Reg. No………………………………………….. Name……………………………………………… **20U545**

B. Sc. DEGREE END SEMESTER EXAMINATION – OCT. 2020: JANUARY 2021

SEMESTER – 5: MATHEMATICS (CORE COURSE)

COURSE: 15U5CRMAT8 – FUZZY MATHEMATICS

(Common for Regular 2018 admission and Improvement / Supplementary 2017/2016/2015 admissions)

Time: Three Hours Max. Marks: 75

PART A

Answer all questions. Each question carries 1 mark.

1. Distinguish between crisp set and fuzzy set.
2. Write the support of the fuzzy set.
3. State the Extension principle of Fuzzy sets.
4. State any three properties of t co norm.
5. State second characterization theorem of fuzzy complements.
6. Define drastic intersection and drastic product.
7. Calculate [2, 5] + [1,3]
8. If A and B are fuzzy numbers, define A+B.
9. Distinguish between classical logic and multi valued logic.
10. Define fuzzy quantifiers. (1 x 10 = 10)

PART B

Answer any Eight questions. Each question carries 2 marks.

11. Differentiate between Interval valued fuzzy sets and type 2 fuzzy sets.
12. State any three properties of Fuzzy sets.
13. Verify De Morgan's law for the fuzzy sets A and B where $A = \left\{\frac{0.2}{a} + \frac{0.3}{b} + \frac{0.5}{c} + \frac{0.8}{d} + \frac{1}{e}\right\}$ and $B = \left\{\frac{0.3}{a} + \frac{0.5}{b} + \frac{0.6}{c} + \frac{0.7}{d} + \frac{0}{e}\right\}$
14. Write the axiomatic skeleton for t-co norm.
15. Show that standard fuzzy intersection is the only idempotent t-norm.
16. Prove that the fuzzy complement defined by $c_\lambda(a) = \frac{1-a}{1+\lambda a}, \lambda \epsilon (-1, \infty)$ for each value of λ, is an involutive fuzzy complement.
17. Show that X=B-A is not the solution of the fuzzy equation A+X=B.
18. If A and B are closed intervals, show that A+B = B+A and AB = BA.
19. Explain the terms linguistic hedges and fuzzy proposition with examples.
20. Discuss about fuzzy propositions and compositional rule of inference.

(2 x 8 = 16)

PART C

Answer any Five questions. Each question carries 5 marks

21. Explain about various types of geometrical representation of membership degree of a fuzzy set.
22. Consider the fuzzy sets A and B be defined on the interval $X = [0,10]$ of real numbers by the membership grade function $A(x) = \frac{x}{x+2}$, $B(x) = 2^{-x}$. Determine the Mathematical formulas and graphs of the membership grade function of the sets (i) $\bar{A}$ (ii) $\bar{B}$
23. Explain why the standard fuzzy complement is not cut worthy and strong cut worthy.
24. Prove that every fuzzy complement has at most one equilibrium.
25. Explain conditional and qualified propositions.
26. Let A and B be two fuzzy numbers whose membership functions are given by :

$$A = \begin{cases} 0 & ; x \leq -1 \; and \; x > 3 \\ \dfrac{x+1}{2} & ; -1 < x \leq 1 \\ (3-x)/2 & ; 1 < x \leq 3 \end{cases} \quad B = \begin{cases} 0 & ; x \leq 1 and \; x > 5 \\ (x-1)/2 & ; 1 < x \leq 3 \\ (5-x)/2 & ; 3 < x \leq 5 \end{cases}$$

    Calculate fuzzy numbers A+B, A-B,A.B.

27. Let $A = \left\{\frac{0.1}{x_1} + \frac{0.8}{x_2} + \frac{1}{x_3}\right\}$ and $B = \left\{\frac{0.5}{y_1} + \frac{1}{y_2}\right\}$ be two fuzzy sets on X, Y. Then find R where R be a fuzzy set on $X \times Y$ defined by $R(x,y) = \mathfrak{I}(A(x), B(y))$ and $\mathfrak{I}$ denote Lukasiewicz implication.

(5 x 5 = 25)

PART D

Answer any Two questions. Each question carries 12 marks

28. For all $a, b \in [0,1]$, $i_{min}(a,b) \leq i(a,b) \leq \min(a,b)$ where i_{min} denotes the drastic intersection.
29. State and prove any three properties of t norm.
30. State and prove the necessary and sufficient condition for a fuzzy set A defined on R to be a fuzzy number.
31. Explain Fuzzy propositions. Let the sets of values of variables $\mathcal{X}$ and $\mathcal{Y}$ be $\mathcal{X} = \{x_1, x_2, x_3\}$ and $\mathcal{Y} = \{y_1, y_2\}$ respectively. Assume that a proposition ' If $\mathcal{X}$ is A then $\mathcal{Y}$ is B is given, where $A = \left\{\frac{0.5}{x_1} + \frac{1}{x_2} + \frac{0.6}{x_3}\right\}$ and $B = \left\{\frac{1}{y_1} + \frac{0.4}{y_2}\right\}$. Given that $\mathcal{X}$ is A' where $A' = \left\{\frac{0.6}{x_1} + \frac{0.9}{x_2} + \frac{0.7}{x_3}\right\}$. Obtain B' by applying the compositional rule of inference.

(12 x 2 = 24)

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