Roll No. _______ **Code No. Q-4396**

FOURTH SEMESTER EXAMINATION 2021-22

M.Sc. Mathematics

Paper - IV

Fuzzy Sets & Their Applications - II

Time : 3.00 Hrs. **Max. Marks : 80**

Total No. of Printed Page : 04 **Mini. Marks : 29**

Note: Question paper is divided into three sections. Attempt question of all three section as per direction. Distribution of Marks is given in each section.

Section - 'A'

Very short type question (in few words). **6x2=12**

Q.1 Attempt any six question from the following questions :

(i) Prove that $Pl(A)+Pl(\overline{A})\geq 1$.

(ii) Write Denipster's rule of combination.

(iii) Prove that $Nec(A)>0\Rightarrow Pos(A)=1$.

(iv) Write the primitives defined by Lukasiewicz.

(v) Write the matrix form of compositional rule of inference.

(vi) Draw the architecture of a fuzzy expert system.

(vii) Write the formula for the degree of membership grade indicating the degree of group preference of alternative x_i over x_j.

(viii) Write the linear programming problem when fuzzy number are triangular.

(ix) If $X=\{w,x,y,z\}$

$.75_S=\{(w,y),(x,y)\}$

find $.75_0$

(x) Calculate :

$\left[c(B)O^{wi}C(A)\right]^{-1}(x,y)$

where w_i represents Lukasiewicz implication.

Section - 'B'

Short answer question (In 200 words) **4x5=20**

Q.2 Attempt any four question from the following questions :

(i) Prove that Bel measure obeys monotonicity property.

(ii) Write short notes on Liguistic Hedges.

(iii) What do you mean by Kernel of an expert system.

(iv) Draw a general scheme of a fuzzy controller.

(v) What do you mean by linear programming problem ?

Section - 'C'

Long answer/Essay type question. **4x12=48**

Q.3 Attempt any four question from the following questions :

(i) (a) Let $X=\{a,b,c,d\}$. Given the basic assignment $m(\{a,b,c\})=.5$, $m(\{a,b,d\})=.2$ and $m(X)=.3$ determine the corresponding belief, playsibility and communality measures.

(b) Prove that :

$Pl(A) \geq Bel(A)$

(ii) (a) Let a given finite body of evidence ($\mathfrak{F}$,w) be nested. then prove that for all $A,B \in P(x)$

$Bel\ (A \cap B) = \min[Bel(A), Bel(B)]$

$Pl(A \cup B) = \max\{Pl(A), Pl(B)\}$

(b) Determine the basic assignment possibility measure and necessity measure for the following possibility distribution defined on $X = \{x_i / i \in N_n\}$ for appropriate values of n

$'r = \langle 1, .8, .8, .5, .2 \rangle$

(iii) 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

$A = .6/x_1 + 1/x_2 + .9/x_3$ & $B = .6/y_1$

Then, given a fact expressed by the proposition " x is A'" where $A' =$ use the generalized. modlus poneus to derive a conclusion is the form " y is B'"

(iv) (a) Write the reasonable axiams of fuzzy implication.

(b) Let i_1, i_2 be $t-$norms such that i_1, i_2 be $t-$norms such that $i_1(a,b) \leq i_2(a,b)$ that for all $a,b \in [0,1]$ and let I_1, I_2 be $R-$implication based on i_1, i_2 respectively.

Then prove that

$I_1(a,b) \geq I_2(a,b)$ for all $a,b \in [0,1]$.

(v) (a) Discuss any two defuzzification methods on fuzzy control.

(b) Consider a fuzzy automation with $X = \{x_1, x_2\}$, $Y = \{y_1, y_2, y_3\}$, $Z = \{z_1, z_2, z_3, z_4\}$ where output relation R and stati-transition relation S are defined, respectively, by the matrix.

$$R = \begin{array}{c} \\ z_1 \\ z_2 \\ z_3 \\ z_4 \end{array} \begin{array}{c} \begin{array}{ccc} y_1 & y_2 & y_3 \end{array} \\ \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ .5 & 1 & .3 \end{bmatrix} \end{array}$$

and the three dimensional array

$$S = \begin{bmatrix} z_1 \\ z_2 \\ z_3 \\ z_4 \end{bmatrix} \quad \begin{array}{c} \begin{array}{cccc} z_1 & z_2 & z_3 & z_4 \end{array} \\ \begin{bmatrix} 0 & .4 & .2 & 1 \\ .3 & 1 & 0 & .2 \\ .5 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix} \end{array} \qquad \begin{array}{c} \\ z_1 \\ z_2 \\ z_3 \\ z_4 \end{array} \begin{array}{c} \begin{array}{cccc} z_1 & z_2 & z_3 & z_4 \end{array} \\ \begin{bmatrix} 0 & 0 & 1 & 0 \\ .2 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \\ 1 & .3 & 0 & .6 \end{bmatrix} \end{array}$$

Generate sequences of three fuzzy internal and output states under the following conditions $C^1 = [1 \;\; 0 \;\; 0 \; 1]$ the input states

$A^1 = [.2 \;\; 1],\; A^2 = [1,0],\; A^3 = [1 \;\; .4]$

(vi) (a) Write short notes on individual Decision making & multiperson decision making.

(b) Assume that each individual of a group of five judges has a total preference odering

$P_i(i \in N_5)$ on four stcaters a,b,c,d . The orderings are

$P_1 = \langle a,b,d,c \rangle$
$P_2 = \langle a,c,d,b \rangle$
$P_3 = \langle b,a,c,d \rangle$
$P_4 = \langle a,d,b,c \rangle$

use fuzzy multiperson decision making to determine the group decision.

(vii) Solve the following FLPP max $z = 6x_1 + 5x_2$

s.t. $(5,3,2)x_1 + (6,4,2)x_2 < (25,6,9)$

$(5,2,3)x_1 + (2,1.5,1)x_2 \le (13,7,4)$

where $x_1, x_2 > 0$

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