

PG CBCS
M.Sc. Semester-IV Examination, 2022
MATHEMATICS
PAPER: MTM 402

(FUZZY MATHEMATICS WITH APPLICATIONS & SOFT COMPUTING)

Full Marks: 40

Time: 2 Hours

Write the answer for each unit in separate sheet

The figures in the right-hand margin indicate full marks.
 Candidates are required to give their answers in their own words as far as practicable.

MTM 402.1: FUZZY MATHEMATICS WITH APPLICATIONS

GROUP-A

1. Answer any two question:

2×2=4

- a) Define fuzzy set. Write three examples of real-life fuzzy sets including its membership functions.
- b) Find α -cut of triangular fuzzy number $\tilde{A} = (2, 8, 12)$ for $\alpha = 0.4$ & 0.6 .
- c) Give two examples for each random and non-random uncertainty.
- d) Define with proper example: (i) empty fuzzy set and subset of a fuzzy set, (ii) relation on fuzzy sets.

GROUP-B

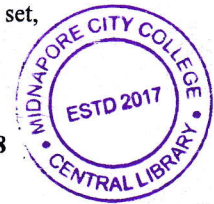
2. Answer any two questions:

2×4=8

- a) Prove that distribution law for fuzzy sets is true.
- b) Illustrate Zadeh's Extension principle. Use it, show that $[4, 7] - [1, 5] = [-1, 6]$
- c) Graphically explain how a triangular fuzzy number $\tilde{A} = (1, 5, 13)$ can be expressed in the form $\tilde{A} = \cup \{\alpha A_\alpha : 0 < \alpha \leq 1\}$, where \cup denotes the standard fuzzy union, αA_α is a special fuzzy set define as $\mu_{\alpha A_\alpha}(x) = \alpha \wedge \chi_{A_\alpha}(x)$ and χ is a characteristic function of a crisp set.
- d) Consider the two triangular fuzzy numbers \tilde{A} and \tilde{B} with the following membership functions given by

$$\mu_{\tilde{A}}(x) = \begin{cases} 0, & x \leq -1 \\ \frac{x+1}{2}, & -1 \leq x \leq 1 \\ \frac{3-x}{2}, & 1 \leq x \leq 3 \\ 0, & x \geq 3 \end{cases} \quad \mu_{\tilde{B}}(x) = \begin{cases} 0, & x \leq 1 \\ \frac{x-1}{2}, & 1 \leq x \leq 3 \\ \frac{5-x}{2}, & 3 \leq x \leq 5 \\ 0, & x \geq 5 \end{cases}$$

[P. T. O]



Using α -cut rules perform the following arithmetic operations: (i) $\tilde{A} + \tilde{B}$ (ii) $\tilde{A} - \tilde{B}$. [2]

GROUP-C

3. Answer any one questions: 8x1=8

a) Illustrate the Bellman and Zadeh's principle for fuzzy LPP. Explain Wiener's method to convert the fuzzy LPP to crisp LPP.

b) For the fuzzy set \tilde{A} , where

$$\mu_A(x) = \begin{cases} \frac{x-5}{3} & 2 \leq x \leq 8 \\ 0 & \text{otherwise} \end{cases}$$

- i) Find \tilde{A}^c the complement of \tilde{A} ii) Find $\tilde{A}_{0.3}$, $\tilde{A}_{0.5}$ where \tilde{A}_α is the α -cut of \tilde{A} iii) Determine the support and height for the fuzzy set \tilde{A} . Is it normal?
- iv) Check whether the given fuzzy set is convex or not. 2+2+2+2

MTM 402.2. SOFT COMPUTING

GROUP-A

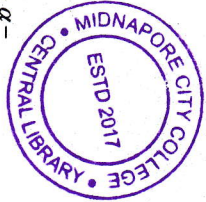
1. Answer any two questions: 2x2=4

- a) Write the features of soft computing.
- b) Write the disadvantages of binary coded genetic algorithm.
- c) Explain the reinforcement learning process.
- d) What is single layer feed forward network.

GROUP-B

2. Answer any two questions: 2x4=8

- a) Describe the two operations cross-over and mutation for a binary coded Genetic Algorithm.
- b) Let $X = \{1, 2, 3, 4\}$ and $Y = \{a, b, c\}$ be two universes of discourses. Also, let $\tilde{A} = \{(1, 0.2), (2, 0.5), (3, 0.7), (4, 1.0)\}$, $\tilde{B} = \{(1, 0.3), (2, 0.4), (3, 0.8), (4, 0.7)\}$ and $\tilde{C} = \{(a, 0.1), (b, 0.6), (c, 0.9)\}$. Determine the fuzzy relation of the following fuzzy rule "IF x is \tilde{A} AND x is \tilde{B} THEN y is \tilde{C} ". [P. T. O]



c) Define max-min composition. Suppose R and S be two relations on $X \times Y$ and $Y \times Z$ respectively. Find the Max-Min composition of $R \circ S$, where

$$R = \begin{pmatrix} 0.2 & 0.8 & 0.0 & 0.9 \\ 0.5 & 0.5 & 0.8 & 0.7 \\ 0.7 & 0.1 & 0.3 & 0.6 \\ 0.9 & 1.0 & 0.8 & 0.0 \end{pmatrix}, S = \begin{pmatrix} 0.1 & 0.0 & 0.4 & 0.4 \\ 0.4 & 0.5 & 0.9 & 0.2 \\ 0.8 & 0.1 & 0.0 & 0.6 \\ 0.0 & 0.0 & 0.1 & 0.0 \end{pmatrix}$$

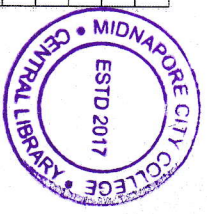
d) Describe two important fuzzy inference rules with clearly mention the purpose of used.

GROUP-C

3. Answer any one questions: 1x8=8

a) Write an algorithm of Hebbian Learning Rule for an artificial neural network. Use it solve the following pattern matching problem:

	INPUT				TARGET			
	x_1	x_2	b		y_1	y_2	y_3	y_4
x_1	-1	-1	1		y_1	-1		
x_2	-1	1	1		y_2	-1		
x_3	1	-1	1		y_3	-1		
x_4	1	1	1		y_4	1		



- b) Maximize $f(x) = |2x + 1|$; $0 \leq x \leq 10$ using binary coded GA (one iteration only). Given that population size $N = 6$; initial population $x_1 = 10011$, $x_2 = 10101$, $x_3 = 10110$, $x_4 = 11100$, $x_5 = 01010$, $x_6 = 01111$; random numbers for selection: 0.19, 0.63, 0.97, 0.11, 0.70, 0.51; cross-over probability, $p_c = 0.65$; random numbers for cross-over: 0.60, 0.85, 0.57, 0.37, 0.70, 0.32; mutation probability, $p_m = 0.05$; and random numbers for mutation: 0.21, 0.37, 0.02, 0.52, 0.07, 0.97, 0.04, 0.61, 0.17, 0.09, 0.14, 0.82, 0.08, 0.21, 0.37, 0.20, 0.25, 0.72, 0.24, 0.16, 0.47, 0.58, 0.49, 0.01, 0.18, 0.09, 0.82, 0.26, 0.43, 0.08.
