MIE-MPI – EXAM					January 04, 2021
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 $f(x, y) = y^3 + xy^2 + x^2y - x$. What is the value of $\frac{\partial^2}{\partial x \partial y} f$ at the point $(-1, 1)$?

(A) 0

(B) 2

(C) $2x + 2y$

(D) -1

(E) No other option is true.

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

$$\iint_D x + 2y \, \mathrm{d}x\mathrm{d}y.$$

(A) 0

(B) $\frac{1}{2}$

(C) 2

(D) $\frac{7}{3}$

(E) No other option is true.

Question 3 (5 points)**.** Select the **correct** statement

(A) Every group of order 4 is cyclic.

(B) The groups $\mathbb{Z}_{12}^{\times}$ and $\mathbb{Z}_{11}^{+}$ are isomorphic.

(C) The group $\mathbb{Z}_{12}^{\times}$ contains a subgroup of order 4.

(D) $P(x) \in K[x]$ is irreducible over a field K if and only if it cannot be decomposed into a product of two elements of $K[x]$.

(E) No other option is true.

Question 4 (5 points)**.** Let us consider the permutation $f = (5\ 3\ 2\ 7\ 4\ 6\ 1) \in S_7$. The permutation f^6 is:

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

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

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

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

(E) No other option is true.

Question 5 (5 points)**.** In the field $GF(2^3)$ with multiplication modulo $x^3 + x + 1$, find the inverse of 101.

(A) 111

(B) 100

(C) 011

(D) 010

(E) No other option is true.

Question 6 (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 Gŏdel t-norm for intersection, give the formula for membership function of $A \cup B$.

(A) $\mu_{A\cup B}(x) = \min\{\mu_A(x), \mu_B(x)\}$

(B) $\mu_{A\cup B}(x) = 1 - \min\{1 - \mu_A(x), 1 - \mu_B(x)\}$

(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) No other option is true.

*** ORAL PART PREPARATION ***

Question 7. (11 points) Let $f : \mathbb{R}^3 \to \mathbb{R}$ and $(x, y, z) \in \mathbb{R}^3$. List sufficient conditions for (x, y, z) to be

(a) a saddle point;

(b) a point of local strict minimum.

Question 8. (11 points)

1. What is a machine number?
2. What is the difference between absolute error and relative error?
3. Discuss about roundoff errors and cancellation errors. Which strategies can we use to minimize them?

Question 9. (12 points)

1. Write down the definition of group.
2. Write down the defitinions of ring and field.
3. Give an example of a field that is not a ring.