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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 $\tilde{A} = \cup\{\alpha A_\alpha : 0 < \alpha \le 1\}$, 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

$$\mu_{\tilde{A}}(x) = \begin{cases} 0, & x \le -1 \\ \dfrac{x+1}{2}, & -1 \le x \le 1 \\ \dfrac{3-x}{2}, & 1 \le x \le 3 \\ 0, & x \ge 3 \end{cases} \qquad \mu_{\tilde{B}}(x) = \begin{cases} 0, & x \le 1 \\ \dfrac{x-1}{2}, & 1 \le x \le 3 \\ \dfrac{5-x}{2}, & 3 \le x \le 5 \\ 0, & x \ge 5 \end{cases}$$

[P. T. O]

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

GROUP-C

3. Answer any one questions: **8×1=8**

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

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

$$\mu_A(x)=\begin{cases}\left|\frac{x-5}{3}\right|, & 2\le x\le 8\\ 0, & \text{otherwise}\end{cases}$$

i) Find $\tilde{A}^C$ the complement of $\tilde{A}$ ii) Find $\tilde{A}_{0.3}, \tilde{A}_{0.5}$ where $\tilde{A}_\alpha$, is the $\alpha-$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 question: **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: **2×4=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

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

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

GROUP-C

3. Answer any one questions: **1×8=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
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 $f(x)=|2x+1|;\ 0\le x\le 10$ 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.

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