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MA./M.Sc. (Fourth Semester)
EXAMINATION, May - June, 2022
MATHEMATICS
(Optional)
Paper Third (B)
(Fuzzy Sets Theory and its Application-II)

Time : Three Hours] *[Maximum Marks:80*

Note: Attempt all sections as directed.

(Section - A)

(Objective/Multiple Choice Questions)

(1 mark each)

Note: Attempt all questions.

Choose the correct answer:

P.T.O.

1. If p and q are two proposition and the inference rule $(p \wedge (p \Rightarrow q_1) \Rightarrow q$ is called:
   (A) Modus ponens
   (B) Modus tollens
   (C) Hypothetical syllogism
   (D) None of these
2. If a = 1 and b = ½ in three valued logic then what is value of Lukasiewicz implication.
   (A) 0
   (B) 1
   (C) ½
   (D) None of these
3. Let a modifier h be an increasing bijection then it is called weak modifier if $\forall a \in [0,1]$
   (A) $h(a) = a$
   (B) $h(a) > a$
   (C) $h(a) < a$
   (D) None of these
4. Inference from conditional and qualified propositions þ: "if x is A then y is B is S where S is a fuzzy truth qualifier is:
   (A) The generalized modus ponens
   (B) Composition rule of inference
   (C) Method of truth value restriction
   (D) All of the above

5. A fuzzy implication *J* is a function of the form:

(A) $J:[0,1] \rightarrow [0,1]$

(B) $J:[0,1] \times [0,1] \rightarrow [0,1]$

(C) $J:[0,1] \rightarrow R$

(D) $J:[0,1] \times [0,1] \rightarrow R$

6. The gaines Rescher implication $Js(a, b) = \begin{cases} 1 & a \le b \\ 0 & a > b \end{cases}$ satisfy:

(A) The generalized modus ponens

(B) Modus tollens

(C) Hypothetical syllogism

(D) All of the above

7. Let fuzzy relation equation $B = A \overset{i}{o} R$ and

$c(A) = c(B) \overset{i}{o} R^{-1}$ then the problem of determing R for a given conditional fuzzy propositon with antecedent A and consequent B. The system of fuzzy relation equation has a solution for R if

(A) $\hat{R} = A \overset{\omega i}{o} B$ is the greatest solution

(B) $\hat{R} = A \overset{i}{o} B$ is the greatest solution

(C) $\hat{R} = (A \overset{\omega i}{o} B) \bigcap (C(B) \overset{\omega i}{o} C(A))^{-1}$ is the greatest solution.

(D) None of these

8. If $f(a) = a^{\omega}$ where $\omega > 0$ then fuzzy implicaton define by the formula:

(A) $J_{\omega}(a,b) = \min[1, (1 + a^{\omega} + b^{\omega})^{1/\omega}]$

(B) $J_{\omega}(a,b) = \min[1, (1 - a^{\omega} + b^{\omega})^{1/\omega}]$

(C) $J_{\omega}(a,b) = \min[1, (1 + a^{\omega} - b^{\omega})^{\omega}]$

(D) None of these

9. A collection of rules refering to a particular system is called:

(A) Fuzzy system

(B) Fuzzy rule base

(C) Fuzzy expert system

(D) None of these

10. The purpose of defuzzification is:

(A) Conversion of fuzzy set into a single real number

(B) Conversion of fuzzy set into a single real interval

(C) Both (A) and (B) are true

(D) None of these

11. Neural networks have already been proven very useful in numerous applications of fuzzy sets theory:

(A) For constructing membership

(B) For solving fuzzy relation equation

(C) For modifying fuzzy inference rules

(D) All of the above

12. In fuzzy automata $A = (X, Y, Z, R, S)$ the input state is called:
    (A) Stimuli
    (B) Responses
    (C) Current state
    (D) None of these

13. Which one is not a defuzzification method:
    (A) Centre of gravity method
    (B) Centre of maxima method
    (C) Centre of range method
    (D) Mean of maxima method

14. The method of Defuzzification given by $x^* = \frac{\sum A(x) \cdot \overline{x}}{\sum A(x)}$
    where $\overline{x} =$ centroid and $\sum$ denote the algebraic sum, is called:
    (A) Centre of area method
    (B) Centre of maxima method
    (C) Weighted average method
    (D) None of these

15. The opted uncertainty is a subset of:
    (A) Epictemology
    (B) Pragmatic
    (C) Both (A) and (B)
    (D) None of these

16. In any fuzzy automata, the operation min. and max. be replaced with other t norme and t - conorme respectively and when min. is replaced with the product and max. is replaced with the algebraic sum such that input states are singletone and $\sum c'(z_i) = 1$,

    $\sum R(z_i, y_i) = 1$ for each $z_i \in z$

    $\sum S(x_k, z_i, z_j) = 1$ for each $(x_k, z_j) \in x \times z$ then classical probabilistic automaton of the:
    (A) Moore machine
    (B) Mealy machine
    (C) Both (A) and (B)
    (D) None of these

17. The formula for relative popularity of alterative x_i over x_j is given by:
    (A) $n.N(x_i, x_j)$
    (B) $\frac{N(x_i, x_j)}{n}$
    (C) $\frac{N(x_i, x_j)}{10}$
    (D) None of these

18. If $P_1 = (w, x, y, z)\, P_2 = P_5 = (z, y, x, w)$

$P_3 = P_7 = (x, w, y, z)\;\; P_4 = P_8 = (w, z, x, y)$

$P_6 = (z, w, x, y)$ then $S(w, z) = ?$

(A) 0.375

(B) 0.5

(C) 0.75

(D) 0.625

19. If the priority fuzzy set P on (A, B) is P (A) = 0.75 and P (B) = 0.5 then

(A) $A \le B$

(B) $B \le A$

(C) $A = B$

(D) None of these

20. Fuzzy linear progrmming problem is solved-

(A) By a method which is only for FLPP using defuzzification technique

(B) With the help of simplex method

(C) Both (A) and (B)

(D) None of these

Section - B

(Very Short Answer Type Questions)

(2 marks each)

Note: Attempt all questions.

1. Write types of fuzzy propositions.
2. Write quantifier extension principle
3. Define expert system shell in expert system
4. If Lukasiewicz implication $J_a(a, b) = \min(1, 1 - a + b)$ and largest S - implication

$$J_{LS}(a,b) = \begin{cases} b \, when \, a = 1 \\ 1 - a \;\, when \;\, b = 0 \\ 1 otherwise \end{cases}$$

then prove that $J_a(a, b) \le J_{LS}(a, b)$

5. What do you mean by state of Variable in fuzzy system.
6. Write center of area method
7. Write all features of fuzzy Neural network.
8. Write characterization of fuzzy model of individual decision making.

Section - C

(Short Answer Type Questions)

(3 marks each)

Note: Attempt all questions.

1. Explain inference from conditional fuzzy proposition.

2. If $B_1' = A'O^{(\cup R_j)}_{j \in Nn}$, $B_2' = A'O^{(\cap Rj)}_{i \in Nn}$, $B_3' = {}^{\cup A' ORj}_{S \in Nn}$ and $B_4' = {}^{\cap A' ORj}_{S \in Nn}$ then prove that $B_2' \leq B_4' \leq B_1' = B_3'$.

3. Let i and u be the standard fuzzy intersection and fuzzy union, respectively suppose that J is a fuzzy implication satisfying monotonicity. Prove that

   $J(a, i(b, c)) = i(J(a, b), J(a, c))$ for all $a, b, c \in [0, 1]$

4. Explain fuzzification in fuzzy controller.

5. Explain mean of maxima method

6. Explain fuzzy controllers

7. Write the formulation of fuzzy linear programming problem.

8. Define any two method for finding Rank of two fuzzy number A and B.

Section - D

(Long Answer Type Questions)

(5 marks each)

Note: Attempt all questions.

1. Explain fuzzy quantifier.

   OR

   Explain Generalized modus tollens and let sets of values of variables x and y be $X = \{x_1, x_2, x_3\}$ and $Y = \{y_1, y_2\}$ respectively. Assume that a proposition "If x is A then Y is B" is given where $A = \frac{\cdot 5}{x_1} + \frac{1}{x_2} + \frac{\cdot 6}{x_3}$ and $B = \frac{1}{y_1} + \frac{\cdot 4}{y_2}$ then a fact expressed by the proposition "Y is B' " Where $B' = \frac{\cdot 9}{y_1} + \frac{\cdot 7}{y_2}$ Derive a conclusion in the form "$x \text{ is } A$"

2. Explain interval valued approximate reasoning and let $X = \{x_1, x_2, x_3\}$ and $Y = \{y_1, y_2\}$ and a proposition of the form "if x is A, then y is B" where $L_A = \frac{\cdot 5}{x_1} + \frac{\cdot 6}{x_2} + \frac{1}{x_3}$

$U_A = \frac{\cdot 6}{x_1} + \frac{\cdot 8}{x_2} + \frac{1}{x_3}$ and $L_B = \frac{\cdot 4}{y_1} + \frac{1}{y_2}$ $U_B = \frac{\cdot 6}{y_1} + \frac{1}{y_2}$.
Assume that the Lukasiwicz implication

$J(a,b) = \min(1, 1-a+b)$ Given a fact "x *is* A'" where

$L_{A'} = \frac{\cdot 4}{x_1} + \frac{\cdot 8}{x_2} + \frac{1}{x_3}$ $U_{A'} = \frac{\cdot 5}{x_1} + \frac{\cdot 9}{x_2} + \frac{1}{x_3}$ obtain conclusion

$B' = [L_{B'}, U_{B'}]$ by the composition rule of inference.

OR

Formulate reasonable fuzzy inference rules for an air conditioning fuzzy control system.

3. Explain fuzzy automata.

OR

Explain defuzzification with example.

4. Assume that each individual of a group of five judes has a total preference ordering $Pi(i \in N_5)$ on four figure skaters a, b, c, d. The ordering are $P_1 = <a, b, d, c>$ $P_2 = <a, c, d, b>$ $P_3 = <b, a, c, d>$ $P_4 = <a, d, b, c>$.
Use fuzzy multiperson decision making to determine the group decision.

OR

Let us consider and automaton with

$X = \{x_1, x_2\}$ $Z = \{z_1, z_2, z_3\}$ and the state transition function expressed by the matrix

$$\begin{array}{c|cc} & x_1 & x_2 \\ \hline z_1 & z_1 & z_2 \\ z_2 & z_3 & z_1 \\ z_3 & z_1 & z_3 \end{array}$$

whose entries are next internal state for any given present internal and output state. The fuzzy goal at t =2 is $c^2 = \frac{\cdot 8}{z_1} + \frac{1}{z_2} + \frac{\cdot 9}{z_3}$ and the fuzzy constraints

$A^\circ = \frac{\cdot 8}{x_1} + \frac{1}{x_2}$ and $A' = \frac{1}{x_1} + \frac{\cdot 7}{x_2}$.