

NIE-MPI – EXAM				JANUARY 26, 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 $(1, 2)$?

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

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

- (A) $\frac{41}{50}$;
- (B) $\frac{4}{5}$;
- (C) -4 ;
- (D) 0;
- (E) None of the above values.

Question 3 (5 points). Which of the following statement is true?

- (A) The group \mathbb{Z}_{13}^\times contains 12 generators.
 - (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 non-negative 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 Gödel t-norm for intersection, give the formula of the membership function of $A^c \cup B$.

- (A) $\mu_{A^c \cup B}(x) = 1 - \mu_A(x)\mu_B(x)$;
 - (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). Which of the following polynomial is reducible over \mathbb{Z}_3 ?

- (A) $x^3 + x^2 + x + 1$.
 - (B) $x^3 + x^2 + 2x + 1$.
 - (C) $2x^2 + 2x + 1$.
 - (D) $x + 1$.
 - (E) None of the above option.
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Question 6 (5 points). Let us consider the permutation $f = (84253176) \in S_8$. The permutation f^{122} is

- (A) (83215467);
- (B) (42538176);
- (C) (65432871);
- (D) (51427683);
- (E) None of the above permutations.

*** ORAL PART PREPARATION ***

Question 7. (10 points)

1. Write down the definition of t-norm.
 2. Give an example of t-norm.
 3. How can we use t-norms in fuzzy logic?
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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).