Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – MAY/ JUNE 2025

Date: 03-06-2025 **Time:** 09:30 am – 12:30 pm

School: SOE	**Program:** ECE	
Course Code : ECE3030	**Course Name :** Fuzzy Logic and It's Engineering Applications	
Semester: VI	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**
Marks	**14**	**14**	**36**	**36**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1	Name the two different types of uncertainty in the situations (a) "The tossing of a Die will result in 3" and (b) "It is a cloudy day", and compare the two.	**2 Marks**	**L1**	**CO1**
2	Fuzzy set A is given as $A = \left\{\frac{.5}{1} + \frac{.4}{2} + \frac{.3}{3} + \frac{1}{4} + \frac{.5}{5}\right\}$. Is it a normal fuzzy set and find it's Height.	**2 Marks**	**L1**	**CO1**
3	CON(DIL A) = _____ ; DIL(CON A) = _____	**2 Marks**	**L1**	**CO2**
4	Write the Zadeh's implication relation for the statement IF x is A and B, THEN y is C or D	**2 Marks**	**L1**	**CO2**
5	Clustering refers to identifying the number of subclasses of c clusters in a data universe X comprising n data samples, and partitioning X into c clusters. Mention range of values that c can take.	**2 Marks**	**L1**	**CO3**
6	Hard c Means is one of the methods used for the classification of data. If the first row of Hard 2-partition is [1 0 0 1 1 0 1], Find it's second row.	**2 Marks**	**L1**	**CO3**

7	Distance measure with reference to a cluster centre is an important parameter in clustering of data. Consider two points $x_1 = \{5, 3\}$; $x_2 = \{6, 4\}$. Compute the cluster centre for the cluster [0 1] in Hard 2-partition.	**2 Marks**	**L1**	**CO3**
8	Illustrate a fuzzy rule with two antecedents and one consequent using Tsukamoto graphical inference method.	**2 Marks**	**L1**	**CO4**
9	The concept of control surface, or decision surface, is central in fuzzy control systems methodology. Describe the control surface with reference to fuzzy logic control system.	**2 Marks**	**L1**	**CO4**
10	List out the basic steps in the design of FLC system.	**2 Marks**	**L1**	**CO4**

Part B

Answer the Questions **Total 80 Marks.**

11.	**a.**	Two fuzzy sets A and B, both defined on X, are as follows: $\mu(x_i)$ | x_1 | x_2 | x_3 | x_4 | x_5 | x_6 A | 0.1 | 0.7 | 0.8 | 1 | 0.7 | 0.1 B | 1 | 0.9 | 0.5 | 0.2 | 0.1 | 0 Express the following λ-cut sets using Zadeh,s notation: $(A \cup B)_{0.8}$ (b) $(A \cap B)_{0.6}$ (c) $\overline{(A \cap B)}_{0.8}$ (d) $\overline{(A \cup B)}_{0.7}$	**10 Marks**	**L2**	**CO1**
	b.	The following raw data were determined in a pairwise comparison of new premium mobile phone preferences in poll of 100 people. When it was compared with Samsung (S), 79 of polled preferred Nokia(N), 85 preferred Apple (A), 59 preferred OnePlus(P) and 67 preferred LG(L). When a Nokia was compared, the preferences were 21-S, 23-A,37-P and 45-L. When Apple was compared, the preferences were 15-N, 77-S,35-P and 48-L. When a OnePlus was compared, the preferences were 41-S, 63-N,65-A and 51-L. Finally, When LG was compared, the preferences were 33-S, 55-N,52-P and 49-A. Using Rank ordering, plot the Membership function for the most preferred Mobile phone.	**10 Marks**	**L3**	**CO2**

Or

12.	**a.**	$A \cup \overline{A} \neq X$; $A \cap \overline{A} \neq \emptyset$ Prove these theorems using the principles of fuzzy logic.	**10 Marks**	**L2**	**CO 1**
	b.	Differentiate between Mamdani, Sugeno and Tsukamoto fuzzy inference mechanisms.	**10 Marks**	**L2**	**CO 2**

13.	**a.**	A problem in Mobile manufacturing management is to allocate four different job sites to two different teams. Let the job sites be designated as x_i and combined to give a universe universe, $X = \{x_1, x_2, x_3, x_4\}$. The following vectors give the locations of the four job sites: $x_1 = \{5,5\}; \quad x_2 = \{6,8\}; \quad x_3 = \{8,10\}; \quad x_4 = \{9,12\}$. Apply Hard c Means (HCM) algorithm to determine optimum partition, U^*. Start with the initial 2-partition $U^{(0)} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 \end{bmatrix}$	**20 Marks**	**L3**	**CO 3**

Or

14.	**a.**	Suppose we want to sample a complex signal from a demodulator circuit and classify into two sets. The sample points are $x_1 = \{-3,1\}; \quad x_2 = \{-2,2\}; \quad x_3 = \{-1,1.5\}; \quad x_4 = \{1,2\}$. If the first row of your initial 2-partition is [1 0 0 0], apply Fuzzy c Means (FCM) algorithm to find Fuzzy 2- partition after two iterations, $U^{(2)}$. Use weighting parameter $m' = 2$ and criterion for convergence, $\varepsilon_L \leq 0.01$.	**20 Marks**	**L3**	**CO 3**

15.	**a.**	Three families exists, which have a total of 8 people, all of whom are related with some similarity measure. A person not familiar with the members of the three families is asked to grade their resemblance to one another. In conducting this study, the person assigns the similarity level in the equivalence relation matrix R as shown below. Classify the three families using R according to λ-cut levels = 0.2, 0.6 $R = \begin{bmatrix} 1.0 & 0.4 & 0.4 & 0.5 & 0.4 & 0.6 & 0.4 & 0.6 \\ 0.4 & 1.0 & 0.4 & 0.4 & 0.8 & 0.4 & 0.8 & 0.4 \\ 0.4 & 0.4 & 1.0 & 0.4 & 0.4 & 0.4 & 0.4 & 0.4 \\ 0.5 & 0.4 & 0.4 & 1.0 & 0.4 & 0.5 & 0.4 & 0.5 \\ 0.4 & 0.8 & 0.4 & 0.4 & 1.0 & 0.4 & 0.8 & 0.4 \\ 0.6 & 0.4 & 0.4 & 0.5 & 0.4 & 1.0 & 0.4 & 0.8 \\ 0.4 & 0.8 & 0.4 & 0.4 & 0.8 & 0.4 & 1.0 & 0.4 \\ 0.6 & 0.4 & 0.4 & 0.5 & 0.4 & 0.8 & 04 & 1.0 \end{bmatrix}$	**10 Marks**	**L3**	**CO 3**
	b.	Fuzzy logic control is extensively used in many applications such as Washing machines, Traffic light control, weather monitoring etc. Mr. Jose is heading team in Meteorological Department to design a Weather Montoring System using fuzzy logic. The team has decided to use two input variables, namely, Temperature and Speed of the wind and the output variable as Expected	**10 Marks**	**L4**	**CO 4**

		rainfall. Considering the appropriate membership functions and fuzzy rules, design the the fuzzy logic controller for the Weather Montoring System to find the Expected rainfall for the Temperature = 40°F and the Wind speed = 40Kmph.			

Or

16.	**a.**	For the ultimate assignment of data to a particular class, the fuzzy partitions are converted to hard c partitions. Consider the fuzzy c partition matrix U given below and harden it using Nearest centre classifier (minimum distance) method. Assume weighting parameter $m' = 2$ and criterion for convergence, $\varepsilon_L \leq 0.01$ $$U = \begin{bmatrix} 0.992 & 0.98 & 0.003 & 0 \\ 0.008 & 0.02 & 0.997 & 1 \end{bmatrix}$$	**10 Marks**	**L3**	**CO 3**
	b.	Explain the function of each block in a typical fuzzy logic control system with a neat block diagram and list out all six basic assumptions that are commonly made whenever a fuzzy rule based control policy is selected.	**10 Marks**	**L2**	**CO 4**

17.	**a.**	Design a fuzzy logic controller for the safe landing of the aircraft. Consider the two state variables height above the ground, *h* and the vertical velocity of the aircraft, *v*. The control output will be a force, that, when applied to the aircraft, will alter its height, *h*, and vertical velocity, *v*. Assume appropriate membership functions and fuzzy rules in the design. Compute the height, *h* and vertical velocity, *v* for at least 2 iterations. Consider the initial height = 1000ft and initial vertical velocity = -20 ft/sec.	**20 Marks**	**L4**	**CO 4**

Or

18.	**a.**	Design a fuzzy logic Air conditioner controller to turn the dial Z to control the flow of warm/hot or cool/cold air based on change in room temperature, ΔT°C, and the rate of change of temperature $\frac{d\Delta T}{dt}$. Consider ΔT = 4°C and $\frac{d\Delta T}{dt}$ = -1°C/min. Assume appropriate membership functions for the input and output variables.	**20 Marks**	**L4**	**CO 4**