

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- APRIL-2025

COURSE CODE(CREDITS): 21B1WMA831 (3)

MAX. MARKS: 25

COURSE NAME: Soft Computing & Optimization Algorithms

COURSE INSTRUCTORS: Dr. B. K. Pathak

MAX. TIME: 1 Hour 30 Min.

*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>A fuzzy inference system produces the following fuzzy output set for the variable "Speed (km/h)" after applying fuzzy rules:</p> <table><tr><td>Speed (km/h)</td><td>10</td><td>20</td><td>30</td><td>40</td><td>50</td><td>60</td><td>70</td></tr><tr><td>Membership Value (<math>\mu</math>)</td><td>0.2</td><td>0.5</td><td>0.8</td><td>1.0</td><td>0.8</td><td>0.5</td><td>0.2</td></tr></table> <p>Use the following methods to defuzzify the output:</p> <p>(a) Centroid Method (Center of Gravity)</p> <p>(b) Mean of Maximum (MoM) Method</p>	Speed (km/h)	10	20	30	40	50	60	70	Membership Value ( $\mu$ )	0.2	0.5	0.8	1.0	0.8	0.5	0.2	CO-2	4
Speed (km/h)	10	20	30	40	50	60	70												
Membership Value ( $\mu$ )	0.2	0.5	0.8	1.0	0.8	0.5	0.2												
Q2	<p>As a B.Tech student working on a drone project, you want to design a fuzzy logic system to assess the battery level status. You decide to define a fuzzy set for the term "Battery Level is High" using a triangular membership function. The triangular membership function is defined as follows:</p> <ul style="list-style-type: none"><li>Minimum battery level (start of "high"): 60%</li><li>Peak battery level (fully "high"): 80%</li><li>Maximum battery level (end of "high"): 100%</li></ul> <p>Answer the following:</p> <p>(a) Write the equation for the triangular membership function for "Battery Level is High".</p> <p>(b) If the current battery level is 70%, what is the degree of membership in the fuzzy set "High"?</p> <p>(c) If the battery level is 55%, what is the degree of membership?</p> <p>(d) Also plot the graph of the triangular membership function for the fuzzy set "Battery Level is High".</p>	CO-2	5																

Q3	Let the universe of discourse be $X=\{10, 20, 30, 40, 50\}$ and let fuzzy set $Q=\{(10, 0.2), (20, 0.4), (30, 0.6), (40, 0.8), (50, 1.0)\}$ (a) Find the strong $\alpha$ -cut set of fuzzy set $Q$ for $\alpha = 0.4, 0.6$ , and $0.8$ . (b) Find the level set of fuzzy set $Q$ .	CO-3	4										
Q4	You are solving a maximization problem with the objective function $f(x)=2x+3$ Where $x \in [0, 15]$ . Each chromosome is encoded using 4-bit binary representation. (a) Convert the binary chromosome 1010 into its decimal form and calculate its fitness value. (b) What is the fitness of chromosome 0111?	CO-5	2										
Q5	Consider the following population of 4 chromosomes used in a Genetic Algorithm. Each chromosome is evaluated using the objective function $f(x) = x^2$ . <table><tr><td>Chromosome</td><td>Binary</td></tr><tr><td>C1</td><td>001</td></tr><tr><td>C2</td><td>010</td></tr><tr><td>C3</td><td>100</td></tr><tr><td>C4</td><td>111</td></tr></table> (a) Calculate the total fitness of the population. (b) Calculate the selection probability for each chromosome using roulette wheel selection. (c) Which chromosome is most likely to be selected, and why?	Chromosome	Binary	C1	001	C2	010	C3	100	C4	111	CO-5	5
Chromosome	Binary												
C1	001												
C2	010												
C3	100												
C4	111												
Q6	Write the Key components of evolutionary algorithms. Also plot the flow chart of genetic algorithm.	CO-4	5										