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QUESTION PAPER

Name of the Examination: WIN 2022-2023 – CAT-2

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

Set number: 1 | **Date of Exam:** 31/03/2023 (FN)

Duration: 90 Mins | **Total Marks: 50** (E1)

1. Consider a Kohonen self-Organizing net with two cluster units and five input units. The weight vectors for the cluster units are given by

   w_1=[0.5 0.3 0.8 0.4 0.2]

   w_2=[1.0 0.4 0.9 0.3 0.6]

   Use the square of the Euclidean distance to find the winning cluster unit for the input pattern **x=[0.1 0.4 0.2 0.6 0.5]**. Using a learning rate of **0.5**, find the new weights for the winning unit. **10M**

2. a) Given the following set of values for the membership function of a fuzzy set A:

   A = {(0, 0.2), (1, 0.5), (2, 0.8), (3, 1), (4, 0.8), (5, 0.5), (6, 0.2)}

   i) Find Crossover(A), Bandwidth, Core(A).

   ii) Compute Norm(A).

   b) Find the disjunctive sum of the below given fuzzy sets:

   A= {(x_1,0.5), (x_2,0.9), (x_3,0.3), (x_4,0.1)}

   B= {(x_1,0.5), (x_2,0.7), (x_3,0.4), (x_4,0.9)}

   c) Consider the following fuzzy set defined on the universe of discourse

   X = {1, 2, 3, 4}

   A = {(1, 0.2), (2, 0.4), (3, 0.6), (4, 0.8)}

   i) Find the **α cut: $A_{0.2}$, $A_{0.5}$.**

   ii) Find the **strong α cut: $A'_{0.2}$, $A'_{0.5}$.** **10M**

3. Consider two fuzzy sets A and B on the universe of discourse **X = {0, 1, 2, 3, 4}, Y= {10, 20, 30, 40, 50}** with membership functions given by:

   $\mu_A(0)$= 0.1, $\mu_A(1)$= 0.5, $\mu_A(2)$= 0.8, $\mu_A(3)$= 0.9, $\mu_A(4)$= 0.93

   $\mu_B(10)$= 0.2, $\mu_B(20)$= 0.4, $\mu_B(30)$= 0.7, $\mu_B(40)$= 0.8, $\mu_B(50)$= 0.9

   $\mu_C(10)$= 0.9, $\mu_C(20)$= 0.8, $\mu_C(30)$= 0.5, $\mu_C(40)$= 0.4, $\mu_C(50)$= 0.2

   (i) Find the **R= A x B**

   (ii) Compute the Max-Min composition of **C ∘ R**

   (iii) Compute the Max Product Composition of **C ∘ R** **10M**

4. Consider **X={x1,x2,x3}, Y={y1,y2}**. Assume that a rule if x is A, then y is B is given where **A= {(x_1, 0.3), (x_2, 1), (x_3, 0.6)}, B= {(y_1, 0.2), (y_2, 0.5)}.**

i) Assume that the fact expressed by a proposition y is **B'** is given where **B'= {(y_1, 0.1), (y_2, 0.4)}**. From the above conclude x is **A'** (use Zadeh's max-min rule).

ii) ii) Assume that the fact expressed by a proposition x is **A'** is given where **A'= {(x_1, 0.4), (x_2, 0.9), (x_3, 0.7)}**. From the above conclude y is **B'** (use Zadeh's max-min rule). **10M**

5. Temperature (T) **={43, 29, 30, 45, 50}**, Humidity (H)= **{14, 22, 3, 8}**, T_{Cool}**={(43, 0.8), (29,0.5), (30,0.6), (45, 0.9), (50, 1)}**, H_{High}= **{(14,0.5), (22,0.2), (3,0.9), (8,0.7)}**. Determine "$T_{Cool} \rightarrow H_{High}$" using the interpretation A→B as A coupled with B. **10M**

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	2	1,2	3,4,5	1,4	3	10
Q2	3	1,2	3,4,5	1,4	3	10
Q3	3	1,2	3,4,5	1,4	3	10
Q4	4	1,2	3,4,5	1,4	3	10
Q5	4	1,2	3,4,5	1,4	3	10

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QUESTION PAPER

Name of the Examination: WIN 2022-2023 – CAT-2

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

Set number: 3 | **Date of Exam:** 30/03/2023 (FN) (01)

Duration: 90 Mins | **Total Marks: 50**

1. Construct and test an LVQ net with five vectors assigned to two classes. The given vector along with the class as shown in the below table. Let the Learning rate α=0.1. **10M**

Vector	Class
[1 0 0 1]	1
[1 1 0 0]	2
[0 1 0 1]	1
[0 0 1 1]	2

2. Consider the two given fuzzy sets. **10M**

   $A=\left\{\frac{0.3}{2}+\frac{0.5}{3}+\frac{0.7}{4}+\frac{0.8}{5}+\frac{1}{6}\right\}$

   $B=\left\{\frac{0.4}{2}+\frac{0.7}{3}+\frac{0.2}{4}+\frac{0.9}{5}+\frac{0.8}{6}\right\}$

   Find the following:
   a) Algebraic Sum
   b) Algebraic Product
   c) Bounded Sum
   d) Bounded Difference
   e) Bounded Product

3. Using the inference approach, find the membership values for the triangular shapes, for Isosceles (**I**), Equilateral (**E**), Right-angle (**R**), Isosceles and Right-angle (**IR**), Other Triangle (**T**), triangle with angles: **10M**
   i) **40°, 80° and 60°**
   ii) **10°, 60° and 110°**

4. Consider the multiple rules with discrete fuzzy sets A and B on the universe of discourse X = **{0, 1, 2, 3, 4}**, Y= **{10, 20, 30, 40, 50}** with membership functions given by:
   Rule 1: if X is A then Y is B
   Rule 2: if X is C then Y is D
   $\mu_A(0)$= 0.1, $\mu_A(1)$= 0.5, $\mu_A(2)$= 0.8, $\mu_A(3)$= 0.9, $\mu_A(4)$= 0.93
   $\mu_B(10)$= 0.2, $\mu_B(20)$= 0.4, $\mu_B(30)$= 0.7, $\mu_B(40)$= 0.8, $\mu_B(50)$= 0.9

$\mu_C(0)= 0.2$, $\mu_C(1)= 0.4$, $\mu_C(2)= 0.9$, $\mu_C(3)= 1$, $\mu_C(4)= 0.8$

$\mu_D(10)= 0.9$, $\mu_D(20)= 0.8$, $\mu_D(30)= 0.5$, $\mu_D(40)= 0.4$, $\mu_D(50)= 0.2$

Given, $\mu_E(0)= 0.3$, $\mu_E(1)= 0.6$, $\mu_E(2)= 0.6$, $\mu_E(3)= 0.7$, $\mu_E(4)= 0.6$. Find **F** (Use Mamdani implication rule). **10M**

5. Service Quality (S)= $\{x_1,x_2,x_3,x_4,x_5\}$, Food Quality (F)= $\{y_1,y_2,y_3,y_4,y_5\}$, $S_{High}=\{(x_1, 1), (x_2,0.8), (x_3,0.6), (x_4,0.4), (x_5,0.2)\}$, $F_{High}=\{(y_1,0.6), (y_2,0.2), (y_3,0.9), (y_4,0.3), (y_5,0.3)\}$. Determine "$S_{High} \rightarrow F_{High}$" using the interpretation A→B as A entails B. **10M**

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	2	1,2	3,4,5	1,4	3	10
Q2	3	1,2	3,4,5	1,4	3	10
Q3	3	1,2	3,4,5	1,4	3	10
Q4	4	1,2	3,4,5	1,4	3	10
Q5	4	1,2	3,4,5	1,4	3	10

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QUESTION PAPER

Name of the Examination: WINTER 2022-2023 – CAT-2

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

Set number: 5 **Date of Exam:** 30/03/2023 (AN) (D2)

Duration: 90 Mins **Total Marks:** 50

Q1. A) Can a fuzzy membership be True and False at the same time?

B) **Consider the following real variables from everyday life:**

- Income measured in India.
- Speed measured in meters per second.
- A TV show measured in how much you are interested watching it.
- A meal measured in how much you like to eat it.
- A traffic light measured in what colour is on.

In each case, suggest a fuzzy variable corresponding to these real variables. For which of the five variables the use of a fuzzy variable is not really necessary? Why? **(10M)**

Q2. **An athletic race was conducted. The following membership functions are defined based on the speed of the athletes.**

$$\tilde{F} = \left\{\frac{0.6}{500} + \frac{0.8}{1000} + \frac{1.0}{1500}\right\}$$

$$\tilde{L} = \left\{\frac{0.5}{400} + \frac{0.7}{600} + \frac{0.3}{800}\right\}$$

Find the algebraic sum, algebraic product, cartesian product, bounded difference and bounded sum of the given fuzzy set.

(2+2+2+2+2)M

Q3. Suppose P={u, v, w, x, y} and Q={a,b,c,d,e} and $\tilde{F} = \left\{\frac{0.6}{u} + \frac{0.8}{v} + \frac{0.5}{w} + \frac{0.3}{x} + \frac{0.2}{y}\right\}$ **and** $\tilde{E} = \left\{\frac{0.2}{a} + \frac{0.4}{b} + \frac{0.6}{c} + \frac{0.7}{d} + \frac{0.9}{e}\right\}$. **Determine the fuzzy implication relation (Zadeh's Max min rule): If P is $\tilde{F}$ then Q is $\tilde{E}$.**

(10M)

Q4. **Consider a kohonen self-organizing net with two cluster and five input unit. The weight for the cluster are given by W_1=[1.0 0.9 0.7 0.5 0.3] and W_2= [0.3 0.5 0.7 0.9 1.0]. Use the Square of Euclidean distance to find the winning cluster for the input patten X=[0.0 0.5 1.0 0.5 0.0] and find new weight for the winning unit (learning rate=0.25).**

(10M)

Q5. Determine the crisp α-cut relation when α= 0.2, 0.4, 0.7, 0.2^+ and 0.9 for the following relation R:

$$R=\begin{bmatrix}0.2 & 0.5 & 0.7 & 1.0 & 0.9\\ 0.3 & 0.5 & 0.7 & 1.0 & 0.8\\ 0.4 & 0.6 & 0.8 & 0.9 & 0.4\\ 0.9 & 1.0 & 0.8 & 0.6 & 0.4\end{bmatrix}$$

(10M)

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	4	3	1	2	1	10
Q2	3	2	1	2	1	10
Q3	3	3	1	2	1	10
Q4	2	2	4	-	1	10
Q5	4	3	4	-	1	10

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QUESTION PAPER

Name of the Examination: WINTER 2022-2023 – CAT-2

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

Set number: 6 **Date of Exam:** 03/04/2023 (AN) (G12)

Duration: 90 Mins **Total Marks:** 50

Q1. **For a given kohosen self-organizing map with weight**

$$W_{ij} = \begin{bmatrix} 0.3 & 0.1 & 0.2 & 0.7 & 0.6 \\ 0.4 & 0.6 & 0.8 & 0.4 & 0.3 \end{bmatrix}$$

Use the Square of Euclidean distance to find the winning cluster for the input patten X= [0.5 0.5]. Using learning rate 0.4, calculate the new weight. (10M)

Q2. Let a fuzzy relational matrix R is given below. Find out R is an equivalent relationship or not

$$R = \begin{bmatrix} 1.0 & 0.8 & 0.4 & 0.5 & 0.8 \\ 0.8 & 1.0 & 0.4 & 0.5 & 0.9 \\ 0.4 & 0.4 & 1.0 & 0.4 & 0.4 \\ 0.5 & 0.5 & 0.4 & 1.0 & 0.5 \\ 0.8 & 0.9 & 0.4 & 0.5 & 1.0 \end{bmatrix}$$

(10M)

Q3. Let $\tilde{A} = (a, 0.5), (b, 0.6), (c, 0.7), (d, 0.8), (e, 0.9), (f, 0.9)$ and

$\tilde{B} = (p, 0.9), (q, 0.8), (s, 0.3), (r, 0.2), (s, 0.7), (t, 0.2), (z, 0.2)$.

i. **Find out the λ-cut sets for the values of λ= 1,0.9, 0.5 and 0.2 for $\tilde{A}$ and $\tilde{B}$**
ii. **Find out the λ-cut sets for the values of $\lambda = 0.9^+$, 0.5^+ and 0.2^+ for $\tilde{A}$ and $\tilde{B}$.**
iii. **Find out the Complement of $\tilde{B}$**

(4+4+2)M

Q4.

Let us consider the discrete fuzzy set, using Zadeh's notation, defined on universe X={1,*0.7,0.8,0.5,0.6,2*},

$$\tilde{X} = \frac{1}{1} + \frac{0.9}{0.7} + \frac{0.6}{0.8} + \frac{0.5}{0.5} + \frac{0.4}{0.6} + \frac{0.8}{2}$$

and

$$\tilde{Y} = \frac{1}{1} + \frac{0.8}{0.7} + \frac{0.5}{0.8} + \frac{0.2}{0.5} + \frac{0.1}{0.6} + \frac{0.8}{2}$$

Find out the following operation between $\breve{X}$ and $\breve{Y}$.

a) $\breve{X} \cup \breve{Y}$ b) $\breve{X} \cap \breve{Y}$ c) $\overline{(\breve{X}^{c} \cup \breve{Y}^{c})}$ d) $\overline{\breve{X}^{c}}$ e) $\breve{X} \times \breve{Y}$

(10M)

Q5. Let's consider a fuzzy rule in the following.

"x and y are approximately equal." For this rule, a premise is given like **"x is small."** From the above facts, determine the knowledge about y. the variables x and y are positive integers in [1,4], and R(x, y) = Approximately_Equal(x, y) and R(x) = Small(x) and the membership degrees of R(x) and R(x, y) are given in (Tables 1, 2.) . Determine the value of R(y) using fuzzy reasoning procedure (Generalized modus ponens).

Table 1: Membership degrees of R(x)

x	1	2	3	4
$\mu_R(x)$	1	0.6	0.2	0

Table 2: Membership degrees of R(x)

x \ y	1	2	3	4
1	1	0.5	0	0
2	0.5	1	0.5	0
3	0	0.5	1	0.5
4	0	0	0.5	1

(10M)

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	2	2	1	2	1	10
Q2	3	2	1	2	1	10
Q3	3	3	1	2	1	10
Q4	3	3	4	-	1	10
Q5	4	2	4	-	1	10

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QUESTION PAPER

Name of the Examination: WINTER 2022-2023 – CAT-2

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

Set number: 7 **Date of Exam:** 31/03/2023 (AN) (E2)

Duration: 90 Mins **Total Marks:** 50

Q1. There is a fuzzy rule in the following.

If temperature is high, then humidity is fairly high.

It is a fuzzy rule and a fuzzy relation. **Determine the membership function (using min operation of Mamdani) of the rule.** Let T and H be universe of discourse of temperature and humidity, respectively, and let's define variables t ∈ T and h ∈ H. The fuzzy terms "high" and "fairly high" are represented by A and B respectively: A = "high", A ⊆ T **and** B = "fairly high", B⊆**H.** Assume membership functions $\mu_A(t)$ and $\mu_B(t)$ are given in (Tables 1 and Table 2) respectively. If the temperature is 40, then what about fairly high humidity.

Table 1: Membership of A in T (temperature)

t	20	30	40
$\mu_A(t)$	0.1	0.5	0.9

Table 2: Membership degrees of B in H (humidity)

h	20	50	70	90
$\mu_B(h)$	0.2	0.6	0.7	1

(10M)

Q2.

A. Justify the sentence "Our world is better described fuzzily".

B. Let $\tilde{P}$ and $\tilde{Q}$ are two fuzzy set.

$$\tilde{P} = \left\{\frac{0.6}{m} + \frac{0.8}{n} + \frac{1.0}{r}\right\}$$

$$\tilde{Q} = \left\{\frac{0.5}{m} + \frac{0.7}{n} + \frac{0.3}{r}\right\}$$

Find the union, complement, difference and bounded difference over the fuzzy set $\tilde{P}$ **and** $\tilde{Q}$.

(2+2+2+2+2)

Q3. Consider a universe of aircraft speed near the speed of sound as $X=\{0.72, 0.725, 0.75, 0.775, 0.78\}$ and a fuzzy set on this universe for the speed "Mach 0.75"=$\breve{M}$ where

$\breve{M} = \left\{\frac{0.0}{0.72} + \frac{0.8}{0.725} + \frac{1.0}{0.75} + \frac{0.8}{0.775} + \frac{0.0}{0.78}\right\}$ and define a universe of altitudes as

Y = {21, 22,23, 24, 25, 26, 27} in feet and a fuzzy set on this universe for the altitude fuzzy set "approximately 24,000 feet" = $\breve{N}$ where

$\breve{N} = \left\{\frac{0.0}{21k} + \frac{0.2}{22k} + \frac{0.7}{23k} + \frac{0.8}{24k} + \frac{1}{25k} + \frac{0.2}{26k} + \frac{0.0}{27k}\right\}$.

A) Construct a relation $\breve{R}= \breve{M}\times\breve{N}$

B) For another aircraft speed, say in the $\breve{M}_1$ region of "Mach 0.75" where

$\breve{M}_1= \left\{\frac{0.0}{0.72} + \frac{0.8}{0.725} + \frac{1.0}{0.75} + \frac{0.6}{0.775} + \frac{0.0}{0.78}\right\}$. Find relation S=$\breve{M}_1$ ■ R using Max min composition.

5+5

Q4. Consider the fuzzy sets: short, middle, tall

cm	short	middle	tall
140	1	0	0
150	1	0	0
160	0.9	0.1	0
170	0.7	1	0
180	0.3	0.8	0.3
190	0	0	1

a) Compare the support of each set.
b) What is the normalized fuzzy set?
c) Find the level set of each set.
d) Compare α-cut set of each set where α =0.5 and α =0.3. **(2+2+2+4)**

Q5. Consider an ART 1 neural net with four F1 units and three F2 units. After some training, the weights are as follows:

Bottom-up weights

$$b_{ij}= \begin{bmatrix} 0.67 & 0.00 & 0.2 \\ 0.00 & 0.00 & 0.2 \\ 0.00 & 0.00 & 0.2 \\ 0.00 & 0.67 & 0.2 \end{bmatrix} \quad \text{and} \quad t_{ji} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

Determine the new weight matrices after the vector [0, 0, 1, I] is presented if the vigilance parameter is 0.3. **(10M)**

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	4	2	1	2	1	10
Q2	3	2	1	2	1	10
Q3	3	3	1	2	1	10
Q4	4	3	4	-	1	10
Q5	2	2	4	-	1	10

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QUESTION PAPER

Name of the Examination: Fall 2023-24 Semester – CAT-2

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

Set number: 1 | **Date of Exam:** 18/10/2023 (AN)(D2)

Duration: 1 Hr 30 Minutes | **Total Marks: 50**

Instructions:

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

1. Consider two fuzzy sets athletes **[10]**

$$A = \{\frac{1}{2.0} + \frac{0.65}{4.0} + \frac{0.5}{6.0} + \frac{0.35}{8.0} + \frac{0}{10.0}\}$$

$$B = \{\frac{1}{2.0} + \frac{0.35}{4.0} + \frac{0.5}{6.0} + \frac{0.65}{8.0} + \frac{1}{10.0}\}$$

Find the foll0wing:

Find the following:

(a) $A \cup B$; (b) $A \cap B$; (c) $\bar{A}$; (d) $\bar{B}$;
(e) $\bar{A} \cap \bar{B}$; (f) $\bar{A} \cup \bar{B}$; (g) $\overline{A \cup B}$;
(h) $\overline{A \cap B}$; (i) $A \cup \bar{A}$; (j) $A \cap \bar{A}$;
(k) $B \cup \bar{B}$; (l) $B \cap \bar{B}$

2. An athletic race was conducted. The following membership functions are defined based me speed of athletes **[10]**

$$\underset{\sim}{\text{Low}} = \left\{\frac{0}{100} + \frac{0.1}{200} + \frac{0.3}{300}\right\}$$

$$\underset{\sim}{\text{Medium}} = \left\{\frac{0.5}{100} + \frac{0.57}{200} + \frac{0.6}{300}\right\}$$

$$\underset{\sim}{\text{High}} = \left\{\frac{0.8}{100} + \frac{0.9}{200} + \frac{1.0}{300}\right\}$$

Find the following:

(a) $\underset{\sim}{R} = \text{Low} \times \text{Medium}$

(b) $\underset{\sim}{S} = \text{Medium} \times \text{High}$

(c) $\underset{\sim}{T} = \underset{\sim}{R} \circ \underset{\sim}{S}$ using max-min composition.

(d) $\underset{\sim}{T} = \underset{\sim}{R} \circ \underset{\sim}{S}$ using max-product composition.

3) 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* **[10]**

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

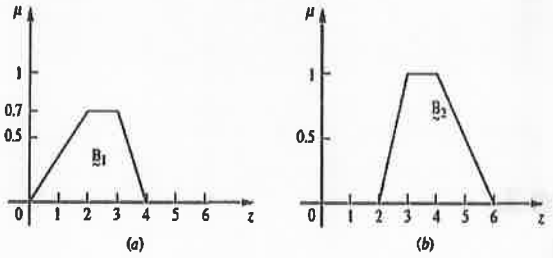

Figure 1.

4) Prove the following two fuzzy rules using given fuzzy set (A, B, C) **[10]**

1. If X is A then Y is B
2. If X is A then Y is B else Y is C

A={(a,0.4),(b,0.3),(c,0.2),(d,0.1)(e,0)}

B={(a,0.41),(b,0.2),(c,0.3),(d,0.4)(e,5)

C={(a,1),(b,0),(c,0.2),(d,0.4)(e,0.7)}

5) Write 10 Fuzzy rules for Automatic Air Conditioner using Assignment/ Unconditional/ Conditional Statements and Multiple Conjunctive/ Disjunctive antecedents with the parameters as **[10]**

Humidity (very high, high, normal, low, very low)

Humidity rate (increasing, decreasing, zero)

Temperature (very high, high, normal, low, very low)

Temperature rate (increasing, decreasing, zero)

Return Damper (fast open, open, steady, close, fast close)

Supply Damper (fast open, open, steady, close, fast close)

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	3	2	1, 2, 3	1	1	10
Q2	3	2	1, 2, 3	1	1	10
Q3	3	2	1, 2, 3	1	1	10
Q4	4	2	1, 2, 3, 4	1	1	10
Q5	4	2	1, 2, 3, 4	1	1, 3	10

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QUESTION PAPER

Name of the Examination: Fall 2023-24 Semester – CAT-2

Course Code: CSE2009

Course Title: SOFT COMPUTING

Set number: 4

Date of Exam: 17/10/2023 (FN) (C1)

Duration: 1 Hr 30 Minutes

Total Marks: 50

Instructions:

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

Q1. Consider a Local Area Network (LAN) of interconnected workstations that communicate using Ethernet Protocols at a maximum rate of 12 Mbit/s. The two fuzzy sets given below represent the loading of the LAN: **(10 M)**

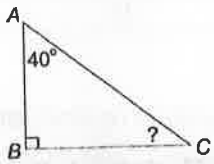
$$\mu S(x) = \left\{\frac{1.0}{0} + \frac{1.0}{1} + \frac{0.8}{2} + \frac{0.2}{5} + \frac{0.1}{7}\right\} \quad \mu C(x) = \left\{\frac{0.0}{0} + \frac{0.0}{1} + \frac{0.0}{2} + \frac{0.5}{5} + \frac{0.7}{7}\right\}$$

$$\mu P(x) = \left\{\frac{0.1}{0} + \frac{0.2}{1} + \frac{0.3}{2} + \frac{0.4}{5} + \frac{0.5}{7}\right\}$$

where S represents Silent and C represents Congestion. Perform the following operations over the Three Fuzzy sets:

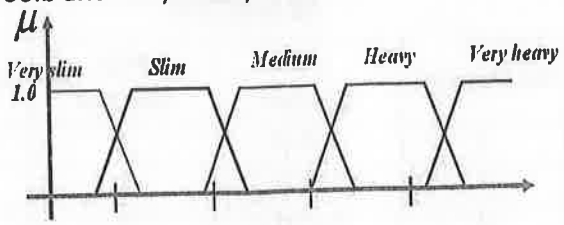
a. $T = S \times C \times P$
b. $R = S \otimes P$
c. Min-Max Composition of T o R

Q2. a. Define the Triangle from the figure shown with three given angles, Find the Inference fuzzification using Equilateral, Isosceles, Right Triangle, any other type of Triangle. **(5 M)**

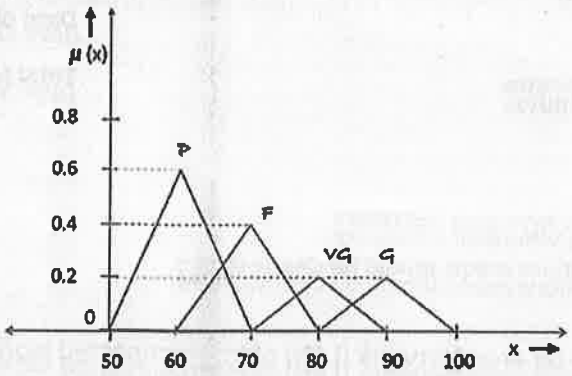


Angles in a triangle add up to 180°

b. Convert and Draw the following Linguistic Variable into Angular Fuzzy set Fuzzification values where Z value for Very Slim is 150lb, Slim as 200lb, Medium as 250lb, Heavy as 300lb and Very Heavy as 350lb. **(5 M)**



Q3. Let A be a fuzzy set that says about a Student as shown in figure below. Here, the linguistic variables P represents a Pass student, F stands for 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 Mean- Max Membership, Center of Largest Area method, First and Last of Maxima. **(10 M)**



Q4. Individual Decision Making for the Alternatives Car1, Car2, and Car3 with the Criterias Price in Lakhs, Fuel Efficiency in Km/Litre, Comfort and Looks. Construct the Fuzzy set for the below table using Individual Decision Making, let an individual wants a Price range between [3 Lakhs to 10 Lakhs] and Fuel Efficiency in Km/Litre between [10 to 20]. Find the preferred decision.

Similarly, using Multi-attribute Decision Making using Lexicographic method for the Alternative Car4, Car5 and Car6. Construct decision as Rank 1 for Price, Rank 2 for Comfort, Rank 3 for Looks, and Rank 4 Fuel. Find the preferred decision, choose alternatives in case of tie, find all 4 Rank possibilities. **(10 M)**

	Price in Lakhs	Fuel Efficiency in km/Litre	Comfort	Looks
Car1	4	15	Good	★★★☆☆
Car2	8	16	Good	★★★★☆
Car3	10	17	Excellent	★★★★★
Car4	3.5	16	Average	★★★☆☆
Car5	4	18	Average	★★★☆☆
Car6	6	17	Good	★★★★☆

Q5. Write 10 Fuzzy rules for Temperature control using Assignment/ Unconditional/ Conditional Statements and Multiple Conjunctive/ Disjunctive antecedents with the parameters as **(10 M)**

Temperature (Too-cold, Cold, Warm, Hot, Too Hot),
Humidity (high, low, normal),
Fan speed (fast, slow, medium), etc.,
(Add much Parameters for Fuzzy rule)

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	3	2	1, 2, 3	1	1	10
Q2	3	2	1, 2, 3	1	1	10
Q3	3	2	1, 2, 3	1	1	10
Q4	4	2	1, 2, 3, 4	1	1	10
Q5	4	2	1, 2, 3, 4	1	1, 3	10

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Name of the Examination: CAT 2

School	SCOPE		
Course Code	CSE2009	Course Title	**Soft Computing**
Semester	II	Class id	AP2021225000803
Slot	A1	Faculty Name & ID	70093, Dr.J.Vijaya
Duration	90	Total Marks	50

Q1. Consider an ART1 neural network with 4 input units and 3 cluster units. After some training, the net contains the bottom up and top down weight matrices as shown below [10]

Bottom-up weights $b_{ij\ (4x3)}$

0.2	0.3	0.2
0.4	0.4	0.2
0.6	0.5	0.2
0.8	0..6	0.2

Top-down weights $t_{ij\ (3x4)}$

1	1	0	0
1	1	1	1
1	0	0	1

Determine the new weights matrices after the vector [1, 1, 1, 1] is presented if the vigilance parameter is 0.6, with α =2.

Q2. Cluster the following 4 input vector using kohonen self organizing map. The number of cluster to be formed is 2 with initial learning rate is 0.7. Assume the weight between 0 to 1. [10]

Input vectors	**S1**	**S2**	**S3**	**S4**
1	1	0	0	1
2	1	0	1	0
3	1	1	0	0
4	1	1	1	1

Q3. Consider the following three fuzzy set and perform the following operation over the fuzzy set (10)

X={(1,0.5),(2,0.7),(3,0.6),(4,0.9)(5,1)}

Y={(1,0.5),(2,0.4),(3,1),(4,0.1)(5,1)}

Z={(1,0.0),(2,0.8),(3,0.2),(4,0.3)(5,0.7)}

i. Associative law of (X,Y,Z)
ii. Distributive law of (X,Y,Z)
iii. Algebraic sum of (X,Y)
iv. Bounded difference of (Y,Z)
v. Bounded Product of (X,Z)

Q4. Humidity of a city is recorded. The following membership functions are defined based on the level of temperature of the city and perform the following operation over the fuzzy set [10]

Too dry={(10,0.4),(20,0.3),(30,0.2),(40,0.1),(50,0)}

Optimum={(10,0.5),(20,0.4),(30,1),(40,0.1),(50,1)}

Moist ={(10,0.9),(20,0.8),(30,0.6),(40,0.3),(50,0.7)}

i. R=Too dry X Optimum
ii. S= Too dry X Moist
iii. R union S
iv. Min Max composition of (R,S)
v. Max Product composition of (R,S)

Q5. Prove the following two fuzzy rules using given fuzzy set (A, B, C) [10]

i. If X is A then Y is B
ii. If X is A then Y is B else Y is C

A={(a,0.4),(b,0.3),(c,0.2),(d,0.1),(e,0)}

B={(a,0.41),(b,0.2),(c,0.3),(d,0.4),(e,0.5)}

C ={(a,1),(b,0),(c,0.2),(d,0.4),(e,0.7)}

QP Mapping

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	2	C03	P01,P02			10
Q2	2	C03	P01,P02			10
Q3	3	C04	P01,P02			10
Q4	3	C04	P01,P02			10
Q5	3	C04	P01,P02			10

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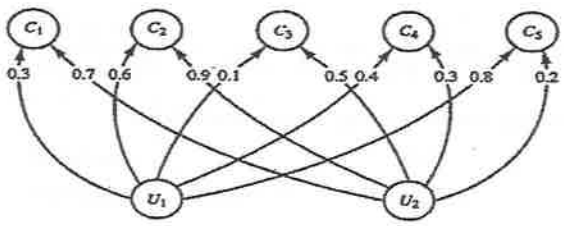
TEMPLATE FOR QUESTION PAPER

Name of the Examination: CAT 2

School	SCOPE	AP2021225000817	
Course Code	CSE2009	Course Title	SOFT COMPUTING
Semester	Elective Paper	Date of exam	18-4-2022
Slot	A1/TA1	Faculty Name & ID	70003 Hari Seetha
Duration	90 min	Total Marks	50

1. Construct an ART-1 network to cluster the four given vectors (1, 0, 1, 1), (1, 0, l, 0), (1, 1, 0, 0) and (1, l, 0, l) into three clusters using vigilance parameter 0.3 and α=2 (or L=2).

2. Construct a Kohonen self-organizing feature map to cluster four vectors [1 0 0 1], [1 1 01], [0 1 1 0], [1 0 1 1]. The maximum number of clusters to be formed is 2 and assume learning rate as 0.5.



3.

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For flight simulator data the determination of certain changes in operating conditions of the aircraft is made on the basis of hard breakpoints in the Mach region. Let us define a fuzzy set to represent the condition of "near" a Mach number of 0.74. Further, define a second fuzzy set to represent the condition of "in the region of" a Mach number of 0.74. In typical simulation data, a Mach number of 0.74 is a hard breakpoint.

$$\underset{\sim}{A} = \text{near Mach } 0.74 = \left\{\frac{0}{0.730} + \frac{0.8}{0.735} + \frac{1}{0.740} + \frac{0.6}{0.745} + \frac{0}{0.750}\right\}.$$

$$\underset{\sim}{B} = \text{in the region of Mach } 0.74 = \left\{\frac{0}{0.730} + \frac{0.4}{0.735} + \frac{0.8}{0.740} + \frac{1}{0.745} + \frac{0.6}{0.750}\right\}.$$

For these two fuzzy sets find (a) $\underset{\sim}{A} \cup \underset{\sim}{B}$, (b) $\underset{\sim}{A} \cap \underset{\sim}{B}$, (c) $\overline{\underset{\sim}{A}}$, (d) $\underset{\sim}{A}|\underset{\sim}{B}$, (e) $\overline{\underset{\sim}{A} \cup \underset{\sim}{B}}$, and (f) $\overline{\underset{\sim}{A} \cap \underset{\sim}{B}}$.

4.

In public transportation systems there often is a significant need for speed control. For subway systems, for example, the train speed cannot go too far beyond a certain target speed or the trains will have trouble stopping at a desired location in the station. Set up a fuzzy set

$$\underset{\sim}{A} = \text{"speed way over target"} = \left\{\frac{0}{T_0} + \frac{0.6}{T_0 + 5} + \frac{0.9}{T_0 + 10} + \frac{1.0}{T_0 + 15}\right\}$$

on a universe of target speeds, say $T = [T_0, T_0 + 15]$, where T_0 is a lower bound on speed. Define another fuzzy set

$$\underset{\sim}{B} = \text{"apply brakes with high force"} = \left\{\frac{0.3}{10} + \frac{0.8}{20} + \frac{0.9}{30} + \frac{1}{40}\right\}$$

on a universe of braking pressures, say $S = [10, 40]$.

(a) For the compound proposition, IF speed is "way over target," THEN "apply brakes with high force," find a fuzzy relation using classical implication.

(b) For a new antecedent,

$$\underset{\sim}{A}' = \text{"speed moderately over target"} = \left\{\frac{0.2}{T_0} + \frac{0.6}{T_0 + 5} + \frac{1.0}{T_0 + 10} + \frac{0.3}{T_0 + 15}\right\},$$

find the fuzzy brake pressure using max–min composition.

and max-product composition

5.

The mixing composition of a chemical plant is governed according to a differential equation. But, to approximate this process, we know the following linguistic information: IF the concentration within the tank is "high", THEN the tank should drain at a "fast" rate. The fuzzy sets for a "high" concentration and a "fast" drainage rate can be

$$\underset{\sim}{H} = \text{"high"} = \left\{ \frac{0}{100} + \frac{0.2}{150} + \frac{0.4}{200} + \frac{0.7}{250} + \frac{1}{300} \right\},$$

represents universe X in grams/liter, and

$$\underset{\sim}{F} = \text{"fast"} = \left\{ \frac{0}{0} + \frac{0.3}{2} + \frac{0.6}{4} + \frac{1.0}{6} + \frac{0.8}{8} \right\},$$

represents universe Y in liters/minute.

(a) From these two fuzzy sets construct a relation for the rule using classical implication.

(b) Suppose a new rule uses a different concentration, say "moderately high," and is expressed by the fuzzy membership function for "moderately high," or

$$\underset{\sim}{H}' = \text{"moderately high"} = \left\{ \frac{0}{100} + \frac{0.3}{150} + \frac{0.3}{200} + \frac{1.0}{250} + \frac{0.1}{300} \right\}.$$

Using max–product composition, find the resulting drainage rate.

c)Using max-min composition determine the resulting drainage rate

QP Mapping

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	2	CO3	PO3			10
Q2	2	CO3	PO3			10
Q3	3	CO4	PO4			10
Q4	3	CO4	PO4			10
Q5	4	CO4	PO3			10

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TEMPLATE FOR QUESTION PAPER

Name of the Examination: CAT 2

AP2021225000535

School	School of Computer science and Engineering		
Course Code	CSE2009	Course Title	Soft Computing
Semester	Winter Semester 2021-22	Date of exam	21-04-2022
Slot	D1+TD1	Faculty Name& ID	Arindam Dey (70369)
Duration	90 minutes	Total Marks	50

Q1. Construct and test an LVQ net with five vectors assigned to two classes. The given vector along with the class as shown in Table 1.

Vector	Class
[0 0 1 1]	1
[1 0 0 0]	2
[0 0 1 1]	2
[1 1 0 0]	2
[0 1 1 0]	1

Q2.

Construct an ART1 for clustering four input vectors with low vigilance parameter of 0.4 into three clusters. The four input vectors are [0 0 0 1], [1 0 1 0], [0 0 1 1] and [1 0 0 0].

Q3.

An athletic race was conducted. The following membership functions are defined based on the speed of the athletes.

$$\widetilde{Big} = \left\{\frac{0.6}{500} + \frac{0.8}{1000} + \frac{1.0}{1500}\right\}$$

$$\widetilde{Medium} = \left\{\frac{0.5}{400} + \frac{0.7}{600} + \frac{0.3}{800}\right\}$$

$$\widetilde{Small} = \left\{\frac{0.8}{100} + \frac{0.2}{200} + \frac{0.1}{300}\right\}$$

i. $R=\widetilde{Big} \times \widetilde{Small}$

ii. $T=\widetilde{Big} \bullet \widetilde{Small}$ using max min operation.

Q4.

The following membership functions are defined based on the speed of the athletes.

$$\widetilde{Big} = \left\{\frac{0.6}{500} + \frac{0.8}{1000} + \frac{1.0}{1500}\right\}$$
$$\widetilde{Medium} = \left\{\frac{0.5}{400} + \frac{0.7}{600} + \frac{0.3}{800}\right\}$$
$$\widetilde{Small} = \left\{\frac{0.8}{100} + \frac{0.2}{200} + \frac{0.1}{300}\right\}$$

i. Find out the $\widetilde{Big} \cup \widetilde{Small}$
ii. Find out the $\widetilde{Big} \cap Medium$
iii. Find out the Complement of Big

Q5

Let A= {(a,0. 1),(b, 0.6), (c,0.8), (d,0.9)}
B= {(1,0. 2),(2, 0.8), (3,0.5), (4,0.4)}

Determine the implication relation.

QP Mapping

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	2	CO3	PO3			10
Q2	2	CO3	PO3			10
Q3	3	CO4	PO4			10
Q4	3	CO4	PO4			10
Q5	4	CO4	PO3			10

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QUESTION PAPER

Name of the Examination: CAT (Long Summer Semester 2021-2022)

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

Slot: C+TC+TCC | **Date of Exam: 04/07/2022**

Duration: 90 min | **Total Marks: 50**

Class ID: AP2021228000037

Instructions:

1. Assume data wherever needed.
2. If any assumptions are made, the assumptions should be clearly stated in respective questions.

Q1. Using the Hebb rule, find the weights required to perform the following classification of the given input pattern. Consider the initial weights on all the edges are 0. **(7 Marks)**

Inputs										Target
x_0	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	y
1	1	1	1	-1	1	-1	1	1	1	1
1	1	1	1	1	-1	1	1	1	1	-1

Q2. Find the weights required to perform the following classification using perceptron network. The vectors (1, 1, 1, 1) and (-1, 1, -1, -1) are belonging to the target class 1. The vectors (1, 1, 1, -1) and (1, -1, -1, 1) are belonging to the target class -1. Assume the learning rate as 1 and initial weights as 0. Tabulate the values for 2 epochs. **(13 Marks)**

Q3. Construct and test the bidirectional associative memory to associate the targets t_1 and t_2 with erroneous bipolar input and output vectors. The target output of t_1 is (-1, 1) and for t_2 is (1,1). Use the below table to train the network. **(10 Marks)**

Inputs															Target
x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	y
1	1	1	1	-1	-1	1	1	1	1	-1	-1	1	1	1	(-1, 1)
1	1	1	1	1	1	1	-1	-1	1	-1	-1	1	-1	-1	(1, 1)

Q4. Design a learning vector quantization based neural network with five vectors assigned to two classes. The vectors along with the classes are given below. Tabulate the values. **(10 Marks)**

Vector	Class
[0, 0, 1, 1]	1
[1, 0, 0, 0]	2
[0, 0, 0, 1]	2
[1, 1, 0, 0]	1
[0, 1, 1, 0]	1

Q5. Let U = Flowers = {Jasmine, Rose, Lotus, Daffodil, Sunflower, Hibiscus, Chrysanthemum}} be a universe on which two fuzzy sets, one of beautiful flowers and the other one of Fragrant flowers are defined as shown below. **(10 Marks)**

$$P = Beautiful\ flower = \frac{0.3}{Jasmine} + \frac{0.9}{Rose} + \frac{1.0}{Lotus} + \frac{0.7}{Daffodil} + \frac{0.5}{Sunflower} + \frac{0.4}{Hibiscus} + \frac{0.6}{\text{Chrysanthemum}}$$

$$Q = Fragnant\ flower = \frac{0.1}{Jasmine} + \frac{1.0}{Rose} + \frac{0.5}{Lotus} + \frac{0.2}{Daffodil} + \frac{0.2}{Sunflower} + \frac{0.1}{Hibiscus} + \frac{0.4}{\text{Chrysanthemum}}$$

Compute the fuzzy sets P∪Q, P∩Q, P', Q', P-Q, P⊕Q. Also verify PUP' ≠ U, P∩Q ≠ ϕ.

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1	2	3	-	-	7
Q2	1	2	3	-	-	13
Q3	2	4	3	-	-	10
Q4	2	4	3	-	-	10
Q5	3	3	2	-	-	10

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QUESTION PAPER

Name of the Examination: FAT (Winter 2021-2022)

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

Slot: A1 **Date of Exam:** 23-05-2022

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

Q1. Let the following be a training set, (x1, x2, x3, x4), t)

((0,0,0,0), 1))
((0,1,0,0), 1))
((1,0,0,1), -1))
((1,1,0,1), -1))

Let initial weights be w = {w0, w1, w2, w3, w4) = {0.2, 0.1, −0.3, 0.2, -0.6}. Using the Perceptron learning rule, train the perceptron for one epoch, setting $\alpha = 0.2$. Choose threshold value 0.01.What are the weights after training? [10M]

Q2. Construct an LVQ net to cluster five vectors assigned to two classes. The following input vectors represent two classes 1 and 2.

Vectors	Class
(I 0 0 1)	1
(1 1 0 0)	2
(0 1 1 0)	1
(1 0 0 0)	2
(0 0 1 1)	1

Perform only one epoch of training.[10M]

Q3. A problem in construction management is to allocate four different job sites to two different construction teams such that the time wasted in shuttling between the sites is minimized. Let the job sites be designated as xi and combined to give a universe, X = {x1, x2, x3, x4}.

If the head office, where the construction teams start every day, has coordinates {0, 0}, the following vectors give the locations of the four job sites: x1 = {5, 5} x2 = {6, 8} x3 = {8, 10} x4 = {9, 12}.

Conduct an FCM and show the resulting partition matrix after first iteration. Start with the following initial 2-partition:

$$\underset{\sim}{U}^{(0)} = \begin{bmatrix} 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \end{bmatrix}.$$

(Use m' = 2.0 and $\varepsilon_L \leq 0.01$.)

Q4. i). Maximize $f(x) = x^3$ 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}. [10M]

ii) Differentiate between Genetic Algorithm, Particle Swarm Optimization and Ant Colony Optimization. [5M]

QP Mapping

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1	CO1	PO1,PO2			15
Q2	2	CO2	PO1,PO2 and PO4			15
Q3	4	CO3	PO1,PO2 and PO4			15
Q4	5 and 6	CO4	PO1,PO2 ,PO4and PO6			15

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QUESTION PAPER

Name of the Examination: FAT (Winter 2021-2022)

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

Slot: A1 **Date of Exam: 23.05.2022**

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

Q1. Use Hebb rule to store the vectors [-1 -1 -1 1] in an auto-associative network.

- Find the weight matrix after the training. [8 marks]
- Test the net using [-1 -1 -1 -1]. [2.5 Marks]
- Test the net using [1 1 1 1]. [2.5Marks]
- Test the net using [0 1 1 0]. [2 Marks]

Q2. Streaming services often use clustering analysis to identify viewers who have similar behaviour. For example, a streaming service may collect the following data about individuals and need to divide in to two clusters. Perform the FCM clustering algorithm **till 1 iteration** for the data by considering Euclidean distance.

SI.No	Minutes watched per day	Total viewing sessions per week
P1	24	10
P2	32	5
P3	71	4
P4	90	4

Start with the following initial 2-partition:

$$\underset{\sim}{U}^{(0)} = \begin{Bmatrix} 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \end{Bmatrix}.$$

. (Use $m' = 2.0$ and $\varepsilon_L \leq 0.01$.)

Q3. Using Genetic Algorithm, maximize the function f(x) = 2x+y over {0, 1, 2,…., 31} with initial chromosome values of 5 samples as given below

Chromosome [1] =[x, y] = [12; 05]
Chromosome [2] =[x, y] = [02, 21]
Chromosome [3] =[x, y] = [10; 04]
Chromosome [4] =[x, y] = [20; 01]
Chromosome [5] =[x, y] = [01; 04]

Show all the steps involved **in one generational** cycle. [15 marks]

150

Q4. a. Consider the following two fuzzy sets:

A= {0.3/1 + 0.4/2 + 0.5/3 + 0.6/4}.

B= {0.2/1 + 0.3/2 + 0.3/3 + 1/4}

Perform the following operations between the given fuzzy sets: [10 marks]

I. Algebraic sum
II. Algebraic product
III. Bounded sum
IV. Bounded difference
V. Bounded product

b. What are the 2 main equations involved in particle swarm optimisation? [2.5 Marks]
c. Which of the real world problems can be solved by ant colony optimization? [2.5 Marks]

QP Mapping

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	2	CO1	PO1,PO2			15
Q2	4	CO2	PO1,PO2 and PO4			15
Q3	5	CO3	PO1,PO2 and PO4			15
Q4	3 and 6	CO4	PO1,PO2 ,PO4and PO6			15

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TEMPLATE FOR QUESTION PAPER

Name of the Examination: FAT

QUESTION PAPER

Name of the Examination: FAT (Winter 2021-2022)

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

Slot: D1+TD1 **Date of Exam:** 26/05/2022

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

Instructions:

Q1. A) Construct and test an LVQ net with five vectors assigned to two classes. The given vector along with the class as shown in Table 1.

Vector	Class
[0 0 1 1]	2
[1 0 0 0]	1
[0 0 1 1]	1
[1 1 0 0]	2
[0 1 1 0]	2

B) Train the auto associative network for input vector [-1 1 1 1] and test the network for the same input vector. Test the auto associative network with one missing, one mistake, two missing and two mistake entries in test vector.

Q2. The following membership functions are defined based on the speed of the athletes.

$$\breve{A} = \left\{\frac{0.9}{500} + \frac{1}{1000} + \frac{1.0}{1500}\right\}$$

$$\breve{B} = \left\{\frac{0.5}{500} + \frac{0.7}{1000} + \frac{0.3}{1500}\right\}$$

$$\breve{C} = \left\{\frac{0.8}{500} + \frac{0.2}{1000} + \frac{0.1}{1500}\right\}$$

i. $R = \breve{A} \times \breve{B}$

ii. $T = \breve{A} \cdot \breve{C}$ **using min max operation.**

iii. $D = \breve{A} \cup \breve{B}$

iv. $D = \breve{A} \cap \breve{C}$

Q3. Maximize the function $f(x)=2x^2+1$ where x value range between 1 to 50 using genetic algorithm.

Q4. A) Using Fuzzy C means clustering algorithm solve the following problem

X	Y	C1	C2
1	6	0.8	0.1
2	5	0.9	0.2
3	8	0.7	0.3
4	4	0.3	0.5
5	7	0.5	0.7
6	9	0.2	0.8

B) Find the maximum function $f(x) = x^3+1$ $(-10 \leq x \leq 10)$ using PSO algorithm. Use 9 particles with initial position $x_1 = -9.6$, $x_1 = -6$, $x_1 = -2.6$, $x_1 = -1.1$, $x_1 = -0.6$, $x_1 = 2.5$, $x_1 = -2.5$, $x_1 = -2.8$, $x_1 = -8.3$, $x_1 = -10$. Show the detailed computations for iterations 1 & 2.

QP Mapping

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	2	CO1	PO5			15
Q2	3	CO2	PO3			15
Q3	5	CO3	PO2			15
Q4	6	CO4	PO3			15

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QUESTION PAPER

Name of the Examination: FAT (Long Summer Semester 2021-2022)

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

Slot: C+TC+TCC | **Date of Exam: 30/07/2022**

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

Class ID: AP2021228000037

Instructions:

1. Assume data wherever needed.
2. If any assumptions are made, the assumptions should be clearly stated in respective questions.

Q1. Design a learning vector quantization based neural network with five vectors assigned to three classes. The vectors along with the classes are given below. Tabulate the values. Consider the learning rate as $\eta = 0.1$. **(10 Marks)**

Vector	Class
[0, 0, 1, 1]	1
[1, 0, 0, 0]	2
[0, 0, 0, 1]	2
[1, 1, 0, 0]	1
[0, 1, 1, 0]	1
[0, 0, 0, 0]	3
[1, 1, 1,1]	3

Q2. Consider a universe of sports car and the relative speed are denoted in fuzzy representation.

$$Speed\ (S) = \left\{\frac{0}{maruthi}, \frac{0.8}{ferrari}, \frac{1}{bugatti}, \frac{0.8}{BMW}, \frac{0}{kia}\right\}$$

Corresponding milage of cars under different speed are given in the below fuzzy set

$$Mileage\ (M) = \frac{0}{180km/h}, \frac{0.2}{160km/h}, \frac{0.7}{120km/h}, \frac{1}{90km/h}, \frac{0.7}{115km/h}, \frac{0.2}{150km/h}, \frac{0}{190km/h}$$

Performance of each car are given in the below fuzzy set

$$Performance\ (P) = \left\{\frac{0}{maruthi}, \frac{0.8}{ferrari}, \frac{1}{bugatti}, \frac{0.6}{BMW}, \frac{0}{kia}\right\}$$

Construct the relation $R = S \times N$ and $S = P \cdot R$ using min max composition. **(10M)**

Q3. Maximize the given function $f(x) = 2x^2 + 2x - 7$ where $0 < x < 64$. The initial population P_0 of size 6 is given by (101010, 010101, 111100, 000011, 001100, 110011).

i) Evaluate its fitness values.
ii) Perform rank-based selection strategy and select the chromosome with the rank (1,4), (2,4), (1,6).
iii) Use the 2-point crossover and divide the chromosomes into equal parts and perform crossover and generate 6 children.
iv) Perform flipping (F) and swapping (S) alternatively mutation with the mutation rate 0.33. The pairs for flipping and swapping is F (1,2), S (2,3), F (3,4), S (4,5), F (5,6), S (6,1).

v) Evaluate the fitness of the population P_1

Repeat the same steps once again and generate P_2. What is maximum value attained after iteration for the above given function? **(15M)**

Q4. Apply Ant Colony Optimization (ACO) algorithm for the below given symmetric Travelling Salesperson (TSP) problem instance and find the shortest tour cost. The parameter for the calculation is given by $\alpha = 0.5, \beta = 0.5$, initial pheromone deposits across all edge are $\tau_0(r,s) = 0.2$, pheromone evaporation rate $\rho = 0.3$, number of agents $n = 3$. Diagrammatically represent the pheromone deposits after the first iteration (including the evaporation). **(15M)**

$$cost = \begin{bmatrix} 0 & 2 & 4 & 6 \\ 2 & 0 & 6 & 4 \\ 4 & 6 & 0 & 2 \\ 6 & 4 & 2 & 0 \end{bmatrix}$$

Q5. Maximize the function $f(x) = 2x^2$ where $0 < x < 32$ using the particle swarm optimization (PSO) algorithm. The initial swarm population is 5, 6, and 8. The initial velocity $v_0 = 0.5$ for all the particles. The algorithmic parameters are given by $\omega = 0.4, \alpha = 0.5$ and $\beta = 0.5$. The random values needed for the calculation are given by (0.22, 0.72, 0.34, 0.43, 0.71, 0.10). Use the given random values cyclically. Find the maximum value attained after 2 iterations. **(10M)**

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	2	2	2	-	-	10
Q2	4	2	2	-	-	10
Q3	5	3	4	-	-	15
Q4	6	4	3	-	-	15
Q5	6	3	4	-	-	10