PG/IVS/MA-2203/10

M.Sc 4th Semester Examination, 2010

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER—MA - 2203

Full Marks : 50

Time : 2 hours

The figures in the right-hand margin indicate marks

GROUP—A

(*Fuzzy Sets and their Applications*)

[*Marks* : 25]

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

1. Answer any *two* questions :   1 + 1

   (a) Give the membership function of a fuzzy set which is not a fuzzy number.

   (b) Give the membership function of a convex fuzzy set.

   (c) Give an example of a trapezoidal fuzzy number.

2. Explain why law of excluded middle and law of contradiction is not valid for fuzzy sets. Using definitions of union, intersection and complement for fuzzy sets prove the De Morgan's law. $2 + 4$

$$(\underset{\sim}{A} \cap \underset{\sim}{B})^c = \underset{\sim}{A}^c \cup \underset{\sim}{B}^c$$

3. Let the membership function of two fuzzy sets $\underset{\sim}{A}$ and $\underset{\sim}{B}$ be given respectively by

$$\mu_{\underset{\sim}{A}}(x) = \begin{cases} 0 & x \leq 0 \\ x/3 & 0 \leq x \leq 3 \\ 1 & 3 < x < 5 \\ (8-x)/3 & 5 \leq x < 8 \\ 0 & x \geq 8 \end{cases}$$

$$\mu_{\underset{\sim}{B}}(x) = \begin{cases} 0 & x \leq 2 \\ (x-2)/2 & 2 < x < 4 \\ 1 & 4 \leq x \leq 8 \\ (10-x)/2 & 8 < x < 10 \\ 0 & x \geq 10 \end{cases}$$

Find the membership functions of $\underset{\sim}{A} \cup \underset{\sim}{B}$ and $\underset{\sim}{A} \cap \underset{\sim}{B}$. $3 + 3$

4. (a) Simplify

$$2[-3, 4, 5] - 3[2, 3, 6, 7] + 6[-10, 5] \\ - 8[1, 4] + 9.$$

(b) If $\underset{\sim}{A} = [5, 6, 10]$ and $\underset{\sim}{B} = [-2, 3, 5]$ be two triangular fuzzy numbers, then using the interval addition rule determine $\underset{\sim}{A} + \underset{\sim}{B}$.   2 + 4

5. Discuss Verdegay's method to solve a fuzzy LPP.   6

6. Using Zimmermann's method form a crisp LPP corresponding to the following fuzzy LPP. Find x_1, x_2, x_3 such that

$$g_0 = 2x_1 - 4x_2 + 3x_3 \geqslant \tilde{5}$$
$$g_1 = 2x_1 + x_2 + x_3 \leqslant \tilde{10}$$
$$g_2 = -x_1 + 3x_2 + 2x_3 \leqslant \tilde{20}$$
$$g_3 = 2x_1 + 4x_2 + 3x_3 \leqslant \tilde{15}$$
$$g_4 = x_1 + x_2 + 3x_3 \leqslant \tilde{10}$$

with tolerances as $p_0 = 1$, $p_1 = 2$, $p_3 = 1$.   6

[*Internal Assessment* : 5 Marks]

GROUP—B

(*Soft Computing*)

[*Marks* : 25]

1. Answer any *two* of the following:

(a) Explain the Roulette - Wheel Selection Process in a real coded genetic algorithm alongwith the steps/algorithm to be followed. Apply this process to find the population after 1st selection of the following:

$$\text{Maximize} \quad f(x) = x^3 - 12x^2 + 45x$$

in the interval (0, 4).

[Given population size = $N = 5$

Initial population $x(i) = 1.852, 3.828, 1.380,$
$$1.472, 1.776, i = 0, 1, \dots 4.$$

Random Nos. to be used for selection:

$$.46, .30, .82, .90, .56]. \qquad 4 + 4$$

(Continued)

(b) Explain the single layer perceptron architecture of an Artificial Neural Network alongwith its learning rule. Generate the output of logical AND function by single perceptron using initial weights $W = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ and bias, $b = -2$. 6 + 2

(c) Apply the fuzzy Modus Ponens rule to deduce rotation is quite slow given : 8

   (i) If the temperature is high then the rotation is slow.

   (ii) The temperature is very high.

   Where $\tilde{H}$ (high), $\tilde{V}H$ (very high), $\tilde{S}$ (slow) and $\tilde{Q}S$ (quite slow) indicate the associated fuzzy sets as follows :

   For $X = \{30, 40, 50, 60, 70, 80, 90, 100\}$ — the set of temperatures.

   $Y = \{10, 20, 30, 40, 50, 60\}$ — the set of rotations per min.

                (*Turn Over*)

$$\tilde{H} = \{(70, 1), (80, 1), (90, 0.3)\}$$

$$\tilde{V}H = \{(90, 0.9), (100, 1)\}$$

$$\tilde{Q}S = \{(10, 1), (20, 0.8)\}$$

$$\tilde{S} = \{(30, 0.8), (40, 1), (50, 0.6)\}$$

2. Answer any *one* of the following :   4

(a) Mention four logical connectives and their truth values for two fuzzy propositions $\tilde{P}$ and $\tilde{Q}$.

Let $X = \{a, b, c, d\}$, $Y = \{1, 2, 3, 4\}$

$$\tilde{A} = \{(a, 0), (b, 0.8), (c, 0.6), (d, 1)\}$$

$$\tilde{B} = \{(1, 0.2), (2, 1), (3, 0.8), (4, 0)\}$$

Determine the implication relation

IF x is $\tilde{A}$ THEN y is $\tilde{B}$.

(b) Explain two methods of cross over in binary coded *GA* and two methods of mutation in real coded *GA* with examples.

[*Internal Assessment* : 5 Marks]