TB156505A **Reg.No……………………...**

Name……………………..

B. Sc. DEGREE (C.B.C.S.S) EXAMINATION, MARCH 2018
(2015 Admission Regular)
SEMESTER VI – CORE COURSE (MATHEMATICS)
MT6B11B - FUZZY MATHEMATICS

Time: Three Hours **Maximum marks: 80**

Part A

I. Answer all questions. Each one carries 1 mark.

1. Define fuzzy set and give an example.
2. Find α-cut and strong α-cut for $\alpha = 0.2$ of the fuzzy set $A(x) = \frac{x}{x+2}; x \in [0,10]$.
3. Give an example for involutive fuzzy complement.
4. Prove that every fuzzy number is a convex fuzzy set.
5. Define universal quantification.
6. Define Standard Lukasiewicz logicL_1. **(6×1=6)**

Part B

II. Answer any seven questions. Each one carries 2 marks.

7. Show that Yager class of fuzzy complements are involutive.
8. Find the pseudo inverse of the generator $f(a) = -\ln a \,; a \in [0,1]$and $f(0) = \infty$.
9. Define ax.omatic skelton for fuzzy union. Give two examples.
10. Let A be a membership function defined on [0,1]by $A(x) = \begin{cases} 0; & x \leq 2 \text{ or } x \geq 60 \\ \frac{x-20}{15}; & 20 < x < 35 \\ \frac{60-x}{15}; & 45 < x < 60 \\ 1; & 35 \leq x \leq 45 \end{cases}$.

    Find α_A and $\alpha +_A$for $\alpha = {}^1/_4, {}^1/_2$.
11. Compute the scalar cardinality of the fuzzy set $A = \frac{0.4}{v} + \frac{0.2}{w} + \frac{0.5}{x} + \frac{0.4}{y} + \frac{1}{z}$.
12. Consider the fuzzy sets A, B, C defined on the interval $X = [0,1]$ of real numbers by the membership grade functions $A(x) = \frac{x}{x+2}, B(x) = 2^{-x}, C(x) = \frac{1}{1+10(x-2)^2}$. Determine mathematical formulas for $\overline{A}, \overline{B}and\overline{C}$ using standard fuzzy operations.
13. Using characterization theorem of fuzzy numbers, find a fuzzy number for $a = 90, b = 100, w_1 = 77.5, \ w_2 = 100$.
14. Explain why $X = B - A$ is not a solution of the fuzzy equation $A + X = B$.
15. Differentiate quasi tautology and quasi contradiction.
16. When will be logic formulas equivalent. Give example for equivalent logic formulas.

(7×2=14)

Part C

III. Answer any five questions. Each one carries 6 marks.

17. Explain two cut worthy properties.
18. Illustrate the decomposition of a fuzzy set with an example.

19. Define dual triple. Prove that (min, max, c) is a dual triple, where c is any fuzzy complement.
20. Write first and second characterization theorems for fuzzy complements.
21. Find MAX for the following fuzzy numbers $A(x) = \begin{cases} x+2; & -2 \le x \le 1 \\ \frac{4-x}{3}; & 1 < x \le 4 \\ 0; & \text{otherwise} \end{cases}$ and

$$B(x) = \begin{cases} x-1; & 1 \le x \le 2 \\ 3-x; & 2 < x \le 3. \\ 0; & \text{otherwise} \end{cases}$$

22. Solve the fuzzy equation $AX = B$ where $A(x) = \begin{cases} x-3; & 3 < x \le 4 \\ 5-x; & 4 < x < 5 \\ 0; & x \le 3 \text{ or } x \ge 5 \end{cases}$ and

$$A(x) = \begin{cases} \frac{x-12}{8}; & 12 < x \le 20 \\ \frac{32-x}{12}; & 20 < x \le 32. \\ 0; & \text{otherwise} \end{cases}$$

23. How is Lukasiewicz logic L_1 isomorphic to fuzzy set.
24. Write a short essay on multivalued logics.

(5×6=30)

Part D

IV. Answer any two questions. Each one carries 15 marks.

25. Explain fuzzy propositions.
26. State and prove first, second and third decomposition theorems of fuzzy sets.
27. a) Prove that, for all $a, b \in [0,1]$, $i_{min}(a,b) \le i(a,b) \le \min(a,b)$; where i_{min} is the drastic intersection.

    b) Let the Yager class of t-norm is defined by

    $i_w(a,b) = 1 - min\left(1, [(1-a)^w + (1-b)^w]^{\frac{1}{w}}\right); w > 0$, then prove that $i_{min}(a,b) \le i_w(a,b) \le \min(a,b)$.
28. Let $A \in \mathcal{F}(\mathbb{R})$. Then prove that, A is a fuzzy number if and only if there exists $[a,b] \neq \emptyset$ such that $A(x) = \begin{cases} 1; & x \in [a,b] \\ l(x); & x \in (-\infty, a) \\ r(x); & x \in (b, \infty) \end{cases}$ where $l: (-\infty, a) \to [0,1]$ is a monotonic increasing continuous from right and $l(x) = 0$ for $x \in (-\infty, w_1)$ and $r: (b, \infty) \to [0,1]$ is a monotonic decreasing continuous from the left and $r(x) = 0$ for $w \in (w_2, \infty)$.

(2×15=30)