K24U 0229

Reg. No. : .....

Name : .....

Sixth Semester B.Sc. Mathematics (Honours) Degree (CBCSS – OBE – Regular) Examination, April 2024
(2021 Admissions)
DISCIPLINE SPECIFIC ELECTIVE COURSE
6B27C BMH : Fuzzy Mathematics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **4** questions out of 5 questions. **Each** question carries **1** mark. **(4×1=4)**

1. Compute the scalar cardinality for the fuzzy set $A = \frac{.4}{v} + \frac{.2}{w} + \frac{.5}{x} + \frac{.4}{y} + \frac{1}{z}$.
2. Define interval valued fuzzy set with an example.
3. Find the pseudo inverse of the function $g(a) = \begin{cases} \frac{a}{2} & \text{when } a \neq 1 \\ 1 & \text{when } a = 1. \end{cases}$
4. State characterization theorem of t-conorms.
5. State **true** or **false**, justify your answer.
   "Every fuzzy numbers is a convex fuzzy set".

SECTION – B

Answer **any 6** questions out of 9 questions. **Each** question carries **2** marks. **(6×2=12)**

6. Explain why we need fuzzy set theory.
7. Define height of a fuzzy set. Differentiate normal and subnormal fuzzy sets.

P.T.O.

8. Let A be a fuzzy set defined by $A = \frac{0.5}{x_1} + \frac{0.4}{x_2} + \frac{0.7}{x_3} + \frac{0.8}{x_4} + \frac{1}{x_5}$. List all α-rules and α-cuts of A.
9. Determine whether $g(a) = 1 + a$ is an increasing generator, if it is find the fuzzy complement, t-norm and t-conorm generated by it.
10. Give an example of a fuzzy set complement that is continuous but not involutive. Define fuzzy complement.
11. Show that the t-norm ab and t-conorm a + b – ab are dual with respect to the standard fuzzy complement.
12. Show that the triples $\langle \min, \max, c \rangle$ and $\langle i_{min}, i_{max}, c \rangle$ are dual with respect to any fuzzy complement c.
13. Determine whether the following is a fuzzy set.
    $B(x) = \begin{cases} x & \text{for } 0 \leq x \leq 1 \\ 0 & \text{otherwise} \end{cases}$
14. Calculate the following :
    a) [–1, 2] + [1, 3]
    b) [–3, 4] + [–3, 4].

SECTION – C

Answer **any 8** questions out of 12 questions. **Each** question carries **4** marks. **(8×4=32)**

15. Write a short note on characteristic and significance of the paradigm shift.
16. Determine the union and intersection of the following sets :
    A = {(1, 0.2), (2, 0.4), (3, 0.8), (4, 1)}
    B = {(1, 1), (2, 0.8), (3, 0.5), (4, 0.2)}

17. Describe different properties of fuzzy sets. Prove whether the laws of excluded middle and contradiction true for fuzzy sets.
18. For the following fuzzy set $A = \frac{0.1}{x_1} + \frac{0.4}{x_2} + \frac{0.6}{x_3} + \frac{1}{x_5}$, show that $A = {}_{0.2}A \cup {}_{0.4}A \cup {}_{0.6}A \cup {}_{1}A$.
19. Prove that the extension principle is strong cutworthy but not cutworthy.
20. Prove that every fuzzy complement has atmost one equilibrium.
21. Prove that the standard fuzzy union is the only idempotent t-conorm.
22. For all a, b ∈ [0, 1] prove that $\max(a, b) \leq u(a, b) \leq U_{max}(a, b)$.
23. Let $\langle i, u, c \rangle$ be a dual triple that satisfies the law of excluded middle and the law of contradiction. Then prove that $\langle i, u, c \rangle$ satisfies the distributive laws.
24. Write short note on linguistic variables.
25. Explain two methods for developing fuzzy arithmetic.
26. Prove that arithmetic operation on closed intervals satisfy commutativity and associativity property.

SECTION – D

Answer **any 2** questions out of 4 questions. **Each** question carries **6** marks. **(2×6=12)**

27. Let A, B ∈ F(X) and for all $\alpha \in [0, 1]$ prove that ${}^{\alpha}(A \cap B) = {}^{\alpha}A \cap {}^{\alpha}B$ and ${}^{\alpha}(A \cup B) = {}^{\alpha}A \cup {}^{\alpha}B$.
28. State and prove first decomposition theorem of fuzzy sets.
29. Let $\langle i, u, c \rangle$ be a dual triple generated by g. Prove that the fuzzy operations i, u, c satisfy the laws of excluded middle and law of contradiction.

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

$$A(x) = \begin{cases} \frac{(x+2)}{2} & \text{for } -2 < x < 0 \\ \frac{(2-x)}{2} & \text{for } 0 < x < 2 \\ 0 & \text{otherwise} \end{cases}$$

$$B(x) = \begin{cases} \frac{(x-2)}{2} & \text{for } 2 < x \leq 4 \\ \frac{(6-x)}{2} & \text{for } 0 < x \leq 6 \\ 0 & \text{otherwise} \end{cases}$$

Calculate the fuzzy numbers A + B, A – B, A/B, A · B, MIN(A, B) and MAX(A, B).