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QUESTION PAPER

Name of the Examination: Fast Track Fall 2023-24 Semester – FAT

Course Code: CSE2009 **Course Title: Soft Computing**

Set number: 4 **Date of Exam: 19/8/23 (Q) (AN)**

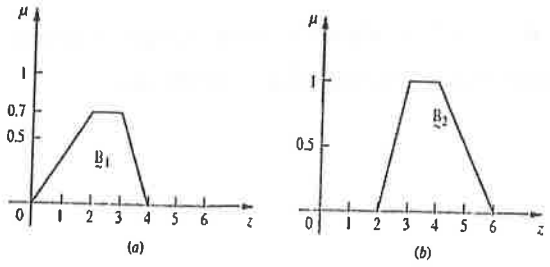
Duration: 120 Min **Total Marks: 60**

Instructions:

1. **Assume data wherever necessary.**
2. **Any assumptions made should be clearly stated.**

1) Two companies bid for a contract. A committee has to review the estimates of those companies the reviewed reports are evaluated on a non-dimensional scale and assigned a weighted score that is represented by a fuzzy membership function and give reports to its chairperson. The reviewed reports are evaluated on a non-dimensional scale and assigned a weighted score that is represented by a fuzzy membership function, as B_1 and B_2 illustrated by the two fuzzy sets, in Figure 1. The chairperson is interested in the lowest bid, as well as a metric to measure the combined ''best'' score. For the logical union of the membership functions shown we want to find the defuzzified quantity. For each of the seven methods presented in this chapter assess calculate the defuzzified value, z* **[15M]**

a) Centroid method b) Max membership principle c) Weighted average method



2) Suppose you are a soils engineer and you wish to track the movement of soil particles under applied loading in an experimental apparatus that allows viewing of the soil motion. You are

building pattern recognition software to enable a computer to monitor and detect the motions. However, there are some difficulties in ''teaching'' your software to view the motion. The tracked particle can be occluded by another particle. The occlusion can occur when a tracked particle is behind another particle, behind a mark on the camera's lens, or partially out of sight of the camera. We want to establish a relationship between particle occlusion, which is a poorly known phenomenon, and lens occlusion, which is quite Well-known in photography. Let these membership functions,

$$\underset{\sim}{A} = \left\{\frac{0.1}{x_1} + \frac{0.9}{x_2} + \frac{0.0}{x_3}\right\} \quad \text{and} \quad \underset{\sim}{B} = \left\{\frac{0}{y_1} + \frac{1}{y_2} + \frac{0}{y_3}\right\}$$

describe fuzzy sets for a tracked particle moderately occluded behind another particle and alens mark associated with moderate image quality, respectively. Fuzzy set A~ is defined on a universe X = {x1, x2, x3} of tracked particle indicators, and fuzzy set B~ (note in this case that B~ is a crisp singleton) is defined on a universe Y = {y1, y2, y3} of lens obstruction indices. Atypical rule might be: IF occlusion due to particle occlusion is moderate, THEN image quality will be similar to a moderate lens obstruction, or symbolically,

(a) Find $\underset{\sim}{R} = (\underset{\sim}{A} \times \underset{\sim}{B}) \cup (\bar{\underset{\sim}{A}} \times Y)$.

(b) Now define another fuzzy linguistic variable as

$$\underset{\sim}{A}' = \left\{\frac{0.3}{x_1} + \frac{1.0}{x_2} + \frac{0.0}{x_3}\right\}$$

And for the "new" rule IF $\underset{\sim}{A}'$ THEN $\underset{\sim}{B}'$ find $\underset{\sim}{B}'$ using max-min composition, that is, is, find $\underset{\sim}{B}' = \underset{\sim}{A}' \circ \underset{\sim}{R}$ **[15M]**

3)Maximize the function $f(x)=2x^2+1$ where x value range between 1 to 50 using genetic algorithm. Find the maximum value attained after 2 iterations. **[15M]**

4).Minimize the function f(x) =- $f(x) = 2x^2$ with a swarm of 4 particles .Initial Positions and velocities are given below .Consider the initial weight, w=0.5, the acceleration constants, and consider the below table for $C_1 = C_2 = 1.5$ and consider the below table for random number with respective iterations. Show the detailed computations for iterations 1, 2, 3 and 4.Find minimum value after 2 iterations. **[15M]**

	r1	r2
Iteration 1	0.1	0.2
Iteration 2	0.3	0.2
Iteration 3	0.3	0.5
Iteration 4	0.2	0.5

Position		Initial Velocity	
X1	0.4	V1	0.5
X2	0.2	V2	0.5
X3	-0.5	V3	0.5
X4	0.6	V4	0.5

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1, 2, 3	1, 2	1, 2, 3, 4	1, 4	3	15
Q2	4	2	1, 2	1, 4	3	15
Q3	5	3	1, 2, 3, 4	1, 4	3	15
Q4	6	3	1, 2, 3, 4	1, 4	3	15

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QUESTION PAPER

Name of the Examination: Fast Track Fall 2023-24 Semester – FAT

Course Code: CSE2009 | **Course Title: Soft Computing**

Set number: 6 | **Date of Exam:** 22/8/23 (E1)(FN)

Duration: 120 Min | **Total Marks: 60**

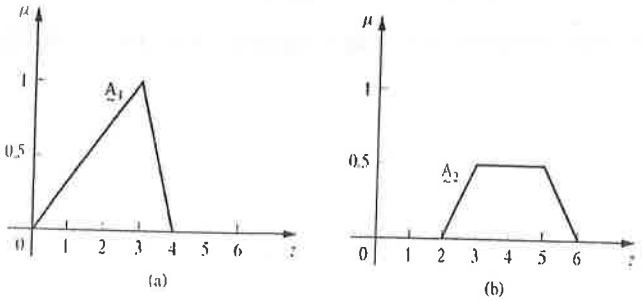
Instructions:

1. **Assume data wherever necessary.**
2. **Any assumptions made should be clearly stated.**

1) In metallurgy, material are made with mixtures of various metal and other elements to achieve certain desirable properties. In a particular preparation of steel, three elements namely iron, manganese and carbon are mixed in two different proportions. The samples obtained from these two different proportions are placed on a normalized scale, as shown in Figure 1 are fuzzy sets A_1 and A_2.You are interested in findings some sort of "average" steel proportion .For the logical union of membership functions shown. We want to find the defuzzified quantity. Calculate defuzzified value z* using

a) Centroid method b) Max membership principle c) Weighted average method

[15M]



2. Suppose we have a distillation process where the objective is to separate components of a mixture in the input stream. The relationship between the input variable, temperature, and the output variable, distillate fractions, is not precise but the human operator of this process has developed an intuitive understanding of this relationship. The universe for each of these Variables is X = universe of temperatures (degree fahrenheit)

= {160, 165, 170, 175, 180, 185, 190, and 195}.

Y = universe of distillate fractions (percentage)

= {77, 80, 83, 86, 89, 92, 95, 98}

Now we define fuzzy sets $\underset{\sim}{A}$ and $\underset{\sim}{B}$ on X and Y, respectively:

$\underset{\sim}{A}$ = Temperature of input steam is hot = $\left\{\frac{0}{175}+\frac{0.7}{180}+\frac{1}{185}+\frac{0.4}{190}\right\}$

$\underset{\sim}{B}$ = Separation of mixture is good = $\left\{\frac{0}{89}+\frac{0.5}{92}+\frac{0.8}{95}+\frac{1}{98}\right\}$.

(a) Find $\underset{\sim}{R} = (\underset{\sim}{A} \times \underset{\sim}{B}) \cup (\overline{\underset{\sim}{A}} \times Y)$.

(b) Now define another fuzzy linguistic variable as

$$\underset{\sim}{A}' = \left\{\frac{1}{170}+\frac{0.8}{175}+\frac{0.5}{180}+\frac{0.2}{185}\right\}$$

And for the "new" rule IF $\underset{\sim}{A}'$ THEN $\underset{\sim}{B}'$ find $\underset{\sim}{B}'$ using max-min composition, that is, find $\underset{\sim}{B}' = \underset{\sim}{A}' \circ \underset{\sim}{R}$. **[15M]**

3) Maximize f(x) = $\mathbf{X^3}$ for x varying in the range [0-31] X is an unsigned binary integer of length 5.Let the initial population be randomly chosen as x={4,12,18,24} for two complete iterations. **[15M]**

4) Minimize the function $f(x) = -X^2+2X+1$ with a swarm of 4 particles .Initial Positions and velocities are given below .Consider the initial weight, w=0.5, the acceleration constants, and consider the below table for $C_1 = C_2 = 1.5$ and consider the below table for random number with respective iterations. Show the detailed computations for iterations 1, 2, 3 and 4. **[15M]**

	r1	r2
Iteration 1	0.1	0.2
Iteration 2	0.3	0.2
Iteration 3	0.3	0.5
Iteration 4	0.2	0.5

Position		Initial Velocity	
X1	0.4	V1	0
X2	0.2	V2	0
X3	-0.5	V3	0
X4	0.6	V4	0

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1, 2, 3	1, 2	1, 2, 3, 4	1, 4	3	15
Q2	4	2	1, 2	1, 4	3	15
Q3	5	3	1, 2, 3, 4	1, 4	3	15
Q4	6	3	1, 2, 3, 4	1, 4	3	15

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QUESTION PAPER

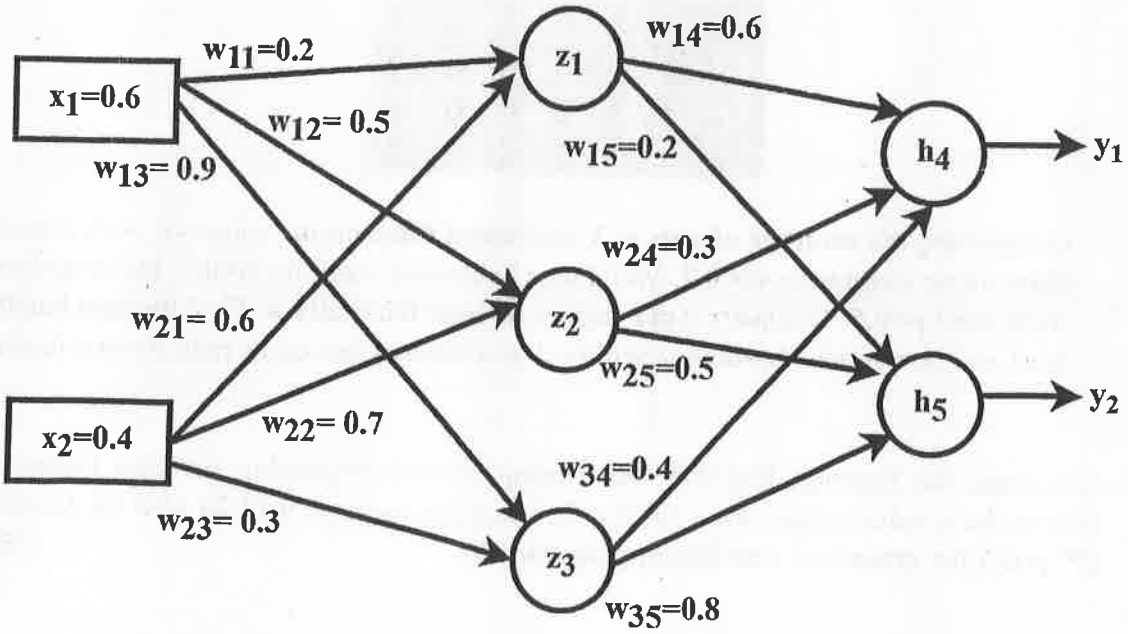
Name of the Examination: LONG SEM 2022-2023 – FAT

Course Code: CSE2009 | **Course Title: Soft Computing**

Set number: 1 | **Date of Exam:** 17/07/2023 (FN)(A1)

Duration: 120 Mins | **Total Marks: 60**

1. Using the backpropagation network find the new weights for the given network as shown below. Use the **learning rate as 0.6** and the sigmoid activation function. The actual output of y_1 and y_2 is 1. Consider the bias for all neurons as the same as 0.25. **(15M)**



2. a) For a speed control of DC motor, the membership functions of series, resistance, armature current and speed are given as follows: **(10M)**

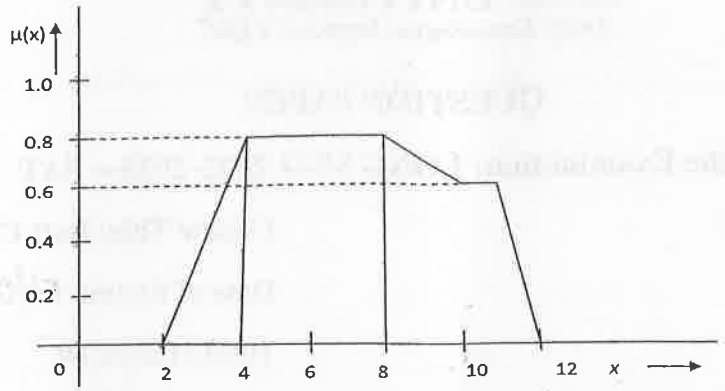
$$R(\text{se}) = \left\{\frac{0.4}{30} + \frac{0.6}{60} + \frac{1.0}{100} + \frac{0.1}{120}\right\}$$

$$\text{I(a)} = \left\{\frac{0.2}{20} + \frac{0.3}{40} + \frac{0.6}{60} + \frac{0.8}{80} + \frac{1.0}{100} + \frac{0.2}{120}\right\}$$

$$\text{N} = \left\{\frac{0.35}{500} + \frac{0.67}{1000} + \frac{0.97}{1500} + \frac{0.25}{1800}\right\}$$

Compute relation T for relating series resistance to motor speed, i.e., $R = R \times I, S = I \times N$ and $T = R \circ S$. Use both max-min and max-product composition.

b) Determine the defuzzified values for the following membership graph using Maxima methods (First, Last and Mean). **(5M)**



3. Solve the following Travelling Salesperson problem using ACO. **(15M)**

Cities	A	B	C	D	E
A	0	3	6	2	3
B	3	0	5	2	3
C	6	5	0	6	4
D	2	2	6	0	6
E	3	3	4	6	0

Considering the **number of ants is 3**, the **Initial Pheromone** value for each edge is **1**, Pheromone weightage, **α= 0.7**, Weightage to control visibility, **β=0.7**, and evaporation coefficient **ρ=0.5. Consider Ant1 begins its tour from city A.** Find the tour length of Ant1 and how much pheromone will be deposited by Ant1 on its path for one iteration.

4. Maximize the function **$f(x)=2x^2+4x+3$** using Genetic Algorithm for One Generation. Where the x value ranges from (0-25). Consider the samples **9,13,24 and 16.** (Consider **2nd point for crossover and flipping operators**). **(15M)**

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1,2	1,2	3,4,5	1,4	3	15
Q2	3,4	1,2	3,4,5	1,4	3	15
Q3	5	1,2	3,4,5	1,4	3	15
Q4	6	1,2	3,4,5	1,4	3	15

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QUESTION PAPER

Name of the Examination: Fast Track Fall 2023-24 Semester – FAT

Course Code: CSE2009 **Course Title: SOFT COMPUTING**

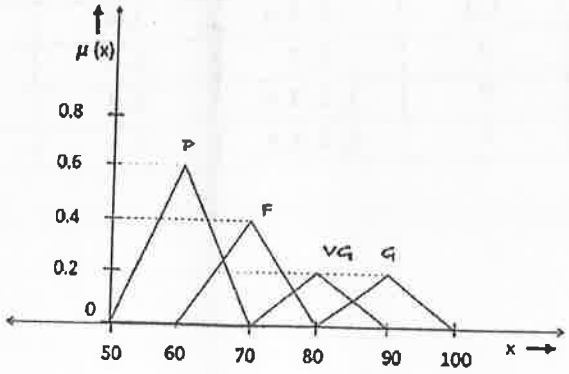
Set number: 1 **Date of Exam:** 19/8/23 (C1)(FN)

Duration: 120 MINUTES **Total Marks: 60**

Instructions:

1. Assume data wherever necessary.
2. Any assumptions made should be clearly stated.

Q1. Let A be a Fuzzy set that says about a Student Performance as shown in figure below. Here, the Linguistic variables P represents a Pass student, F represents a Fair student, G represents a Good student and VG represents a Very Good student. Calculate the de-fuzzified value for the fuzzy set A using Center of Gravity method, Center of Largest Area method, Weighted Average Method and Maxima Method. **(15M)**



Q2. For the alternative Company1, Company2, Company3 and Company4 with the criteria Salary, Distance, Promotion/Increment and Review. Construct the Fuzzy set for the below table using Multi-Objective Decision Making, find the Selection of the best with Salary 35% weightage, Distance 30% weightage, Promotion 20% weightage, Review 15% weightage. Decide as non-beneficial for Promotion and Review and Beneficial for Salary and Distance. Find the preferred decision with multiple objectives. **(15M)**

	Salary	Distance	Promotion/ Increment	Review
Company1	40,000	27 Kms	Good	✓✓✓
Company2	45,000	7.5 Kms	Good	✓✓✓
Company3	50,000	12 Kms	Excellent	✓✓✓✓✓
Company4	60,000	2.5 Kms	Average	✓✓✓✓

Q3. Suppose a Genetic algorithm uses Chromosomes Population of strings size is 5 and the values in binary code are 10111, 00111, 01001, 01010. Assuming that the string represents a binary encoding, and that the fitness function is given by $f(x) = x^2 + 10$, use the Roulette wheel algorithm for the initial parent selection to generate a mating pool and perform two-point crossover sites in 2nd and 4th position to generate a new population. Calculate Fitness for each member of the new population. Find this string using Bit-wise mutation that provides an improvement by finding Sum, Average and Max comparison. **(15M)**

Q4. Find the Optimization using Particle Swarm Optimization (PSO) where the fitness maximize f(x) = $x_1^2 + x_1 x_2 + 3 x_2 + 2$ where -5 ≤ x_1, x_2 ≤ 5 use 3 particles in each x_1 *and* x_2 randomly, c1=2 and c2=2, Initial Velocities can be randomly between (0,1) and r1 and r2 for iteration1 should be (0.2, 0.8) and r1 and r2 for iteration2 should be (0.1, 0.7) respectively, Global maxima should be considered as max of local maxima values. Show the detailed computation for iteration 1 and 2. **(15M)**

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1, 2, 3	1, 2	1, 2, 3, 4	1, 4	3	15
Q2	4	2	1, 2	1, 4	3	15
Q3	5	3	1, 2, 3, 4	1, 4	3	15
Q4	6	3	1, 2, 3, 4	1, 4	3	15

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QUESTION PAPER

Name of the Examination: Fast Track Fall 2023-24 Semester – FAT

Course Code: CSE2009 **Course Title: SOFT COMPUTING**

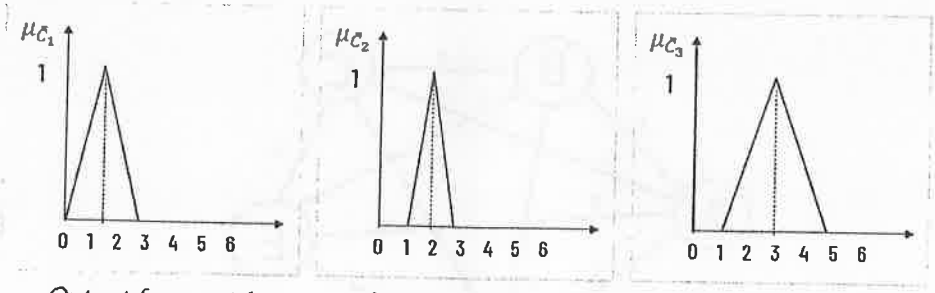
Set number: 3 **Date of Exam: 22/8/23** (E2)(AN)

Duration: 120 MINUTES **Total Marks: 60**

Instructions:

1. Assume data wherever necessary.
2. Any assumptions made should be clearly stated.

Q1. Let C be a fuzzy set that says about Automatic Temperature control system as shown in figure below. Here, the linguistic variables of Ouput Fuzzy set1 represents Hot, Ouput Fuzzy set2 represents Normal, and Ouput Fuzzy set3 represents Cold. Find crisp value Z* corresponding to the following fuzzy output sets using various defuzzification methods as Center of Gravity method, Center of Largest Area method, Weighted Area Method and Maxima method. **(15M)**



Output fuzzy set 1 *Output fuzzy set 2* *Output fuzzy set 3*

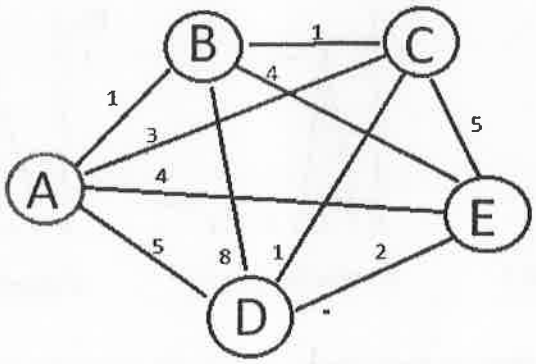
Q2. **A)** Multi-attribute Decision Making using Lexicographic method for the Alternative Mobile1, Mobile2 and Mobile3 with the Criteria Price, Storage Space, Camera and Looks. Construct decision as Rank 1 for Price, Rank 2 for Storage Space, Rank 3 for Looks, and Rank 4 for Camera. Find the preferred decision, choose alternatives in case of tie, find all 4 Rank possibilities. **(8M)**

Alternative	Attribute Or Criteria ➡	Price or Cost	Storage Space	Camera	Looks
	Mobile 1	250 $	16 GB	12 MP	Excellent
	Mobile 2	200 $	16 GB	8 MP	Average
	Mobile 3	300 $	32 GB	16MP	Good
	Mobile 4	275 $	32 GB	8MP	Good
	Mobile 5	225 $	16 GB	16 MP	Below Average

B) Write at least 7 Fuzzy rules for Autonomous Driving car using Assignment/ Unconditional/ Conditional Statements and Multiple Conjunctive/ Disjunctive antecedents with the parameters as Distance of another vehicle (Small, Large, Perfect), Distance of Obstacle (Large, Close), Speed (High, Slow, Medium, Decline), Steering angle (Large, Medium, Low), Acceleration (increase, maintain, decrease), etc., **(7M)**

Q3. Suppose a Genetic algorithm uses chromosomes Population of strings size is 5 and the values in binary code are 11100, 11000, 11001, 00011. Assuming that the string represents the fitness function is given by $f(x) = x^3 + 7$, use the Roulette wheel algorithm for the initial parent selection to generate a mating pool and perform multi-point crossover sites after 1st, 3rd and 4th position to generate a new population. Calculate Fi for each member of the new population. Use 2 position Swap Mutation and find the string provides an improvement by finding Sum, Average and Max comparison. **(15M)**

Q4. Find the Optimization using Scatter Search Technique – Tabu Search Algorithm to solve minimum spanning tree problem for the following graph. The Constraints should be followed in Traverse as No Loop/ Cycle will be allowed; Link AD can be included only if link DE is also included - If this constraint violate there will be 100 penalties. At most one of three links AB, AD, CD there should be only one, If two links exist then there will be 200 penalties, If three links exist then there will be 300 penalties. Find at least 2 iterations to find minimum path. **(15M)**



QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1, 2, 3	1, 2	1, 2, 3, 4	1, 4	3	15
Q2	4	2	1, 2	1, 4	3	15
Q3	5	3	1, 2, 3, 4	1, 4	3	15
Q4	6	3	1, 2, 3, 4	1, 4	3	15

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QUESTION PAPER

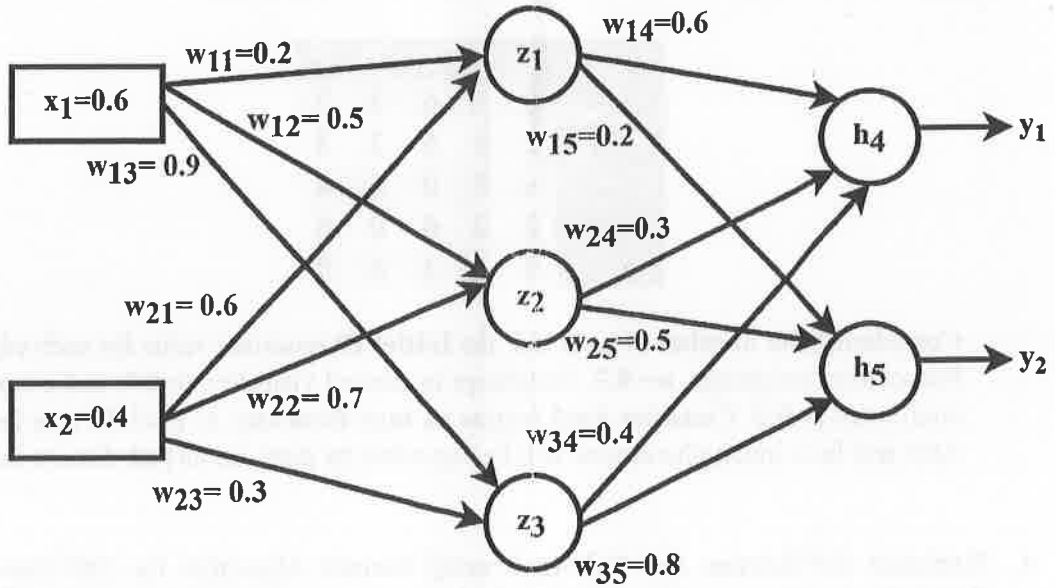
Name of the Examination: WIN 2022-2023 – FAT

Course Code: CSE2009 | **Course Title: Soft Computing**

Set number: 1 | **Date of Exam:** 19/05/2023 (FN) (EI)

Duration: 120 Mins | **Total Marks: 60**

1. Using the backpropagation network find the new weights for the given network as shown below. Use the **learning rate as 0.6** and the sigmoid activation function. The actual output of y_1 and y_2 is 1. Consider the bias for all neurons as the same as 0.25. **(15M)**



2. a) For a speed control of DC motor, the membership functions of series, resistance, armature current and speed are given as follows: **(10M)**

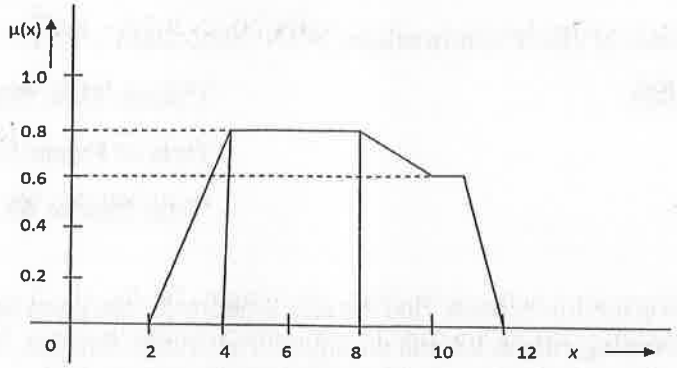
$$R(\text{se}) = \left\{\frac{0.4}{30} + \frac{0.6}{60} + \frac{1.0}{100} + \frac{0.1}{120}\right\}$$

$$\text{I(a)} = \left\{\frac{0.2}{20} + \frac{0.3}{40} + \frac{0.6}{60} + \frac{0.8}{80} + \frac{1.0}{100} + \frac{0.2}{120}\right\}$$

$$\text{N} = \left\{\frac{0.35}{500} + \frac{0.67}{1000} + \frac{0.97}{1500} + \frac{0.25}{1800}\right\}$$

Compute relation T for relating series resistance to motor speed, i.e., $R = R \times I, S = I \times N$ and $T = R \circ S$. Use both max-min and max-product composition.

b) Determine the defuzzified values for the following membership graph using Maxima methods (First, Last and Mean). **(5M)**



3. Solve the following Travelling Salesperson problem using ACO. **(15M)**

Cities	A	B	C	D	E
A	0	3	6	2	3
B	3	0	5	2	3
C	6	5	0	6	4
D	2	2	6	0	6
E	3	3	4	6	0

Considering the **number of ants is 3**, the **Initial Pheromone** value for each edge is **1**, Pheromone weightage, **α= 0.7**, Weightage to control visibility, **β=0.7**, and evaporation coefficient **ρ=0.5. Consider Ant1 begins its tour from city A**. Find the tour length of Ant1 and how much pheromone will be deposited by Ant1 on its path for one iteration.

4. Maximize the function **$f(x)=2x^2+4x+3$** using Genetic Algorithm for One Generation. Where the x value ranges from (0-25). Consider the samples **9,13,24 and 16.** (Consider **2nd point for crossover and flipping operators).** **(15M)**

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1,2	1,2	3,4,5	1,4	3	15
Q2	3,4	1,2	3,4,5	1,4	3	15
Q3	5	1,2	3,4,5	1,4	3	15
Q4	6	1,2	3,4,5	1,4	3	15

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QUESTION PAPER

Name of the Examination: FAT (Winter 2022-2023)

Course Code: CSE2009 | **Course Title: Soft Computing**

Slot: 2 | **Date of Exam: 18/05/2023 (AN) (D2)**

Duration: 120 min | **Total Marks: 60**

Instructions:

1. Assume Data wherever necessary.
2. Any assumptions made should be clearly stated.

Q1. a) Find the weight matrix in bipolar form for the bidirectional associative memory (BAM) using outer products rule for the following binary input-output vector pairs. **(5M)**

Input	Output
(1 0 0 0)	(1 0)
(1 0 0 0)	(1 0)
(1 0 0 0)	(0 1)
(1 0 0 0)	(0 1)

b) Using the unit step function (with threshold 0) as the output units activation function, test the response of the above BAM network on each of the input. **(5M)**

c) Test the response of the BAM network on combinations of input patterns **(5M)**
net input X= [1 0 -1 -1], [-1 1 0 -1], [1 1 -1 -1], [-1 0 0 -1]
net output Y= [1 1]

Q2. a) Consider a local area network (LAN) of interconnected workstations that communicate using Ethernet protocols at a maximum rate of 12 Mbits/s. The two fuzzy sets given below represent the loading of the LAN: **(8M)**

$$\varphi_s(x) = \left\{\frac{1.0}{0} + \frac{1.0}{1} + \frac{0.8}{2} + \frac{0.2}{5} + \frac{0.1}{7} + \frac{0.0}{9} + \frac{0.0}{10}\right\}$$

$$\varphi_c(x) = \left\{\frac{0.0}{0} + \frac{0.0}{1} + \frac{0.0}{2} + \frac{0.5}{5} + \frac{0.7}{7} + \frac{0.8}{9} + \frac{0.0}{10}\right\}$$

where S represents silent, and C represents congestion. Perform algebraic sum, algebraic product, bounded sum, and bounded difference over the two fuzzy sets.

b) For a speed control of DC motor, the membership functions of series, resistance, armature current and speed are given as follows: **(7M)**

$$R(se) = \left\{\frac{0.4}{30} + \frac{0.6}{60} + \frac{1.0}{100} + \frac{0.1}{120}\right\}$$

$$I(a) = \left\{\frac{0.2}{20} + \frac{0.3}{40} + \frac{0.6}{60} + \frac{0.8}{80} + \frac{1.0}{100} + \frac{0.2}{120}\right\}$$

$$N = \left\{\frac{0.35}{500} + \frac{0.67}{1000} + \frac{0.97}{1500} + \frac{0.25}{1800}\right\}$$

Compute relation T for relating series resistance to motor speed, i.e., $R = R \times I, S = I \times N$ and $T = R \circ S$. Use max-min composition.

Q3. Consider there are four items $\{A, B, C, D\}$ with initial weight (kg) values $\{5, 3, 7, 2\}$. There is knapsack K with limited capacity that can hold at most 12 kg. The problem is choosing the item to be place in the knapsack, so that it will maximize the knapsack value without breaking the knapsack. The objective function realized here is $f(x) = x^2$. Use genetic algorithm to maximize the knapsack process and depict the results for 1 generation. The initial population should be generated using the binary encoding method. Roulette wheel should be used for parent selection. Use single point crossover and mutation flipping operation. **(15M)**

Q4. Find the maximum of the following function using PSO algorithm. **(15M)**

$$f(x) = -x^2 + 5x + 20 \text{ with } -10 \leq x \leq 10$$

Use 9 particles with the initial positions $x_1 = -9.6$, $x_2 = -6, x_1 = -9.6$, $x_3 = -2.6$, $x_4 = -1.1$, $x_5 = 0.6$, $x_6 = 2.3$, $x_7 = 2.8$, $x_8 = 8.3$, $x_9 = 10$. Show the detailed computations for 1 iteration. The initial velocities of all the particles are set to 0. The cognitive and the social constants are set to 1. The below table depicts the random values to be assumed for each iteration.

Iterations	r1	r2
1	0.213	0.876
2	0.113	0.706
3	0.178	0.507

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1	1,2	4,5	1, 2	1,4	15
Q2	3	1,2	2,4,5	1, 2	1,4	15
Q3	5	1,2	2,4,5,12	1, 2	1,4	15
Q4	6	1,2	2,4,5,12	1, 2	1,4	15

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QUESTION PAPER

Name of the Examination: WIN 2022-2023 – FAT

Course Code: CSE2009 | **Course Title: Soft Computing**

Set number: 3 | **Date of Exam:** 19/05/2023 (AN)

Duration: 120 Mins | **Total Marks: 60** (E2)

1. Solve and Test the following problem with the perceptron rule. Apply each input vector in order, for as many repetitions as it takes to ensure that the problem is solved with the initial weight vector as w1=0, w2=1, and b=1. **15M**

$$\left\{p_1 = \begin{bmatrix}1\\0\end{bmatrix}, t_1 = 0\right\} \quad \left\{p_2 = \begin{bmatrix}-1\\2\end{bmatrix}, t_1 = 0\right\} \quad \left\{p_3 = \begin{bmatrix}1\\2\end{bmatrix}, t_1 = 1\right\}$$

2. Using the Fuzzy C-Means clustering algorithm, Solve the following problem for one iteration. Consider m=20. **15M**

X	Y	C1	C2
1	4	0.4	0.5
2	5	0.8	0.7
3	9	0.7	0.1
4	8	0.9	0.6
5	3	0.4	0.2
6	2	0.3	0.5

3. Suppose a genetic algorithm uses chromosomes of the form x = a b c d e f g h 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:

   x1 = 6 5 4 1 3 5 3 2

   x3 = 2 3 9 2 1 2 8 5

   a) Evaluate each individual's fitness, showing all your workings, and arrange them in order with the fittest first and the least fit last.
   b) Perform the following crossover operations:
      i) Cross the fittest two individuals using one–point crossover at the middle point.

ii) Cross the second and third fittest individuals using a two–point crossover (points b and f).

iii) Cross the first and third fittest individuals (ranked 1st and 3rd) using a uniform crossover.

c) Suppose the new population consists of the six offspring individuals received by the crossover operations in the above question. Evaluate the fitness of the new population, showing all your workings. Has the overall fitness improved?

d) By looking at the fitness function and considering that genes can only be digits between 0 and 9 find the chromosome representing the optimal solution (i.e. with the maximum fitness). Find the value of the maximum fitness.

e) By looking at the initial population of the algorithm can you say whether it will be able to reach the optimal solution without the mutation operator? **15M**

4. Maximize the function **$f(x)= -x^2+2x-1$** with a swarm of **4 particles**. Initial Positions and velocities are given below. Consider the inertia weight, **w=0.8**, the acceleration constants, **c1=c2=1.5**, and consider the below table for random numbers with respective iterations. Show the detailed computations for iterations 1, 2, 3 and 4. **15M**

Position		Initial Velocity	
X1	0.5	V1	0
X2	0.2	V2	0
X3	-0.4	V3	0
X4	0.9	V4	0

	r1	r2
Iteration 1	0.2	0.6
Iteration 2	0.2	0.6
Iteration 3	0.5	0.5
Iteration 4	0.5	0.5

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1,2	1,2	3,4,5	1,4	3	15
Q2	3,4	1,2	3,4,5	1,4	3	15
Q3	5	1,2	3,4,5	1,4	3	15
Q4	6	1,2	3,4,5	1,4	3	15

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QUESTION PAPER

Name of the Examination: FAT (Winter 2022-2023)

Course Code: CSE2009 | **Course Title: Soft Computing**

Slot: 4 | **Date of Exam:** 13/05/2023 (AN)

Duration: 120 min | **Total Marks: 60** (G12)

Instructions:

1. Assume Data wherever necessary.
2. Any assumptions made should be clearly stated.

Q1. Consider an ART1 neural network with four F1 units and three F2 units. After some time, the training weights are as follows: **(15M)**

$$Bottom\ up\ weights\ b_{ij} = \begin{bmatrix} 0.67 & 0 & 0.2 \\ 0 & 0 & 0.2 \\ 0 & 0 & 0.2 \\ 0 & 0.67 & 0.2 \end{bmatrix}$$

$$Top\ Down\ weights\ t_{ij} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

Determine the new weights matrices after the vector [0,0,1,1] is presented if the vigilance parameter is 0.3 and 0.7.

Q2. Using Fuzzy C means method, cluster the group of 2D data objects, having level of fuzziness 2, and number of clusters C =2. Data Object $X = \{(1,6), (1,6), (2,8), (3,6), (6,6), (8,1)\}$ and the initial membership value for the data points is given in the following table. Update the membership matrix with respect to 3 iterations. **(15M)**

$\mu =$

	X1	X2	X3	X4	X5	X6
C1	0.6	0.6	0.5	0.4	0.4	0.4
C2	0.4	0.4	0.5	0.6	0.6	0.6

Q3. Use genetic algorithm to maximize the function $f(x) = x^2$ over $\{0, 1, 2, \ldots., 31\}$ with the initial x values of $\{13, 24, 8, 16\}$. Perform GA process for 1 generation and depict the results. The initial population should be encoded using binary method. Roulette wheel should be used for parent selection. Use single point crossover and mutation flipping operation. **(15M)**

Q4. Consider the travelling salesman problem with five cities $\{A, B, C, D, E\}$. Using the ACO algorithm, find the shortest possible route that visits each city exactly once and returns to the origin city. Here table 1 represents the distance between each pair of cities. Table 2 represents the visibility of edges and table 3 represent the randomly selected first city by ant X. Show the detailed computations of the first iteration for ant X. **(15M)**

Table.1 Distance of Cities

Cities	A	B	C	D	E
A	∞	3	6	2	3
B	3	∞	5	2	3
C	6	5	∞	6	4
D	2	2	6	∞	6
E	3	3	4	6	∞

Table.2 Visibility of Edge

Cities	A	B	C	D	E
A	∞	0.33	0.16	0.5	0.33
B	0.33	∞	0.2	0.5	0.33
C	0.16	0.2	∞	0.16	0.25
D	0.5	0.5	0.16	∞	0.16
E	0.33	0.33	0.25	0.16	∞

Table.3 City selection

Ant	X
City	A

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	2	1,2	4,5	1, 2	1,4	15
Q2	4	1,2	2,4,5	1, 2	1,4	15
Q3	5	1,2	2,4,5,12	1, 2	1,4	15
Q4	6	1,2	2,4,5,12	1, 2	1,4	15

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QUESTION PAPER

Name of the Examination: WINTER 2022-2023 – FAT

Course Code: CSE2009 **Course Title:** Soft Computing

Set number: 5 **Date of Exam:** 18/05/2023 (FN) (D1)

Duration: 120 Mins **Total Marks: 60**

1. Train a heteroassociative memory network to store the input vectors s = (S_0, S_1, S_2, S_3) to the output vectors t = (t_1, t_2). The vector pairs are given in Table 1. Also test the performance of the network using its training input as testing input.

Table 1

Input & target	S_0	S1	S2	S3	t1	t2
1st	1	0	0	0	0	1
2nd	1	1	0	0	0	1
3rd	0	0	0	1	1	0
4th	0	0	1	1	1	0

15M

2. Let us assume there are 2 clusters in which the data is to be divided. Use **Fuzzy C Means Clustering Algorithm to solve this problem.** The table below represents the values of the data points along with their membership in each cluster.

Cluster	(1, 3)	(2, 5)	(4, 8)	(7, 9)
1)	0.8	0.7	0.2	0.1
2)	0.2	0.3	0.8	0.9

15M

3.

A) What is the difference between global best and personal best in PSO? What are some typical applications of PSO in optimization problems? Provide some examples from different fields, such as engineering, economics, and biology.

B) How is the velocity of a particle updated in PSO? How can the PSO algorithm be modified to handle constraints? Discuss the role of inertia weight in PSO, and how it affects the convergence behaviours of the algorithm.

C) Explain the concept of swarm diversity in PSO, and discuss its importance for the performance of the algorithm. How can diversity be promoted or maintained in PSO, and what are some challenges in achieving this?

(5+5+5)M

4.

A) Consider a genetic algorithm with a population size of 100, a mutation rate of 0.01, and a crossover rate of 0.7. What is the expected number of mutated individuals and the expected number of crossover events in a single generation?

B) Let f(x) be the fitness function for a genetic algorithm, where x is a binary string of length n. Suppose the optimal solution has a fitness value of 100, and the average fitness value of the population is 50. If we use proportional selection, what is the probability that the optimal solution is selected for reproduction in a single generation?

C) Consider two parent chromosomes with the following bit strings:

Parent 1: 0110011010

Parent 2: 1010101010

Apply single-point crossover with the crossover point at bit position 5. What are the resulting offspring chromosomes? (5+5+5)M

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	2	2	1			15
Q2	4	4	2			15
Q3	6	4	1			15
Q4	5	2	4			15