LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – MATHEMATICS

FIFTH SEMESTER – NOVEMBER 2024

UMT 5602 – FUZZY SETS AND APPLICATIONS

Date: 21-11-2024   Dept. No.   Max. : 100 Marks
Time: 09:00 am-12:00 pm

SECTION A - K1 (CO1)	
Answer ALL the Questions -	**(10 x 1 = 10)**
1.	**Answer the following**
a)	Define the disjunctive sum of two fuzzy subsets A and B of a set E.
b)	Explain ordinary subset nearest to a fuzzy subset.
c)	State hamming distance.
d)	What is the fuzzy matrix model?
e)	Explain an expert system.
2.	**Fill in the blanks**
a)	The range of membership values in a fuzzy set typically lies between ____.
b)	A path of a finite graph in fuzzy is a sequence of ____ with associated membership values.
c)	Resemblance relations measure the degree of __ between elements in a set.
d)	In relational mappings, a _____ mapping is a one-to-one correspondence between elements of two sets.
e)	Fuzzification is the process of converting ____ inputs into fuzzy sets.

SECTION A - K2 (CO1)	
Answer ALL the Questions	**(10 x 1 = 10)**
3.	**Choose the correct answer for the following**
a)	What is a fuzzy subset? (i) A subset with elements having uncertain membership (ii) A subset with only crisp elements (iii) A subset with elements having random membership (iv) A subset with all elements having equal membership
b)	If two distinct lines x and y are incident with a common point, then they are (i) Adjacent lines (ii) Data lines (iii) Edge lines (iv) Complete lines
c)	What is a fuzzy preorder? (i) A relation that is reflexive, transitive, and symmetric (ii) A relation that is reflexive, transitive, and anti-symmetric (iii) A relation that is reflexive, transitive, and asymmetric (iv) A relation that is reflexive, transitive, and irreflexive
d)	Fuzzy Cognitive Maps (FCMs) are more applicable when the data in the first place is (i) Uncertain or imprecise information

(ii) Unsupervised one
(iii) Binary entries
(iv) Supervised one

e)	De-fuzzification in fuzzy control is the process of: (i) Converting fuzzy outputs into crisp values (ii) Converting crisp inputs into fuzzy sets (iii) Evaluating the fuzzy rules (iv) Mapping fuzzy inputs to crisp outputs
4.	**State True or False**
a)	Two sets are equal if and only if they have the same elements.
b)	Fuzzy graphs and fuzzy relations are primarily used in image processing and computer vision applications.
c)	Fuzzy binary relations are reflexive, anti-symmetry and transitive.
d)	The fuzzy matrix model extends the concept of classical matrix theory by allowing elements in the matrix to have uncertain or fuzzy values.
e)	Rule evaluation in fuzzy control involves applying a set of predefined rules to fuzzy inputs to determine the appropriate control actions.

SECTION B - K3 (CO2)

Answer any TWO of the following (2 x 10 = 20)

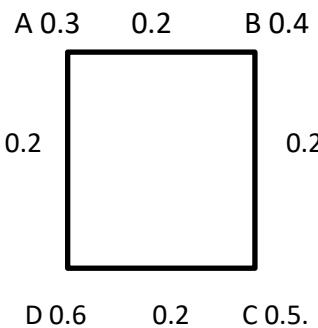| 5.	State and prove decomposition theorem for fuzzy relation.
6.	Consider the reference set $E = [A, B, C, D, E, F, G]$ and the fuzzy subsets. $\underset{\sim}{A} = \{(A,0),(B,0.3),(C,0.7),(D,1),(E,0),(F,0.2),(G,0.6)\}$ $\underset{\sim}{B} = \{(A,0.3),(B,1),(C,0.5),(D,0.8),(E,1),(F,0.5),(G,0.6)\}$ $\underset{\sim}{C} = \{(A,1),(B,0.5),(C,0.5),(D,0.2),(E,0),(F,0.2),(G,0.9)\}$ Find (i) $A \cup B$ (ii) ¿ (iii) $\left(A \cap B\right) \cup C$ (iv) $A \oplus B$.
7.	Examine the order, size, degree and complement for the following graph. A 0.3 0.2 B 0.4 0.2 0.2 D 0.6 0.2 C 0.5.
8.	Let R be a fuzzy relation. If for some $k, R^{k+1} = R^k$, then show that $R = R \cup R^2 \cup R^3 \cup \text{.......} \cup R^k$.

SECTION C – K4 (CO3)

Answer any TWO of the following (2 x 10 = 20)

9.	Let $p_i, m_i, n_i \in R^{+}, i=1,2...k$, 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 $p_i \leq m_i + n_i, i=1,2...k$.
10.	Define fuzzy graph and explain in detail the different types with examples.

11.

(a) Let $X = \begin{bmatrix} 0.6 & 0.7 & 0.2 & 1 & 0.5 & 0.4 \\ 0.4 & 0.5 & 1 & 0.3 & 0.8 & 0.5 \\ 0.6 & 0.1 & 0.4 & 0.8 & 0.3 & 0.5 \\ 0.8 & 0.4 & 0.6 & 1 & 0.3 & 0 \end{bmatrix}$ and $Y = \begin{bmatrix} 0.1 & 0.9 & 0.3 & 0.4 & 0.5 & 0 \\ 0.8 & 0.5 & 0.2 & 0.1 & 0.1 & 1 \\ 0.5 & 1 & 0.8 & 1 & 0 & 0.3 \\ 0.2 & 0.7 & 0 & 0.4 & 0.6 & 0.9 \end{bmatrix}$

Estimate Max$\{X,Y\}$ and Min$\{X,Y\}$.

(b) Let $A = \{(x_1, 0.7), (x_2, 0.2), (x_3, 0), (x_4, 0.6), (x_5, 0.5), (x_6, 1), (x_7, 0)\}$

$B = \{(x_1, 0.2), (x_2, 0), (x_3, 0), (x_4, 0.6), (x_5, 0.8), (x_6, 0.4), (x_7, 1)\}$

Find (i). $d(A,B)$ (ii) $\delta(A,B)$ (iii) $e^2(A,B)$ (iv) $\in(A,B)$.

12.

Let R_1 and R_2 be two 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 (a). $R_1 \cup R_2$ (b). $R_1 \cap R_2$ (c). $R_1 \cdot R_2$ (d). $R_1 + R_2$ (e). $\overline{R_1}, \overline{R_2}$ (f) $R_1 \oplus R_2$

SECTION D – K5 (CO4)

Answer any ONE of the following (1 x 20 = 20)

13. Explain the process of fuzzy control and also demonstrate the method to form bidirectional associative memory.

14. Evaluate $R_2 \circ R_1$ where $\circ$ is max- min composition.

R_1	y_1	y_2	y_3	y_4	y_5
x_1	1	0.2	0	0.2	1
x_2	1	0.5	0.4	1	0.4
x_3	0.7	0	0.5	0	0.9

R_2	z_1	z_2	z_3	z_4
y_1	0.5	0.8	0	0.7
y_2	0.7	0	0.5	0.8
y_3	1	1	1	0
y_4	0.5	0.2	0	0.4
y_5	0.9	0.7	0.8	0.7

SECTION E – K6 (CO5)

Answer any ONE of the following (1 x 20 = 20)

15. Demonstrate in detail the impact of Fuzzy Relational Maps (FRM) in the field of medicine.

16. Determine how expert system is applied in strategic planning and also explain the characteristics attributes of an expert system.

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