MIE-MPI – EXAM					January 20, 2020
Name	Q1–6	Q7	Q8	Q9	Σ

Multiple choice question answer table					
Q1	Q2	Q3	Q4	Q5	Q6

Instructions: The questions 1 – 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 a paper, pen and **your** brain! Good luck!*

Question 1 (5 points)**.** Let us consider the permutation $f = (3\ 8\ 7\ 9\ 4\ 5\ 2\ 1\ 6) \in S_9$. The permutation f^{44} is:

(A) (2 3 5 8 4 1 7 9 6)

(B) (8 7 1 4 5 6 3 2 9)

(C) (1 2 3 9 4 5 7 8 6)

(D) (7 1 2 6 9 4 8 3 5)

(E) No other option is true.

Question 2 (5 points)**.** Select the **correct** statement

(A) Every group of order 15 is cyclic.

(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 $K[x]$.

(C) Every group of order strictly less than 6 is cyclic.

(D) The group $\mathbb{Z}_{36}^{\times}$ contains a subgroup of order 12.

(E) No other option is true.

Question 3 (5 points)**.** In the field $GF(3^2)$ with multiplication modulo $x^2 + 1$, find the results of $(20 - 11) \cdot 12$.

(A) 02

(B) 22

(C) 01

(D) 10

(E) No other option is true.

Question 4 (5 points). Let $f(x,y) = x^3 + x^2y + y^2x - y$. What is the value of $\frac{\partial^2}{\partial x \partial y} f$ at the point $(1,-1)$?

(A) 2

(B) 0

(C) -1

(D) $3x^2 + 2xy + y^2$

(E) No other option is true.

Question 5 (5 points). Let us consider as domain D the triangle with vertices the points $(0,0)$, $(0,2)$ and $(1,0)$. Select the value of the double integral

$$\iint_D x - y \, \mathrm{d}x\mathrm{d}y.$$

(A) 1

(B) $\frac{1}{8}$

(C) $-\frac{7}{3}$

(D) 0

(E) No other option is true.

Question 6 (5 points). Let us consider the set $M = \{\alpha + \beta\sqrt{5} \mid \alpha, \beta \in \mathbb{Z}\}$ with classical addition and multiplication.

(A) $(M, +)$ is a ring.

(B) $(M \setminus \{0\}, \cdot)$ is a group.

(C) $(M, +, \cdot)$ is ring but not a field.

(D) $(M, +, \cdot)$ is a field.

(E) No other option is true.

*** ORAL PART PREPARATION ***

Question 7. (11 points) Let $f : \mathbb{R}^2 \to \mathbb{R}$ and $(x, y) \in \mathbb{R}^2$. List sufficient conditions for (x, y) to be

(a) a saddle point;

(b) a point of local strict minimum;

(c) a point of local strict maximum.

Question 8. (11 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?

Question 9. (12 points)

1. Write down the definition of group and of subgroup.
2. What is the Cayley table of a finite group? Give an example.
3. Can two different groups have the same Cayley talble (up to renaming the elements)?