M.Sc. 4th Semester Examination, 2012

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 ]

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

1.  Answer any two questions : 1 × 2

   (a)  What is a support of a fuzzy set ?

   (b)  Define the union operation of two fuzzy sets.

   (c)  Give an example of a trapezoidal fuzzy number.
2. What are causes of uncertainty? Explain the traditional and modern view of uncertainty? What are random and non-random uncertainty? Explain it.  

3. (a) What is meant by fuzzy optimization? Explain it.  
   (b) Prove that D'Morgan's law is true for fuzzy sets.  

4. Discuss Verdegay's method to solve a fuzzy LPP.  

5. (a) Simplify the following: 

   \[ 3 \left[ 1, 2, 4, 6 \right] - 2 \left[ -3, 4, 5 \right] + 5 \left[ -2, 2 \right] + 10 \]

   (b) If \( \tilde{A} = [2, 4, 5, 7] \) and \( \tilde{B} = [1, 3, 5, 8] \) be two trapezoidal fuzzy numbers, then using \( \alpha \)-cut, find \( \tilde{A} + \tilde{B} \).  

6. Using Zimmerman's method, determine the crisp LPP equivalent to the following fuzzy LPP:  

   Find \( x \) such that  

   \[ 13x_1 + 12x_2 \geq \tilde{b}_0 \]  
   \[ 4x_1 + 3x_2 \leq \tilde{b}_1 \]  
   \[ 2x_1 + 5x_2 \leq \tilde{b}_2 \]  
   \[ 3x_1 + 4x_2 \leq \tilde{b}_3 \]
where the goal $b_0$ of the fuzzy objective is 25 and its corresponding tolerance $p_0$ is 2 and the fuzzy resource $b_i$ and their tolerance $p_i$ are as follows:

$$b_1 = 12, \ b_2 = 10, \ b_3 = 12$$
$$p_1 = 1, \ p_2 = 1, \ p_3 = 2.$$  

\[ \text{[ Internal Assessment : 5 Marks ]} \]

**GROUP – B**

(Soft Computing)

\[ \text{[ Marks : 25 ]} \]

1. Answer any two of the following:

(a) Maximize $f(x) = x^3 - 12x^2 + 45x$ in $0 \leq x \leq 4$ using real coded GA (one iteration only) given that Population size $= N = 5$

Initial population, $x(t) = \{ 1.852, 3.828, 1.380, 1.472, 1.776 \}$

Random Nos. to be used for selection:

$0.46, 0.30, 0.82, 0.90, 0.56, \ p_c = 0.4$

Random Nos. to be used for crossover

$0.346, 0.130, 0.982, 0.090, 0.656, \ p_m = 0.2$
Random Nos. to be used for mutation
0.19, 0.59, 0.65, 0.45, 0.96

Permutation Value = \( \Delta = 1.20 \) for random
random No. = \( r = 0.55 \) for mutation

(b) Let \( X = \{a, b, c, d\}, \quad Y = \{1, 2, 3, 4\} \)
\( \widetilde{A} = \{(a, 0) (b, 0.8) (c, 0.6) (d, 1)\} \)
\( \widetilde{B} = \{(1, 0.2) (2, 1) (3, 0.8) (4, 0)\} \)
\( \widetilde{C} = \{(1, 0) (2, 0.4) (3, 1) (4, 0.8)\} \)

Determine the implication relations

(i) IF \( x \) is \( \widetilde{A} \) THEN \( y \) is \( \widetilde{B} \)

(ii) IF \( x \) is \( \widetilde{A} \) THEN \( y \) is \( \widetilde{B} \)
ELSE \( y \) is \( \widetilde{C} \)

(c) (i) Present the model of an artificial neuron with
hard limit function as threshold function.

(ii) Verify the output of logical AND function by
a single perceptron using initial weights

\[
W = \begin{bmatrix} 1 \\ 1 \end{bmatrix}
\]

and bias, \( b = -2 \).
2. Answer any one of the following: 4 \times 1

(a) Outline the Roulette-Wheel selection process along with the algorithm. 4

(b) Explain the one point and two point crossover for binary cross-over process with examples.

Outline the advantages and disadvantages, if any, of GA. 2 + 2

[ Internal Assessment : 5 Marks ]