



PRESIDENCY UNIVERSITY

BENGALURU

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End - Term Examinations – May / June 2026

Date: 27-05-2026

Time: 01:00pm – 04:00pm

School: SOE	Program: Electronics and Communication Engineering	
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	CO5	CO6
Marks	12	12	12	16	24	24

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

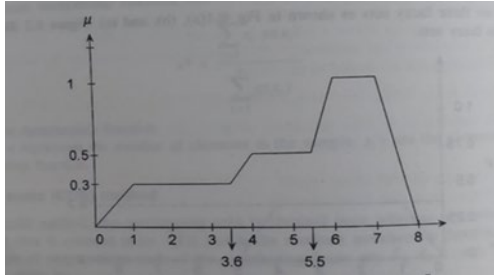
1	Fuzzy set A is given as $A = \left\{ \frac{.5}{1} + \frac{.4}{2} + \frac{.3}{3} + \frac{.9}{4} + \frac{.5}{5} \right\}$. Find Crossover points and Height of fuzzy set A.	2 Marks	L1	CO1
2	From your intuition Draw membership curves in the universe of “speed of the Car” for Slow ; Medium ; Fast	2 Marks	L1	CO2
3	Write the Zadeh’s implication relation for the statement IF x is A, THEN y is B else C	2 Marks	L1	CO3
4	What are the three properties of an equivalence relation?	2 Marks	L1	CO4
5	A tolerance relation is represented by 4 x 4 matrix. How do you convert this to an equivalence relation.	2 Marks	L1	CO4
6	Write the equivalence classes of integers under the relation “same remainder when divided by 2”.	2 Marks	L1	CO4
7	FCM algorithm needs weighting parameter m' to find the cluster centre. Consider two points $x_1 = \{1, 3\}$; $x_2 = \{1.5, 3\}$. Compute the cluster centre for the cluster [0.993 1] in Fuzzy 2-partition with $m' = 2$	2 Marks	L1	CO5

8	Consider the partition matrix U given below and harden it using <i>maximum membership method</i> . $U = \begin{bmatrix} 0.991 & 0.986 & 0.993 & 0 \\ 0.009 & 0.014 & 0.007 & 1 \end{bmatrix}$	2 Marks	L1	C05
9	Illustrate a fuzzy rule with two antecedents and one consequent using Mamdani graphical inference method.	2 Marks	L1	C06
10	Control systems are some times divided into two classes. Mention these control systems with examples.	2 Marks	L1	C06

Part B

Answer the Questions

Total 80 Marks.

11.	a.	Fuzzy sets A and B are defined over the Universe of discourse $X = (1,2,3,4,5)$; Membership functions are given by $\mu_A(x) = \left[\frac{1}{2x^2} \right]$ $\mu_B(x) = \left[\frac{1}{2x + \sigma^{-1}} \right]; \quad \sigma = 2;$ Find (i) $\bar{A} \cup \bar{B}$ (ii) $A \cup \bar{B}$ (iii) λ cut sets $A_{0.3}, B_{0.5}$	10 Marks	L2	C01
	b.	The aggregated fuzzy set of three fuzzy sets is given below. Apply an appropriate defuzzification method to obtain scalar output. 	10 Marks	L3	C02

or

12.	a.	Apply fuzzy logic principles to prove DeMorgan's theorems for both union and intersection.	10 Marks	L2	C01
	b.	A survey of 80 people was conducted to analyze preferences among five online learning platforms: Coursera (C), Udemy (U), edX (E), Skillshare (S), and Pluralsight (P). - Compared with Coursera: 52-U, 61-E, 47-S, 58-P - Compared with Udemy: 28-C, 64-E, 55-S, 62-P - Compared with edX: 19-C, 16-U, 48-S, 53-P - Compared with Skillshare: 33-C, 25-U, 32-E, 49-P - Compared with Pluralsight: 22-C, 18-U, 27-E, 31-S Using the rank ordering method, construct the fuzzy membership function and identify the most preferred platform.	10 Marks	L3	C02

13.	a.	A sensor produces the following data points: $x_1 = (1,2), x_2 = (1.2,2.1), x_3 = (3.8,0.9), x_4 = (4,1)$	20 Marks	L3	C05
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		If the first row of your initial 2-partition is [1 0 0 1], apply Hard c Means (HCM) algorithm to find optimum Hard 2- partition, U^* .			
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or

14.	a.	An IC manufacturing plant has decided to classify five machines into two classes: good investment and bad investment. The data points in our sample, $X = \{x_1, x_2, x_3, x_4\}$, are $x_1 = \{5, 20\}$; $x_2 = \{3.5, 35\}$; $x_3 = \{4, 25\}$; $x_4 = \{7, 10\}$. Apply Fuzzy c Means (FCM) algorithm to determine fuzzy 2-partition after two iterations, $U^{(2)}$. Use weighting parameter $m' = 2$ and criterion for convergence, $\varepsilon_L \leq 0.01$. Start with the initial 2-partition $U^{(0)} = \begin{bmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}$	20 Marks	L3	CO5
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15.	a.	Six cities are compared based on climate similarity . The fuzzy equivalence relation matrix R is given below: $R = \begin{bmatrix} 1.0 & 0.6 & 0.5 & 0.4 & 0.5 & 0.4 \\ 0.6 & 1.0 & 0.4 & 0.5 & 0.7 & 0.5 \\ 0.5 & 0.4 & 1.0 & 0.6 & 0.4 & 0.4 \\ 0.4 & 0.5 & 0.6 & 1.0 & 0.4 & 0.5 \\ 0.5 & 0.7 & 0.4 & 0.4 & 1.0 & 0.6 \\ 0.4 & 0.5 & 0.4 & 0.5 & 0.6 & 1.0 \end{bmatrix}$ Classify the cities using λ-cut levels : $\lambda = 0.5, 0.7, 0.9$	10 Marks	L3	CO4
	b.	For controlling fan speed, consider the fuzzy sets: $A = \text{"fan speed acceptable"}$ $= \{0.5/400 + 0.3/600 + 0.4/800 + 1/1000 + 0.6/1200\}$ $B = \text{"supply voltage nominal"}$ $= \{0.2/180 + 0.4/200 + 0.7/220 + 0.3/240 + 0.1/260\}$ Using Zadeh's implication , find the fuzzy relation for the rule: IF fan speed is acceptable THEN supply voltage is nominal If the new antecedent is $A' = \text{"fan speed slightly slow"}$ $= \{0.6/400 + 0.9/600 + 1/800 + 0.7/1000 + 0.4/1200\}$, Using max-min composition , determine the new voltage.	10 Marks	L3	CO3

Or

16.	a.	Consider five data points in a universe, $X = \{x_1, x_2, x_3, x_4, x_5\}$ and the following fuzzy equivalence relation $R = \begin{bmatrix} 1 & 0.8 & 0.4 & 0.5 & 0.8 \\ 0.8 & 1 & 0.4 & 0.5 & 0.9 \\ 0.4 & 0.4 & 1 & 0.4 & 0.4 \\ 0.5 & 0.5 & 0.4 & 1 & 0.5 \\ 0.8 & 0.9 & 0.4 & 0.5 & 1 \end{bmatrix}$ Form the clusters for the five datapoints in X based on λ -cut	10 Marks	L3	CO4
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		relations for $\lambda = 0.5, 0.8, 0.9$			
	b.	For controlling the heater, two fuzzy sets are defined: $A = \text{"temperature normal"}$ $= \{0.6/30 + 0.4/40 + 0.3/50 + 1/60 + 0.5/70\}$ $B = \text{"heater power nominal"}$ $= \{0.2/1 + 0.4/2 + 0.7/3 + 0.3/4 + 0.1/5\}$ Using Zadeh's implication, find the fuzzy relation for the rule: IF temperature is normal THEN heater power is nominal If the new antecedent is $A' = \text{"temperature slightly low"}$ $= \{0.5/30 + 0.8/40 + 1/50 + 0.6/60 + 0.3/70\}$, Using max-min composition, determine the new consequent.	10 Marks	L3	CO3

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 = 1500ft and initial vertical velocity = -25 ft/sec.	20 Marks	L3	CO6
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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, $\Delta T^\circ\text{C}$, and the rate of change of temperature $\frac{d\Delta T}{dt}$. Consider $\Delta T = 3^\circ\text{C}$ and $\frac{d\Delta T}{dt} = -1^\circ\text{C}/\text{min}$. Assume appropriate membership functions for the input and output variables.	20 Marks	L3	CO6
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