MMSEC-1

Sl.No. : **Total No. of Pages : 3**

III Semester M.Sc. Degree Examination, June/July - 2024

(CBCS, SLM Scheme)

MATHEMATICS

Fuzzy Mathematics

(Skill Enhancement Course - I)

Time : 1½ Hour **Max. Marks : 40**

Instruction: ***Compulsory attend all the sections.***

SECTION - A

Answer any five questions:- **[5×2=10]**

Q1) Define fuzzy set and write an example for fuzzy set.

Q2) If X = {0, 1, 2, ...,10} and A is a fuzzy set. For A : X $\rightarrow$ I defined by A(x) = $\frac{x}{x+4}$, obtain scalar cardinality of A.

Q3) Define difference and symmetric difference for fuzzy sets.

Q4) Let A and B be fuzzy sets on X where A, B $\in$ F(X), then for any a, b $\in$ 0, 1. Prove that ${}^{a}(A \cup B) = ({}^{a}A) \cup ({}^{a}B)$.

Q5) Define fuzzy intersection (t -norms) and Archimedean t - norm.

Q6) Explain Arithmetic operations on Fuzzy numbers.

Q7) Define MIN and MAX for any two fuzzy numbers A and B.

SECTION - B

Answer any four questions: **[4×5=20]**

Q8) Let M be the fuzzy of middle aged persons defined by, M : X $\rightarrow$ 0, 1. Where, X = {0, 1, 2, 3,...,100} and

M(X) = 0 if $x \leq 20$ or $x \geq 60$

$$M(x) = \frac{x-20}{15} \text{ if } 20 \leq x \leq 35$$

$$M(x) = \frac{60-x}{15} \text{ if } 40 \leq x \leq 60$$

$$M(x) = 1 \quad \text{if } 35 \leq x \leq 45$$

Find 1M, $^{0.5}$M and $^{0+}$M.

Q9) Define convex fuzzy set. Prove that a fuzzy set A on $\mathbb{R}$ is convex if and only if $A(lx_1 + (1 - l)x_2) \geq \min(A(x_1), A(x_2)), \forall x_1, x_2 \in \mathbb{R}$.

Q10) State and prove first Decomposition theorem.

Q11) If a fuzzy complement C is defined by $C(a) = \frac{1}{2}(1 + \text{Cos p a})$, find the equilibrium point.

Q12) Obtain a t-norm generated by,

$g(a) = \frac{a}{2}$; $a \neq 1$

$g(a) = 1$; $a = 1$

and $i(a, b) = a.b$

Q13) Define lattice of fuzzy numbers. Let C denote the set of all fuzzy numbers. Then for any A, B, c $\in$ C the following properties hold.

a) Commutativity

MIN (A, B) = MIN (B, A)

MAX (A, B) = MAX (B, A)

b) Associativity

MIN(MIN (A, B), C) = MIN(A, MIN (B, C))

MAX(MAX(A, B), C) = MAX(A, MAX (B, C))

SECTION - C

Answer any one question: **[1×10=10]**

Q14) For the fuzzy sets A, B and C defined on X, prove that

a) $\overline{A \cap B} = \overline{A} \cup \overline{B}$

b) $\overline{A \cup B} = \overline{A} \cap \overline{B}$

c) $A \Delta B \Delta C = \left(\overline{A} \cap \overline{B} \cap C\right) \cup \left(\overline{A} \cap B \cap \overline{C}\right) \cup \left(A \cap \overline{B} \cap \overline{C}\right) \cup \left(A \cap B \cap C\right)$

Q15) Let $f : X \to Y$ be a crisp function for $A_i \in F(X)$ and $B_i \in F(Y)$, $i \in I$, then prove that the following properties hold.

a) $f(A) = f$ iff $A = f$

b) $A_1 \subseteq A_2 \Rightarrow f(A_1) \subseteq f(A_2)$

c) $f\left(\bigcup_{i \in I} A_i\right) = \bigcup_{i \in I} f\left(A_i\right)$

d) $f\left(\underset{i \in I}{I} A_i\right) = \underset{i \in I}{I} f\left(A_i\right)$

e) $A \subseteq f^{-1}(f(A))$

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