LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **MATHEMATICS**

THIRD SEMESTER – **NOVEMBER 2024**

PMT 3502 – FUZZY SETS AND APPLICATIONS

Date: 09-11-2024 Dept. No. Max. : 100 Marks

Time: 01:00 pm-04:00 pm

SECTION A

Answer ANY FOUR of the following **4 x 10 = 40 Marks**

1. Let $p_i, m_i, n_i \in R^{+¿, i=1,2\ldots k¿}$, then prove that

$$\sqrt{\sum_{i=1}^{k} p_i^2} \leq \sqrt{\sum_{i=1}^{k} m_i^2} + \sqrt{\sum_{i=1}^{k} n_i^2}, \text{ where } p_i \leq m_i + n_i, i = 1,2\ldots k.$$

2. Explain the following fuzzy relation of (i) normal and subnormal projection (ii) resemblance (iii) semi- preorder (iv) fuzzy ordinal relation and (v) similitude each with an example.

3. Consider a fuzzy similitude relation R and choosing three quantities a, b and c as the following: $a = \mu_R(x,y) = \mu_R(y,x) : b = \mu_R(y,z) = \mu_R(z,x) : c = \mu_R(z,x) = \mu_R(x,z)$

prove that $c \geq a = b \vee a \geq b \vee b \geq c = a$.

4. Find the max-product transitive closure for the following relations.

$\tilde{R}$	A	B	C	D	E
A	1	0.1	0.8	0.2	0.3
B	0.1	1	0	0.3	1
C	0.8	0	1	0.7	0
D	0.2	0.3	0.7	1	0.6
E	0.3	1	0	0.6	1

5. Let $\underset{\sim}{R} \subset E \times E$ then prove that $\forall (x,y) \in E \times E ; \mu_{R^k(x,y)} = l_{k^¿}(x,y)$ where $l_{k^¿}(x,y)$ is the strongest path existing from x to y of length k.

6. Prove that $\hat{\hat{R}} \subset \hat{\dot{R}}$, where $\underset{\sim}{R}$ is a resemblance relation.

7. Explain how one's face can could be verified using fuzzy tools.

8. Explain the process of fuzzy c- mean algorithm.

SECTION B

Answer ANY THREE of the following **3 x 20 = 60 Marks**

9. Find $R_2 \circ R_1$ using max-min composition.

R_1	y_1	y_2	y_3	y_4	y_5
x_1	0.1	0.2	0	1	0.7
x_2	0.3	0.5	0	0.2	1
x_3	0.8	0	1	0.4	0.3

R_2	z_1	z_2	z_3	z_4
y_1	0.9	0	0.3	0.4
y_2	0.2	1	0.8	0
y_3	0.8	0	0.7	1
y_4	0.4	0.2	0.3	0
y_5	0	1	0	0.8

10. (a) If R is a preorder relation then prove that $R^k = R$ for $k = 1,2,\ldots$

(b) State and prove decomposition theorem for fuzzy subsets.

11. (a) Explain fuzzy equivalence relations with an example.

(b) Consider two relations $\widetilde{R}_1$ and $\widetilde{R}_2$ given by

$\widetilde{R}_1$	y_1	y_2	y_3	y_4
x	0	0.1	0	0.4
x_2	0.5	1	0	0.7
x_3	0.8	0.9	0.9	1

$\widetilde{R}_2$	y_1	y_2	y_3	y_4
x_1	0.1	0	0.2	0.5
x_2	0	1	0.1	1
x_3	0.9	0.4	0.7	0

Determine (i) $\widetilde{R}_1 + \widetilde{R}_2$ and (ii) $\widetilde{R}_1 \oplus \widetilde{R}_2$

12.(a) Explain fuzzy membership roaster method with an example.

(b) In any field of application, explain the concept of fuzzy degree of measure applied with an example.

13. (a) Give a detailed description of fuzzy image processing.

(b) Find the clustering method based on fuzzy equivalence relations for the following points in R^2.

k	1	2	3	4	5
x_{k1}	0	1	2	3	4
x_{k2}	0	1	3	1	0

Analyze the data for q=1 and 2.

14. Explain in detail the fuzzy application in the field of engineering.

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