

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION-2025

B.Tech-VIII Semester (CSE/IT/ECE/CE/BT/BI)

COURSE CODE(CREDITS): 21B1WMA831 (3)

MAX. MARKS: 35

COURSE NAME: Soft Computing & Optimization Algorithms

COURSE INSTRUCTORS: Dr. B. K. Pathak

MAX. TIME: 2 Hours

Note: (a) All questions are compulsory.

(b) The candidate is allowed to make suitable numeric assumptions wherever required for solving problems

Q.No.	Question	CO	Marks
Q1	<p>Let \tilde{A} be a fuzzy set defined on the universe $X=\{1,2,3,4\}$ with membership function given by:</p> $\tilde{A} = \frac{0.7}{1} + \frac{0.5}{2} + \frac{0.1}{3} + \frac{0.6}{4}$ <p>Verify the "Idempotency" property for given fuzzy set \tilde{A}. Also find \tilde{A}^c.</p>	CO-2	5
Q2	<p>Let \tilde{C} be a fuzzy set defined on the universe $X=\{0,1,2,3,4,5,6\}$ with membership function given by:</p> $\mu_{\tilde{C}}(x) = \begin{cases} 0, & x = 0, 6 \\ 0.2, & x = 1, 5 \\ 0.5, & x = 2, 4 \\ 1.0, & x = 3 \end{cases}$ <p>(a) Determine the support, core, and height of the fuzzy set \tilde{C}. (b) Find the α-cut sets of \tilde{C} for $\alpha = 0.1, 0.2, 0.5$, and 0.8.</p>	CO-2	5
Q3	<p>The term "Speed" in a traffic control system is described by fuzzy sets:</p> <ul style="list-style-type: none"> Slow: trapezoidal(0, 0, 20, 40) Moderate: trapezoidal(30, 50, 50, 70) Fast: trapezoidal(60, 80, 100, 100) <p>(a) For a vehicle moving at 45 km/h, calculate its degree of membership in each fuzzy set. (b) Explain how these fuzzy values might influence the triggering of a traffic light.</p>	CO-3	5
Q4	<p>An energy-efficient air conditioning system uses fuzzy logic to determine how comfortable the room temperature is. The fuzzy set "Comfortable Temperature" is represented using a trapezoidal membership function, where:</p> <ul style="list-style-type: none"> Temperatures between 20°C and 22°C are partially comfortable. Temperatures between 22°C and 26°C are considered fully comfortable. Temperatures between 26°C and 28°C are again partially 	CO-3	5

	<p>comfortable.</p> <ul style="list-style-type: none"> • Outside this range, the temperature is not considered comfortable. <p>(a) Write the mathematical expression for the trapezoidal membership function $\mu(x)$ representing the "Comfortable Temperature" fuzzy set.</p> <p>(b) Sketch the graph of the membership function. Calculate the degree of membership for a temperature of 24°C and for 27°C.</p> <p>(c) Briefly explain how the fuzzy membership value can help the system decide whether to cool the room or not.</p>		
	<p>Consider a population of individuals represented as binary strings of length 5. The fitness function is $f(x)$ = Number of 1's in the string. Given the population: {10010, 11001, 11011, 00001}</p>		
Q5	<p>(a) Evaluate the fitness of each individual.</p> <p>(b) Perform rank-based selection and select two parents.</p> <p>(c) Apply single-point crossover on selected parents at position 3 to generate offspring.</p> <p>(d) Find the fitness of generated offspring.</p>	CO-5	5
Q6	<p>Suppose a genetic algorithm uses chromosomes of the form $x = abcdefgh$ with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as: $f(x) = (a + b) - (c + d) + (e + f) - (g + h)$ and let the initial population consist of four individuals with the following chromosomes:</p> <p>$x_1 = 6\ 5\ 4\ 1\ 3\ 5\ 3\ 2$ $x_2 = 8\ 7\ 1\ 2\ 6\ 6\ 0\ 1$ $x_3 = 2\ 3\ 9\ 2\ 1\ 2\ 8\ 5$ $x_4 = 4\ 1\ 8\ 5\ 2\ 0\ 9\ 4$</p> <p>(a) Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last.</p> <p>(b) Perform the crossover between two individuals (x_2 & x_3) using one-point crossover at the middle point and calculate their fitness.</p>	CO-5	5
Q7	<p>State whether the following statements are True or False:</p> <p>(a) Genetic Algorithms always guarantee finding the global optimum.</p> <p>(b) Mutation helps maintain diversity in the population.</p> <p>(c) The selection process in GAs is entirely random.</p> <p>(d) Crossover in Genetic Algorithms always guarantees better offspring than the parents</p> <p>(e) Elitism in Genetic Algorithms helps to preserve the best individuals for the next generation.</p>	CO-4	5