

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2026

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

COURSE CODE (CREDITS): 21B1WMA831 (3)

MAX. MARKS: 35

COURSE NAME: Soft Computing & Optimization Algorithms

COURSE INSTRUCTOR: 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**(c) Calculator is allowed*

Q.No.	Question	CO	Marks
Q1	A manufacturing company wants to optimize its production process. The available data is incomplete, uncertain, and sometimes inconsistent due to machine fluctuations and human errors. The company needs a system that can still make effective decisions under such uncertainty. (a) Explain whether Hard Computing or Soft Computing would be more suitable for this situation. Give reasons for your answer. (b) Give one practical example where Hard Computing is preferred and one example where Soft Computing is preferred.	CO-1	5
Q2	A company wants to evaluate the performance of employees based on their monthly sales (in units). The fuzzy set "Good Performance" is defined as: $\mu_A(x) = \begin{cases} 0 & ; x \leq 20 \\ (x - 20)/20 & ; 20 < x < 40 \\ 1 & ; x \geq 40 \end{cases}$ Where x represents the number of units sold by an employee in a month. Three employees have monthly sales as follows: - Employee A: 25 units - Employee B: 35 units - Employee C: 50 units Answer the following: (a) Find the membership value of each employee in the fuzzy set "Good Performance." (b) Determine which employee has the highest degree of good performance.	CO-2	6
Q3	(a) Write the Gaussian membership function. (b) Compute the membership values: $\mu(0)$, $\mu(1)$, $\mu(2)$, $\mu(3)$ for $c=2$, $\sigma=1$; where c represents the mean (center) and σ controls the spread of the Gaussian function. (c) Compute: $\frac{d\mu(x)}{dx}$ for the Gaussian membership function.	CO-2	6

Q4	A factory manufactures two products: Product A and Product B. - Profit earned per unit of Product A = ₹40 - Profit earned per unit of Product B = ₹60 The factory has the following limitations: - Each unit of Product A requires 2 hours of machine time and each unit of Product B requires 3 hours of machine time. Total machine time available is 120 hours. - Each unit of Product A requires 1 kg of raw material and each unit of Product B requires 2 kg of raw material. Total raw material available is 80 kg. - Due to a prior contract, the factory must produce exactly 30 total units of products A and B combined. (a) Identify the decision variables. (b) Formulate the objective function to maximize profit. (c) Write the inequality constraints. (d) Write the equality constraint. (e) Mention the non-negativity constraints.	CO-4	6												
Q5	In a Genetic Algorithm, five chromosomes C1, C2, C3, C4, and C5 have the following fitness values: <table><thead><tr><th>Chromosome</th><th>Fitness Value</th></tr></thead><tbody><tr><td>(C1)</td><td>12</td></tr><tr><td>(C2)</td><td>18</td></tr><tr><td>(C3)</td><td>25</td></tr><tr><td>(C4)</td><td>30</td></tr><tr><td>(C5)</td><td>15</td></tr></tbody></table> Using Roulette Wheel Selection, answer the following: (a). Calculate the total fitness of the population. (b). Compute the selection probability of each chromosome. (c). Find the cumulative probability for each chromosome. (d). Suppose the random numbers generated for selecting 3 parents are: $r_1=0.22$, $r_2=0.61$, $r_3=0.89$ Determine which chromosomes will be selected as parents.	Chromosome	Fitness Value	(C1)	12	(C2)	18	(C3)	25	(C4)	30	(C5)	15	CO-5	6
Chromosome	Fitness Value														
(C1)	12														
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(C3)	25														
(C4)	30														
(C5)	15														
Q6	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: $x_1 = 6\ 5\ 4\ 1\ 3\ 5\ 3\ 2$ $x_2 = 8\ 7\ 1\ 2\ 6\ 6\ 0\ 1$ $x_3 = 2\ 3\ 9\ 2\ 1\ 2\ 8\ 5$ $x_4 = 4\ 1\ 8\ 5\ 2\ 0\ 9\ 4$ (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. (b) Perform the crossover between two individuals (x_2 & x_3) using one-point crossover at the middle point and calculate their fitness.	CO5	6												