

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)**

CLASS: IMSC
BRANCH: MATHEMATICS

SEMESTER: V
SESSION: MO/2022

SUBJECT: MA303 FUZZY LOGIC

TIME: 2 HOURS

FULL MARKS: 25

INSTRUCTIONS:

1. The total marks of the questions are 25.
2. Candidates attempt for all 25 marks.
3. Before attempting the question paper, be sure that you have got the correct question paper.
4. The missing data, if any, may be assumed suitably.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

- Q1 (a) Restricting the universal set to $[0,10]$ determine which fuzzy sets are convex [2] CO1 BL2,6
 $A(x) = \frac{x}{x+2}$, $B(x) = 2^{-x}$, $C(x) = \frac{1}{1+10(x-2)^2}$
- Q1 (b) Explain why the law of contradiction and law of excluded middle are violated [3] CO1 BL3,6
in fuzzy set theory under the standard fuzzy sets operations.
- Q2 (a) Explain why the standard complement is not cut-worthy and strong cut- [2] CO1 BL3,5,6
worthy.
- Q2 (b) Consider fuzzy sets A and B whose membership functions are defined by [3] CO1 BL6
 $A(x) = \frac{x}{x+1}$, $B(x) = 1 - \frac{x}{10}$ for all $x \in \{0,1,2,\dots,10\}$. Calculate cardinality and fuzzy
cardinality of A and B.
- Q3 (a) Let [2] CO2 BL6
 $X = NXN$, $\tilde{A}_1 = \{(1,.6), (2,.8), (3,1), (4,.6)\}$; $\tilde{A}_2 = \{(0,.5), (1,.7), (2,.9), (3,1), (4,.4)\}$; $f: NXN \rightarrow NXN$
be defined by $f(x,y) = z, x \in \tilde{A}_1, y \in \tilde{A}_2$. Determine the image $f(\tilde{A}_1 \times \tilde{A}_2)$ by
the extension principle.
- Q3 (b) Let the two fuzzy sets \tilde{A} and \tilde{B} be defined as [3] CO2 BL6
 $\tilde{A} = \{(0,.2), (1,.3), (2,.4), (3,.5)\}$; $\tilde{B} = \{(0,.5), (1,.4), (2,.3), (3,0.0)\}$. Is the following
set I a fuzzy relation on \tilde{A} & where $I = \{(0,0), (2), (0,2), (3), (2,0), (2)\}$
- Q4 (a) Discuss the reflexivity properties of the following fuzzy relation: [2] CO2 BL5
- | | | | |
|-------------|----|----|----|
| \tilde{R} | x1 | x2 | x3 |
| x1 | 1 | .7 | .3 |
| x2 | .4 | .5 | .8 |
| x3 | .7 | .5 | 1 |
- Q4 (b) Assume that the fuzzy numbers X and Y are: [3] CO3 BL4, BL6
- | | | | | | | | | |
|---|------------|-----|-----|-----|-----|-----|-----|-----|
| X | X | 1 | 2 | 3 | 4 | 5 | 6 | |
| | $\mu_X(x)$ | .1 | .4 | 1.0 | .8 | .2 | 0.0 | |
| Y | y | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | $\mu_Y(y)$ | 0.0 | 0.1 | 0.7 | 1.0 | 0.8 | 0.5 | 0.0 |
- Find $\mu_Z(z=5)$.
- Q5 (a) Calculate α -cut interval of triangular fuzzy number $A = (-1,0,6)$ [2] CO3 BL6
- Q5 (b) Determine which fuzzy sets defined by the following functions are fuzzy [3] CO3 BL3
numbers:

a. $A(x) = \begin{cases} x & \text{for } 0 \leq x \leq 1 \\ 0 & \text{otherwise} \end{cases}$ b. $B(x) = \begin{cases} 1 & \text{for } 0 \leq x \leq 10 \\ 0 & \text{otherwise} \end{cases}$

c. $C(x) = \begin{cases} \min(1, x) & \text{for } x \geq 0 \\ 0 & \text{for } x < 0 \end{cases}$