LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **MATHEMATICS**

FOURTH SEMESTER – **APRIL 2023**

16/17/18UMT4ES02 – FUZZY SETS AND APPLICATIONS

Date: 06-05-2023   Dept. No.   Max. : 100 Marks
Time: 09:00 AM - 12:00 NOON

Part A

Answer ALL questions: **(10 x 2 = 20)**

1. What is the difference between fuzzy set and crisp set?
2. Define complement of a fuzzy subset and find the complement of
   $A = \{(x_1, 0.2),\ (x_2, 0.5), (x_3, 1), (x_4, 0.9), (x_5, 0.01)\}$
3. Define the union of two fuzzy relations R and Q.
4. What are the types of index of fuzziness?
5. Define relative hamming distance.
6. What is a limit cycle and a fixed point?
7. What is the difference between FCM model and FRM model?
8. State the difference between ordinary graph and a fuzzy graph.
9. Define ordinary subset nearest to a fuzzy subset and construct the ordinary subset nearest to the fuzzy subset $A = \{(x_1, 0.8),\ (x_2, 0.3), (x_3, 0.7), (x_4, 1), (x_5, 0), (x_6, 0.2)\}$
10. What are the three important properties of a fuzzy number?

Part-B

Answer any FIVE questions: **(5 x 8 = 40)**

11. Let R_1 and R_2 be two fuzzy relations.

R_1	Y_1	Y_2	Y_3	Y_4
X_1	0.3	0.2	1	0
X_2	0.8	1	0	0.2
X_3	0.5	0	0.4	0

R_2	Y_1	Y_2	Y_3	Y_4
X_1	0.3	0	0.7	0
X_2	0.1	0.8	1	1
X_3	0.6	0.9	0.3	0.2

Find (i) algebraic product (ii) algebraic sum and (ii) distinctive sum for R_1 and R_2

12. Prove that $\sqrt{\sum_{i=1}^{k} P_i^2} \leq \sqrt{\sum_{i=1}^{k} m_i^2} + \sqrt{\sum_{i=1}^{k} n_i^2}$ where $P_i, m_i, n_i \in R^+, i = 1, 2, 3, \ldots, k$ and $P_i \leq m_i + n_i$, $i = 1, 2, 3, \ldots, k$.

13. State and prove decomposition theorem.

14. Find the power set when $E = \{x_1, x_2, x_3\}$ and $M = \{0, 0.5, 1\}$ and draw the structure of a vectorial lattice.

15. Define fuzzy equivalence relation with an example.

16. Explain the various types of fuzzy numbers with an example.

17. Explain the various attributes of an expert system.

18. Find the order size and degree and complement for the following graph.
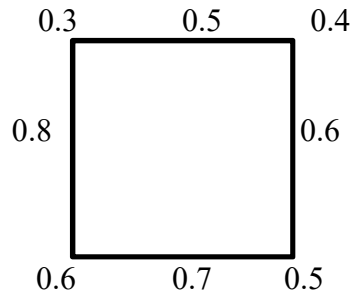
Part C

Answer any TWO questions: **(2 x 20 = 40)**

19. (a) Explain the following fuzzy relations with an example.
    (i) symmetric (ii) dissimilitude and (iii) anti- symmetric.

   (b) Define fuzzy graph and explain different types with examples.

20. Find $R_1 \cdot R_2$, R_3 where $\cdot$ is the max-min composition

R_1	Y_1	Y_2	Y_3	Y_4	Y_5
X_1	0.2	0.3	0.8	0.6	0.1
X_2	0.3	0.8	0.6	0.6	1
X_3	0.2	1	0.4	0.1	0

R_2	Z_1	Z_2	Z_3	Z_4
Y_1	1	0.2	0.3	0.4
Y_2	0.4	1	0.1	0.2
Y_3	0.3	0.4	1	0.1
Y_4	0.2	0.3	0.4	1
Y_5	1	0.2	0.3	0.4

R_3	T_1	T_2	T_3	T_4	T_5
Z_1	0.9	0	0.3	0.4	0.5
Z_2	0.9	0.6	0.4	0.7	0.6
Z_3	0	0.8	0.9	0.3	0.7
Z_4	0.3	1	0.1	0.4	1

21. (a) Let $A = \{(x_1 , 0.2), (x_2 , 0), (x_3 , 0), (x_4 , 0.6), (x_5 , 0.8), (x_6, 0.4), (x_7 , 1)\}$
       $B = \{(x_1 ,0.7), (x_2 , 0.2), (x_3 , 0), (x_4 , 0.6), (x_5 , 0.5), (x_6, 1) (x_7 , 0)\}$
      Find (i) $d (A , B)$ (ii) $\delta (A , B)$ (iii) $e^2 (A , B)$ (iv) $\in (A , B)$

   (b) Explain the structure and the process of fuzzy controller.

22. Explain in detail the impact of Fuzzy Congnitive maps (FCM) in the field of medicines.

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