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M.A./M.Sc. (Final) Examination, 2022

Mathematics

(Optional)

Paper Fifth (III)

(Fuzzy Sets and Their Applications)

Time : Three Hours] *[Maximum Marks:100*

Note: Attempt any two parts from each unit. All questions carry equal marks.

Unit - I

1. (A) Define convex fuzzy sets and show that A fuzzy set A is convex if and only if

$$A\left[\lambda x_1 + (1-\lambda)x_2\right] \geq \min\left(A(x_1), A(x_2)\right)$$

$$\forall x_1, x_2 \in R \quad d \in [0,1]$$

(B) Define Zaheh's extension principle with example

and for $Ai \in j(x)$, show that

(i) $I^{\alpha} Ai = {}^{\alpha}(I \ Ai)$

(ii) $I^{\alpha} + Ai \subseteq {}^{\alpha}+ (I \ Ai)$

(C) Let C be a function from [0,1] to [0,1]. Then show that C is a fuzzy complement if and only if there exists a continuous functions g from [0,1] to R such that g (0) = 0. g is strictly increasing and

$$C(a) = g^{-1}[g(1) - g(a)] \qquad \forall a \in [0,1]$$

Unit - II

2. Let A, B be two fuzzy numbers whose membership functions are given by

$$A(x) = \begin{cases} 0 & for \quad x \leq -1 and\ x > 3 \\ (x+1)/_2 & for \quad -1 < x \leq 1 \\ (3-x)/_2 & for \quad 1 < x \leq 3 \end{cases}$$

$$B(x) = \begin{cases} 0 & for \quad x \leq 1 and\ x > 5 \\ (x-1)/_2 & for \quad 1 < x \leq 3 \\ (5-x)/_2 & for \quad 3 < x \leq 5 \end{cases}$$

Calculate the fuzzy number A + B, A - B and A . B

(B) Define Binary fuzzy relations and solve

$$\begin{bmatrix} \cdot 3 & \cdot 5 & \cdot 8 \\ 0 & \cdot 7 & 1 \\ \cdot 4 & \cdot 6 & \cdot 5 \end{bmatrix} \text{ o } \begin{bmatrix} \cdot 9 & \cdot 5 & \cdot 7 & \cdot 7 \\ \cdot 3 & \cdot 2 & 0 & \cdot 9 \\ 1 & 0 & \cdot 5 & \cdot 5 \end{bmatrix}$$

(C) Define following with examples

(i) Fuzzy equivalence relations

(ii) Fuzzy compatibility relation

(iii) Similarity relation

Unit - III

3. (A) Define fuzzy relation equations based on sup i composition *S*. If $S(Q_1 R) \neq \phi$ for $P_0^i Q = R$, then show that $\hat{P} = (Q_0^{\omega i} R^{-1})^{-1}$ is the greatest member of $S(Q_1 R)$.

(B) Let basic probability assignments m_1 and m_2 on $X = \{a,b,c,d\}$ which are obtained from two independent sources, be defined as follows $m_1(\{a,b\}) = \cdot 2$ $m_1(\{a,c\}) = \cdot 3$ $m_1(\{b,d\}) = \cdot 5$

$m_2(\{a,d\}) = \cdot 2$ $m_2(\{b,c\}) = \cdot 5$ $m_2(\{a,b,c\}) = \cdot 3.$

Calculate the combined basic probability assignment $m_{1,2}$ by using dempster rule of combination.

(C) Define probability theory versus possibility theory.

Unit - IV

4. (A) Explain fuzzy Quantifiers with examples.

(B) Define multi conditional Approximate Reasoning. Show that $B_2^1 \subseteq B_4^1 \subseteq B_1^1 = B_3^1$

(C) Let f be a function defined by $f(a) = \log(1+a)$ for all $a \in [0,1]$. Determine the fuzzy intersection. fuzzy implications and fuzzy complement generated by f.

Unit - V

5. (A) Formulate reasonable fuzzy inference rules for an air - conditioning fuzzy control system.

(B) Define following-

(i) Center of Area method

(ii) Center of maxima method

(iii) Mean of maxima method

(C) Consider five travel packages a_1, a_2, a_3, a_4, a_5 from which we want to choose one their costs are $1000, $ 3000, $ 10,000, $ 5000 and $ 7000, respectively. Their travel times in hours are 15, 10, 28, 10 and 15 respectively. Define your own fuzzy set of acceptable travel times. Then determine the fuzzy set of interesting travel packages whose costs and travel times are acceptable and use this set to choose one of the five travel package.