PG/IVS/MTM-403/13

M.Sc. 4th Semester Examination, 2013

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

(Fuzzy Sets and Their Applications & Soft Computing)

PAPER—MTM-403

Full Marks : 50

Time : 2 hours

The figures in the right-hand margin indicate marks

GROUP – A

(Fuzzy Sets and Their Applications)

[*Marks* : 25]

Time : 1 hour

Answer **Q. No. 1** and any **three** from the rest

1. Answer any *one* question : 2 × 1

(*a*) Define fuzzy set and give an example of the fuzzy set. 1 + 1

(*b*) If $\tilde{A} = \{(x_1, 0{\cdot}15), (x_2, 0{\cdot}27), (x_3, 0{\cdot}57)\}$ and $\tilde{B} = \{x_1, 0{\cdot}35), (x_2, 0{\cdot}48), (x_3, 0{\cdot}69)\}$. Find $\tilde{A} \cup \tilde{B}$ and $\tilde{A} \cap \tilde{B}$. 1 + 1

2. Show that law of contraction and law of excluded middle do not holds for fuzzy sets. 3 + 3

3. Define 'Extension Principle' of Zadeh. Using addition rules of fuzzy numbers, show that 5 + 3 = 8 for real number. 2 + 4

4. Define triangular and trapezoidal fuzzy numbers. Evaluate the following expression $1\frac{1}{2} + 1\frac{1}{2} + 3$

$$4\,[3, 4, 5, 6] - 5[-1, 4, 6] + 3[-7, 7] + 27$$

5. Let $A = [a_1, a_2]$ and $B = [b_1, b_2]$ be two interval numbers. Find $A \cdot B$ if 3 + 3

(*i*) $a_1 < 0, a_2 \geq 0, b_1 < 0$ and $b_2 \geq 0$

(*ii*) $a_1 \geq 0, a_2 < 0, b_1 < 0$ and $b_2 \geq 0$

6. Using Werner's method, find the crisp LPP corresponding to the following fuzzy LPP as 6

$$\text{Max.} \quad Z = x_1 + x_2$$

subject to

$$-x_1 + 3x_2 \leq 21 \text{ to } 23$$
$$x_1 + 3x_2 \leq 25 \text{ to } 27$$
$$4x_1 + 3x_2 \leq 45 \text{ to } 50$$
$$x_1, x_2 \geq 0$$

[*Internal Assessment* : 5 Marks]

GROUP – B

(*Soft Computing*)

[*Marks* : 25]

Time : 1 hour

1. Answer any *two* of the following : 8 × 2

(*a*) Maximize $y = \sqrt{x}$, $1 \leq x \leq 16$ using binary coded GA (one iteration only) given that
Population size = $N = 6$
Each chromosome is of 6 bits
Random nos. for selection :
0·15, 0·27, 0·64, 0·52, 0·79, 0·70

$p_c = 0{\cdot}4$

Random nos. for crossover :

0·62, 0·80, 0·50, 0·47, 0·75, 0·45

$p_m = 0{\cdot}03$

For crossover, pos = 2 (in all cases)

Random nos. for mutation :

0·61, 0·21, 0·75, 0·08, 0·04, 0·91,
0·45, 0·11, 0·06, 0·81, 0·05, 0·09,
0·12, 0·41, 0·51, 0·62, 0·78, 0·84,
0·44, 0·90, 0·78, 0·32, 0·07, 0·06,
0·55, 0·15, 0·29, 0·37, 0·77, 0·67,
0·08, 0·02, 0·61, 0·82, 0·92, 0·83

Initial solution with decoded value :

Solution		Decoded value
100101	.....	37
011010	.....	26
010110	.....	22
111010	.....	58
101100	.....	44
001101	.....	13

(*Continued*)

(*b*) Let the classification is as like as

$$\left\{X_1^T = [2,\ 2], d_1 = 0\right\}, \left\{X_2^T = [1,\ -2], d_2 = 1\right\}$$

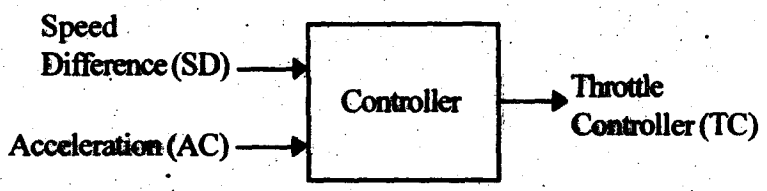
$$\left\{X_3^T = [-2,\ 2], d_3 = 0\right\}, \left\{X_4^T = [-1,\ 1], d_4 = 1\right\}$$

solve it with single vector input, two element perceptron network, hard limit function,

$$\phi(I) = 1, \quad I \geq 0$$
$$= 0, \quad I < 0$$

(upto two iterations only)

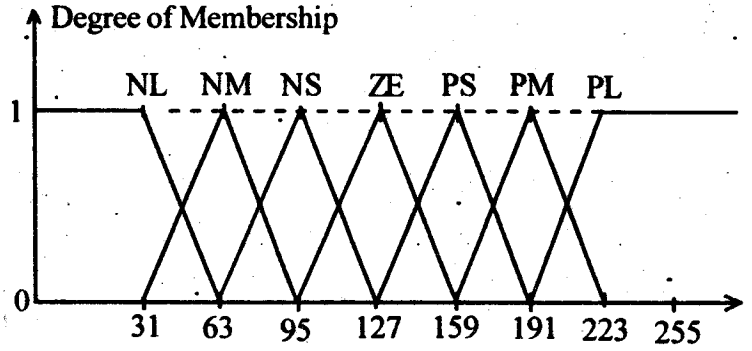
(*c*) If the normalised speed difference be 100 and the normalised acceleration be 70, then what should be the throttle control in normalised for the following controller :



Fuzzy Rule Base :

IF (SD is NL) AND (AC is ZE) THEN
(TC is PL)
IF (SD is ZE) AND (AC is NL) THEN
(TC is PL)
IF(SD is NM) AND (AC is ZE) THEN
(TC is PM)
IF(SD is NS) AND (AC is PS) THEN
(TC is PS)
IF(SD is PS) AND (AC is NS) THEN
(TC is NS)
IF(SD is PL) AND (AC is ZE) THEN
(TC is NL)
IF(SD is ZE) AND (AC is NS) THEN
(TC is PS)
IF(SD is ZE) AND (AC is NM) THEN
(TC is PM)

Where :
SD : Speed Difference, AC : Acceleration
TC : Throttle Control, NL : Negative Large
NM : Negative Medium, NS : Negative Small
ZE : Zero , PS : Positive Small
PM : Positive Medium, PL : Positive Large



2. Answer for SD, AC and TC any *one* of the following : 4

(*a*) Give the working cycle of Genetic Algorithm (with flow-chart) and give a model of an artificial neuron..

(*b*) Let $A = B = \{ 1, 5, 9, 10\}$ be some typical job performance indexes in an application, with the following discrete membership function for the fuzzy description

"poor performance"

$$\mu_A(a) = \begin{cases} 1{\cdot}0 & \text{if } a = 1 \\ 0{\cdot}5 & \text{if } a = 5 \\ 0{\cdot}1 & \text{if } a = 9 \\ 0{\cdot}0 & \text{if } a = 10 \end{cases}$$

Let R be a fuzzy relation between two members in A, meaning "very close to each other" and be defined by the following table.

R;		1	5	9	10
	1	1·0	0·5	0·0	0·0
	5	0·5	1·0	0·5	0·1
	9	0·0	0·5	1·0	0·5
	10	0·0	0·1	0·5	1·0

Suppose that one wants to perform the following fuzzy logic inferrence.

Premise	a has poor performance
Implication	*a* and *b* are very close to each other
Conclusion	*b* has some what poor performance

Compute its membership value $\mu_B^{(5)}$.

[*Internal Assessment* : 5 Marks]