**M. E (ICE), 1st Year 2nd Semester, End-Semester Examination 2012**

***Subject: Soft Computing Techniques (ICE-1004)***

**Full Marks: 70** **Duration: 3 Hours**

***Answer any five questions by taking at least one from each group***

## Group – A

**Q. 1** **4+2+8**

a) Assume the neural network with a single bipolar binary neuron having the initial weight vector $w_0 = [1, -1, 0, 0.5]^T$, and two input vectors $x_1 = [1, -2, 1.5, 0]^T$ and $x_2 = [1, -0.5, -2, -1.5]^T$. The network needs to be trained with a learning rate constant $\eta=1$. The activation function is defined as

$$f(net) = \begin{cases} +1 & net > 0 \\ -1 & net \le 0 \end{cases}$$

What will be the weight vector after first iteration of Hebbian learning?

b) What are the advantages of using multilayer perceptron than single layer perceptron?

c) Explain briefly the back-propagation learning algorithm.

**Q. 2** **7+7**

a) Train a single-layer perceptron for binary to decimal conversion considering the following training patterns as (100, 4), (101, 5), (110, 6). Patterns are in the form of (*binary bits, equivalent decimal value*).

b) Prove perceptron convergence theorem.

**Q. 3** **(2+3+3)+3+3**

a) Consider the following Orthonormal sets of key patterns, applied to a correlation matrix memory:

$x_1=[1, 0, 0, 0]^T$
$x_2=[0, 1, 0, 0]^T$
$x_3=[0, 0, 1, 0]^T$.

The respective stored patterns are $y_1=[5$ [illegible] $0]^T$, $y_2=[-2, 1, 6]^T$, $y_3=[-2, 4, 3]^T$

i) Calculate the memory matrix **M**

ii) Show that memory associates perfectly.

iii) The stimulus applied to the memory is a noisy version of the key pattern x1, as $x=[0.8, -0.15, 0.15, -0.20]^T$. Calculate the memory response **y**. Show that the response y is closest to the

b) Briefly explain about the Competitive learning mechanism.

c) Is the delta rule a supervised training method? Explain.

## Group – B

**Q. 4** **6+8**

a) The assignment model as discussed in different text books of Operation research, can be written as: "*Given N men and N machines, we have to assign each single machine to a single man in such a manner that the overall cost of assignment is minimized.*" To model this problem using GA select an efficient encoding mechanism by justification and show how you can encode the chromosome with example.

b) Consider the problem of maximizing the function $f(x) = x^2$, where $x$ is between 0 and 31. Code $x$ as a binary string. Simulate a *single generation* of GA with reproduction, crossover and mutation. Assume the initial population contains only 4 chromosomes having $x$ values 9, 24, 4 and 19 respectively. Use Roulette-Wheel selection mechanism to select the chromosomes for reproduction process. Assume also the crossover and mutation probability is 1.0 and 0.001 respectively. Repeat the same process with rank selection mechanism and obtain the best results for both cases.

**Q. 5** **3+ 5+6**

a) Define population diversity and selective pressure. How they affect the algorithm?

b) Discuss different crossover operations with example.

c) Explain the effect of selection, crossover and mutation in evolutionary computation. What happens if you use a relatively high rate of mutation? What is a possible problem that might occur in an algorithm that uses elitism?

## Group – C

**Q. 6** **6+8**

a) Let the function $f$ map ordered pairs from $U_1$={a,b,c} and $U_2$={x,y,z} to V={p,q,r}. Let the function $f$ be specified by a mapping matrix as follows: $U_1 \times U_2 = \begin{bmatrix} r & r & p \\ p & q & q \\ q & r & p \end{bmatrix}$

From the elements of the mapping matrix $f$, we can identify the mapping function that results in the elements of the mapping matrix. Let $A_1$ and $A_2$ be fuzzy sets defined on $U_1$ and $U_2$, respectively, $A_1$=0.2/a+0.6/b+0.8/c and $A_2$=0.5/x+1/y+0.3/z.

b) Let X= {$x_1$, $x_2$, $x_3$, $x_4$}. Consider the resemblance relation R(X, X) is

$$R(X,X) = \begin{bmatrix} 1 & 0.6 & 0.3 & 0.3 & 0.7 \\ 0.6 & 1 & 0.3 & 0.3 & 0.9 \\ 0.3 & 0.3 & 1 & 0.3 & 0.3 \\ 0.3 & 0.3 & 0.3 & 1 & 0.7 \\ 0.7 & 0.9 & 03 & 0.7 & 1 \end{bmatrix}$$

Define resemblance class and find the α-cover of X and then draw the partition tree.

**Q. 7** **5+4+5**

a) Given are two fuzzy sets A and B whose membership functions are A=0.2/x1+0.8/x2+1/x3 and B=0.5/y1+0.8/y2+0.6/y3. Determine R such that $A \circ R = B$.

b) Given U={0, 0.1, 0.2, …, 1} and the term set {A, B, C} of the linguistic variable "truth", where A="True" = 0.7/0.8 + 1/ 0.9 + 1/1, B= "More or Less True" = 0.5/0.6 + 0.7 / 0.7 + 1/0.8 + 1/0.9 + 1/1 and C= "Almost True" = 0.6/0.8 + 1/0.9 + 0.6/1. Find the linguistic approximation in terms of the closeness with the fuzzy set D defined by D=0.6/0.8 + 1/0.9 + 1/1 and determine which of the sets among A, B and C is closest to D.

c) Explain the fuzzy extension of the Inference rules with example.

**Q. 8** **7+7**

a) Given the following rule: IF resistance is EXCESSIVE THEN current-flow is SIGNIFICANT. Also given the relation matrix R (resistance, current) = $\begin{bmatrix} 0.8 & 0.7 & 0.9 \\ 0.6 & 0.4 & 0.3 \\ 0.2 & 0.5 & 0.1 \end{bmatrix}$. Resistance set is on {10K, 50K, 100K} and Current set is on {150mA, 50mA, 10mA}.

Suppose the membership distribution of very-excessive = 0.7/10 + 0.8/50 + 0.9/100. Determine the membership distribution of very insignificant current flow through the device under test.

b) Use Center of Sum (COS) method to obtain defuzzified value for the two overlapped fuzzy sets A and B represented in graphical form.