

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- 2026

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

COURSE CODE (CREDITS): 21B1WMA831 (3)

MAX. MARKS: 25

COURSE NAME: Soft Computing & Optimization Algorithms

COURSE INSTRUCTOR: 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

(c) Calculator is allowed

Q.No.	Question	CO	Marks																
Q1	<p>(a) Write the sigmoid membership function.</p> <p>(b) Compute the membership values: <math>\mu(0), \mu(1), \mu(2), \mu(3), \mu(4)</math> for <math>a=3, c=2</math>; where <math>a</math> controls the slope, and <math>c</math> is the center (crossover point).</p> <p>(c) Compute: <math>\frac{d\mu(x)}{dx}</math>, and determine the value of <math>x</math>, where the slope is maximum.</p>	CO-2	6																
Q2	<p>Consider two fuzzy sets defined on universes, <math>X=\{x_1, x_2, x_3\}</math> and <math>Y=\{y_1, y_2, y_3\}</math>. The fuzzy sets are given as:</p> <p style="text-align: center;"><math>A=\{(x_1, 0.2), (x_2, 0.7), (x_3, 1.0)\}</math>  <math>B=\{(y_1, 0.5), (y_2, 0.8), (y_3, 0.4)\}</math></p> <p>Fuzzy Rule is defined as: IF <math>x</math> is A THEN <math>y</math> is B</p> <p>Construct the fuzzy relation matrix <math>R</math> using the Mamdani implication (min operator), write the final relation matrix <math>R</math> in tabular form.</p>	CO-2	5																
Q3	<p>A company wants to select the best supplier among three alternatives A1, A2, A3, based on three criteria:</p> <ul style="list-style-type: none"> <li>• C1: Cost (to be minimized)</li> <li>• C2: Quality (to be maximized)</li> <li>• C3: Delivery Reliability (to be maximized)</li> </ul> <p>The decision matrix (normalized values in [0,1]) is given below:</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>Alternative</th> <th>(C1) (Cost)</th> <th>(C2) (Quality)</th> <th>(C3) (Reliability)</th> </tr> </thead> <tbody> <tr> <td>(A1)</td> <td>0.6</td> <td>0.8</td> <td>0.7</td> </tr> <tr> <td>(A2)</td> <td>0.7</td> <td>0.6</td> <td>0.9</td> </tr> <tr> <td>(A3)</td> <td>0.5</td> <td>0.9</td> <td>0.6</td> </tr> </tbody> </table> <p>The weights of criteria are: <math>w=(0.4, 0.35, 0.25)</math></p> <p>(a) Compute the aggregated score of each alternative using Weighted Arithmetic Mean (WAM) and rank the alternatives.</p> <p>(b) Compute the aggregated score using Weighted Geometric Mean (WGM) <math>WGM = \prod x_i^{w_i}</math> and Rank the alternatives.</p>	Alternative	(C1) (Cost)	(C2) (Quality)	(C3) (Reliability)	(A1)	0.6	0.8	0.7	(A2)	0.7	0.6	0.9	(A3)	0.5	0.9	0.6	CO-3	5
Alternative	(C1) (Cost)	(C2) (Quality)	(C3) (Reliability)																
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(A3)	0.5	0.9	0.6																

Q4	<p>A system is described by the decision variable vector</p> $x = (x_1, x_2, x_3)^T$ <p>The objective is to minimize the cost function:</p> $f(x) = x_1^2 + x_2^2 + x_3^2$ <p>Subject to the following constraints:</p> $g_1(x) = x_1 + x_2 - 5 \geq 0$ $g_2(x) = x_2 + x_3 - 4 \geq 0$ $h_1(x) = x_1 + x_2 + x_3 - 6 = 0$ $0 \leq x_i \leq 5, \quad i = 1, 2, 3$ <p>(a) Identify:</p> <ul style="list-style-type: none"> <li>• Decision variables</li> <li>• Objective function</li> <li>• Inequality constraints</li> <li>• Equality constraints</li> </ul> <p>(b) Explain the role of lower and upper bounds in this problem.</p>	CO-3	3
Q5	<p>(a) Explain the key components of Evolutionary Computation (EC) methods.</p> <p>(b) Discuss the three fundamental principles of Evolutionary Computation.</p> <p>(c) Illustrate these principles with a suitable example, clearly showing how each principle is applied.</p>	CO-4	6