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B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, APRIL 2022

Fifth Semester

Core Course—FUZZY MATHEMATICS

(For Model I B.Sc. Mathematics)

[2013 to 2016 Admissions]

Time : Three Hours Maximum Marks : 80

Part A (Short Answer Questions)

Answer **all** *questions.*
Each question carries 1 mark.

1. Define α-cut of a fuzzy set A.
2. Define a convex fuzzy set.
3. What is the scalar cardinality of a fuzzy set A ?
4. For two fuzzy sets A, B and $\alpha \in [0,1]$, show that ${}^{\alpha}(A \cap B) \subseteq ({}^{\alpha}A) \cap ({}^{\alpha}B)$.
5. Define equilibrium of a fuzzy complement.
6. Define dual point $a \in [0,1]$ with respect to a fuzzy complement C.
7. Give an example of a t-conorm.
8. Define a fuzzy number.
9. What is meant by a contradiction ?
10. What is meant by a tautology ?

$(10 \times 1 = 10)$

Part B (Brief Answer Questions)

Answer any **eight** *questions.*
Each question carries 2 marks.

11. Define support of a fuzzy set A. If $A = \frac{0}{x_1} + \frac{.6}{x_2} + \frac{.9}{x_3} + \frac{1}{x_4}$, then find the support of A.
12. Define the degree of sub-sethood of two fuzzy sets A and B.
13. For two fuzzy sets A and B and $\alpha \in [0,1]$ show that $\alpha_{(A \cup B)} = \alpha_A \cup \alpha_B$.
14. Show that every fuzzy complement has at most one equilibrium.
15. State the axiometric skeleton for a fuzzy t-norm.

Turn over

16. When you can say that a t-norm i and a t-conorm u are dual with respect to a fuzzy complement c. What is a dual triple ?
17. Determine whether the fuzzy set defined by $e(x) = \begin{cases} 1 & \text{for } 0 \le x \le 10 \\ 0 & \text{otherwise} \end{cases}$ is a fuzzy number or not.
18. Give an example to show that distributivity does not hold for intervals in general.
19. Show that X = B – A is not a solution of the equation A + X = B.
20. What are inference rules ? Give some examples.
21. What are linguistic hedges ? Give examples.
22. Define modifiers. Which type of modifier is called as an identity modifier.

(8 × 2 = 16)

Part C (Descriptive/Short Essay Type Questions)

Answer any **six** *questions.*
Each question carries 4 marks.

23. Prove that a fuzzy set A on $\mathbb{R}$ is convex if and only if $A(\lambda x_1 + (1-\lambda)x_2) \ge mm\{A(x_1), A(x_2)\}$ for all $x_1, x_2 \in \mathbb{R}$ and for all $\lambda \in [0,1]$.
24. Illustrate with an example that $\bigcup_{i \in I} \alpha A_i \ne \alpha\left(\bigcup_{i \in I} A_i\right)$ where $A_i \in \sigma F(x)$ and I an index set.
25. Show that if C is a continuous fuzzy complement, then C has a unique equilibrium.
26. If u denote a fuzzy union and $u_{\max}$ denote the drastic union. Then show that $\max(a,b) \le u(a,b) \le u_{\max}(a,b)$.
27. Describe different arithmetic operations on intervals.
28. Obtain subdistributivity property on intervals and illustrate with example that distributy follows in some situation. Give one such case.
29. Define a Boolean Algebra.
30. Describe conditional and unqualified propositions. Define Lukasiewicz implication.
31. Explain generalized modus ponens.

(6 × 4 = 24)

Part D (Long Essays)

Answer any **two** *questions.*
Each question carries 15 *marks.*

32. (i) State and prove First Decomposition Theorem on fuzzy set.

    (ii) Express the fuzzy set $A = .2/x_1 + .4/x_2 + .6/x_3 + .8/x_4 + 1/x_5$ as standard union of fuzzy sets.

33. Prove that $\max(a,b) \leq u_w(a,b) \leq u_{\max}(a,b)$ for all $a, b \in [0, 1]$, where u_w is the class of Yagar t-conorm.

34. State and prove a necessary and sufficient condition for $A \in \mathcal{F}(\mathbb{R})$ to be a fuzzy number.

35. Describe the generalization on the classical inference rules, modus tollens and hypothetical syllogism with examples.

(2 × 15 = 30)