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PRESIDENCY UNIVERSITY

BENGALURU

Mid - Term Examinations - March 2026

Date: 13- 03-2026

Time: 11.45am to 01.15pm

School: SOE	Program: B.Tech		
Course Code : ECE3030	Course Name: Fuzzy Logic and It's Engineering Applications		
Semester: VI	Max Marks: 50	Weightage: 25%	

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	16	17	17		

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.

5Q x 2M=10M

1	Differentiate between Classical set and Fuzzy set with reference to λ and μ . Give at least 1 example for each type with membership curves.	2 Marks	L2	CO1
2	Develop a reasonable membership function for the following fuzzy sets based on the age of the person, in years (a) Young (b) Middle age (c) Old age	2 Marks	L2	CO2
3	Given a fuzzy relation $R(A, B)$, compute it's Range, Domain and Height $R(A, B) = \begin{bmatrix} 0.7 & 0.2 & 0.3 \\ 0.1 & 0.4 & 0.6 \end{bmatrix}$	2 Marks	L2	CO2
4	Write a fuzzy rule using two antecedents.	2 Marks	L2	CO3
5	Write the Zadeh's implication relation for the statement "IF X is P and Q, THEN Y is R and S"	2 Marks	L2	CO3

Part B

Answer the Questions.

Total Marks 40M

6.	a.	<p>In a medical diagnosis system, the universe $U = \{10, 20, 30, 40, 50\}$ represents symptom severity levels.</p> <p>Severely ill patients $A = \{0/10 + 0.3/20 + 0.6/30 + 0.9/40 + 1/50\}$</p> <p>Patients requiring hospitalization $B = \{0/10 + 0.4/20 + 0.7/30 + 1/40 + 1/50\}$</p> <p>Compute fuzzy sets for: (a) Patients who are severely ill or require hospitalization (b) Patients who are severely ill and require hospitalization (c) Patients who are not severely ill (d) $\overline{A \cap B} = \overline{A} \cup \overline{B}$</p>	10 Marks	L2	CO1
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Or

7.	a.	<p>Fuzzy sets A and B are defined over the Universe of discourse $X = (1,2,3,4,5)$;</p> <p>Membership functions are given by $\mu_A(x) = \exp\left[\frac{-(x-a)^2}{2\sigma^2}\right]$ $\mu_B(x) = \exp\left[\frac{-(x-b)^2}{2\sigma^2}\right]$; $\sigma = 1$; $a = 2$; $b = 4$;</p> <p>Find (i) $\overline{A} \cup \overline{B}$; (ii) λ cut sets $A_{0.5}, B_{0+}$; (iii) Show that the above fuzzy sets obey DeMorgan's laws.</p>	10 Marks	L2	CO1
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8.	a.	<p>Two fuzzy sets A and B, both defined on X, are as follows:</p> <table border="1" style="margin: 10px auto; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>$\mu(x_i)$</th> <th>x_1</th> <th>x_2</th> <th>x_3</th> <th>x_4</th> <th>x_5</th> <th>x_6</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>1</td> <td>0.9</td> <td>0.5</td> <td>0.2</td> <td>0.1</td> <td>0</td> </tr> <tr> <td>B</td> <td>0.1</td> <td>0.7</td> <td>0.8</td> <td>1</td> <td>0.7</td> <td>0.1</td> </tr> </tbody> </table> <p>Express the following λ-cut sets using Zadeh's notation: (i) $(A \cup B)_{0.8}$ (ii) $\overline{(A \cap B)}_{0.8}$</p>	$\mu(x_i)$	x_1	x_2	x_3	x_4	x_5	x_6	A	1	0.9	0.5	0.2	0.1	0	B	0.1	0.7	0.8	1	0.7	0.1	4 Marks	L2	CO1
	$\mu(x_i)$	x_1	x_2	x_3	x_4	x_5	x_6																			
	A	1	0.9	0.5	0.2	0.1	0																			
B	0.1	0.7	0.8	1	0.7	0.1																				
b	<p>Consider the following fuzzy linguistic terms: $Low\ temperature = \left\{ \frac{1}{40} + \frac{0.7}{50} + \frac{0.5}{60} + \frac{0.3}{70} + \frac{0}{80} \right\}$; $High\ temperature = \left\{ \frac{0}{40} + \frac{0.2}{50} + \frac{0.4}{60} + \frac{0.7}{70} + \frac{1}{80} \right\}$;</p> <p>Find the membership function for "temperature not very low and not very high"</p>	3 Marks	L2	CO2																						
c	<p>Give a graphical representations of fuzzy rules in Mamdani, Sugeno and Tsukamoto methods of fuzzy inference.</p>	3 Marks	L2	CO3																						

Or

9.	a.	Apply fuzzy logic principles to prove DeMorgan's theorem for union.	4 Marks	L2	CO1
	b.	<p>Consider the following fuzzy linguistic terms:</p> $\text{High water content} = \left\{ \frac{0}{1} + \frac{0.2}{2} + \frac{0.4}{3} + \frac{0.9}{4} + \frac{1}{5} \right\};$ $\text{Low water content} = \left\{ \frac{1}{1} + \frac{0.8}{2} + \frac{0.6}{3} + \frac{0.4}{4} + \frac{0.2}{5} \right\}$ <p>Find the membership function for "water content not very low or slightly low"</p>	3 Marks	L2	CO2
	c.	Differentiate Sugeno and Tsukamoto methods of fuzzy inference.	3 Marks	L2	CO3

10.	a.	<p>The following data were obtained from a pairwise comparison survey of five electric car brands conducted among 120 respondents: Tesla (T), BMW (B), Audi (A), Hyundai (H), and Kia (K). The preferences are as given below.</p> <p>When compared with Tesla : 88-B, 95-A, 72-H, 64-K</p> <p>When compared with BMW : 32-T, 90-A, 68-H, 71-K</p> <p>When compared with Audi : 25-T, 30-B, 79-H, 85-K</p> <p>When compared with Hyundai: 48-T, 52-B, 41-A, 93-K</p> <p>When compared with Kia : 56-T, 49-B, 35-A, 27-H</p> <p>Using rank ordering, determine the most preferred car brand and plot the membership function</p>	10 Marks	L3	CO2
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Or

11.	a.	<p>Hand gestures used by music conductors involve gradual and subjective movements. Let the fuzzy representations of two gestures be:</p> $G_1 = \{0/5 + 0.1/4 + 0.3/3 + 0.2/2 + 0/1\}$ $G_2 = \{0/5 + 0.2/4 + 0.2/3 + 0.1/2 + 0/1\}$ <p>The fuzzy representation of a third gesture is:</p> $G_3 = \{0.3/5 + 0.1/4 + 0/3 + 0/2 + 0.2/1\}$ <p>(a) Determine the fuzzy relation R for the transition from G_1 to G_3.</p> <p>(b) Find $G_2 \circ R$ using max-min composition.</p>	10 Marks	L3	CO2
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12.	a.	<p>Crop yield depends on soil quality and water availability. Let $X = \{1, 2, 3, 4, 5, 6\}$ represent soil quality $Y = \{1, 2, 3, 4, 5, 6\}$ represent water availability. A = medium soil quality $= \{0/1 + 0.4/2 + 1/3 + 0.5/4 + 0.3/5 + 0.1/6\}$ B = adequate water $= \{0/1 + 0.5/2 + 0.9/3 + 1/4 + 0.6/5 + 0.2/6\}$ C = scarce water $= \{0.4/1 + 0.6/2 + 0.7/3 + 0.6/4 + 0.4/5 + 0.2/6\}$</p> <p>Using Zadeh's implication, determine the fuzzy relations for: i) IF soil quality is medium, THEN water availability is adequate ii) IF soil quality is medium, THEN water availability is adequate ELSE water availability is scarce iii) IF soil quality is medium AND water availability is adequate THEN water availability is scarce</p>	10 Marks	L3	CO3
Or					
13.	a.	<p>For controlling the liquid level, the fuzzy sets are defined as: A = "liquid level normal" $= \{0.4/20 + 0.5/30 + 0.3/40 + 1/50 + 0.6/60\}$ B = "pump speed nominal" $= \{0.1/1000 + 0.3/1200 + 0.7/1400 + 0.4/1600 + 0.2/1800\}$</p> <p>Using Zadeh's implication, find the fuzzy relation for the rule: IF liquid level is normal THEN pump speed is nominal</p> <p>If the new antecedent is A' = "liquid level slightly low" $= \{0.6/20 + 0.8/30 + 1/40 + 0.7/50 + 0.4/60\}$, Using max-min composition, determine the new pump speed.</p>	10 Marks	L3	CO3