{4}{5}$;
- (C) -4 ;
- (D) 0;
- (E) None of the above values.

Question 3 (5 points). Which of the following statements is false?

- (A) The group \mathbb{Z}_{13}^\times contains 12 elements.
 - (B) $P(x) \in K[x]$ is irreducible over a field K if and only if it cannot be decomposed into a product of two elements of $K[x]$ of positive degree.
 - (C) Every group of order strictly less than 5 is cyclic.
 - (D) There exists a unique infinite cyclic group up to isomorphism.
 - (E) None of the above is true.
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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 product t-norm for intersection, give the formula of the membership function of $A^c \cup B$.

- (A) $\mu_{A^c \cup B}(x) = 1 + \mu_A(x)\mu_B(x) - \mu_A(x)$.
 - (B) $\mu_{A^c \cup B}(x) = 1 - \min\{1 - \mu_B(x), \mu_A(x)\}$.
 - (C) $\mu_{A^c \cup B}(x) = \max\{\mu_A(x), \mu_B(x)\} + 1$.
 - (D) $\mu_{A^c \cup B}(x) = \mu_A(x) - \mu_B(x)$.
 - (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 12.

- (A) 33;
 - (B) 24;
 - (C) 121;
 - (D) 51;
 - (E) None of the above option.
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Question 6 (5 points). Let us consider the permutation $f = (425316) \in S_6$. The permutation f^{43} is

- (A) (321546);
- (B) (425316);
- (C) (654321);
- (D) (524136);

(E) None of the above permutations.

*** ORAL PART PREPARATION ***

Question 7. (10 points) Let $f, g : \mathbb{R}^3 \rightarrow \mathbb{R}$. List sufficient conditions for a point $(x, y, z) \in \mathbb{R}^3$ 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 8. (10 points)

- (a) Write down the definitions of ring, integral domain and field.
 - (b) Give an example of a ring that is not a field.
 - (c) Is it possible to construct fields of every order?
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Question 9. (10 points) Explain the difference between normalized numbers and subnormal numbers in the number representation system with floating point (IEEE-754).