Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH(ECE-OLD)/SEM-2/MCE-204B/2012

2012

ARTIFICIAL INTELLIGENCE & SOFT COMPUTING

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer Q. No. 1 and any *four* from the rest. 5 × 14 = 70

1. i) How will you measure the distance between two sets ? 2

ii) Determine the truth value of the following propositions P_1 and P_2.

P_1 = "P is very true"

P_2 = "P is false"

where P = "30 is high", the truth value of P is 0·3, $\mu_{\text{very true}} = (\mu_{\text{true}})^2$ 3

iii) Give an example of fuzzy Modus Ponens. How it differs from the classification Modus Ponens ? 2 + 1

iv) Represent the functions $\frac{xy}{3}$ and $3x + \frac{y^2}{5}$ are tree structures. 3

v) Select a suitable crossover point to produce the children $\frac{x}{3}$ and $3xy+\frac{y^2}{5}$ from the parents $\frac{xy}{3}$ and $3xy+\frac{y^2}{5}$. 3

2. a) Consider the fuzzy sets : short, middle and tall, the membership values of which are represented in the following table :

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

i) Compare the support of each set.

ii) What is the normalized fuzzy set ?

iii) Find the level set of each set.

iv) Compare α-cut set of each set where $\alpha = 0 \cdot 5$ and $\alpha = 0 \cdot 3$. 4 × 2½

b) Define fuzzy subsets. Show that this concept generalizes the concept of crisp subsets. 1 + 3

3. a) Prove that the standard fuzzy intersection is the upper bond of any fuzzy intersection. 6

b) Prove that the standard fuzzy intersection is the only idempotent *t*-norm. 8

4. a) State De Luca and Termini axioms which capture our intuitive comprehension of the degree of fuzziness. Define the measure of fuzziness based on the concept of metric distance. 3 + 3

b) There is a fuzzy set A defined on the universal set

$X = \{a, b, c, d\}$

$A = \{(a, 0\cdot5), (b, 0\cdot2), (c, 0\cdot8), (d, 0\cdot1)\}$

Find the fuzziness of the set A by using the concept of Shannon's entropy. 4

c) There is a fuzzy set

$A = \{(1, 0\cdot4), (2, 0\cdot8), (3, 0\cdot4), (4, 0\cdot1)\}$

i) Find the fuzziness of A using Hamming distance

ii) Find the fuzziness of A using Euclidean distance. 4

5. Use the method of hierarchical clustering to cluster the U.S. cities based on their distances in miles between them. Use single-link method to compute the distances between clusters. The distances are given in the following table :

	BOS	NY	DC	MIA	CHI	SEA	SF	LA	DEN
BOS	0	206	429	1504	963	2976	3095	2979	1949
NY	206	0	233	1308	802	2815	2934	2786	1771
DC	429	233	0	1075	671	2684	2799	2631	1616
MIA	1504	1308	1075	0	1329	3273	3053	2687	2037
CHI	963	802	671	1329	0	2013	2142	2054	996
SEA	2976	2815	2684	3273	2013	0	808	1131	1307
SF	3095	2934	2799	3053	2142	808	0	379	1235
LA	2979	2786	2631	2687	2054	1131	379	0	1059
DEN	1949	1771	1616	2037	996	1307	1235	1059	0

6. How will you estimate an unknown probability distribution from a given dataset ? Mention the Histogram method, Adaptive Histogram method, Kernel Density Estimators and Adaptive Kernel Density Estimators for the same with their advantages and disadvantages.

7. Consider the two dimensional function $f(x, y) = x^2 + y^2$. Start with a population of 5 candidate solutions randomly initiation in the range (–10, 10) and apply the Differential Evolution algorithm to evolve the population to the next generation.

8. A factory process control operation involves two linguistic parameters consisting of pressure and temperature in a fluid delivery system. Nominal pressure limits range from 400 psi minimum to 1000 psi maximum. Nominal temperature limits are 130°F and 140° F. We characterise each parameter in fuzzy linguistic terms as follows :

"Low temperature" = $\left\{\frac{1}{131} + \frac{0\cdot8}{132} + \frac{0\cdot6}{133} + \frac{0\cdot4}{134} + \frac{0\cdot2}{135} + \frac{0}{136}\right\}$

"High temperature" = $\left\{\frac{0}{134} + \frac{0\cdot2}{135} + \frac{0\cdot4}{136} + \frac{0\cdot6}{137} + \frac{0\cdot8}{138} + \frac{1}{139}\right\}$

"High pressure" = $\left\{\frac{0}{400} + \frac{0\cdot2}{600} + \frac{0\cdot4}{700} + \frac{0\cdot6}{800} + \frac{0\cdot8}{900} + \frac{1}{1000}\right\}$

"Low pressure" = $\left\{\frac{1}{400} + \frac{0\cdot8}{600} + \frac{0\cdot6}{700} + \frac{0\cdot4}{800} + \frac{0\cdot2}{900} + \frac{0}{1000}\right\}$

a) Find the following membership functions :
   i) Temperature not very low
   ii) Temperature not very high
   iii) Temperature not very low and not very high.

b) Find the following membership functions :
   i) Pressure slightly high
   ii) Pressure fairly high
   iii) Pressure not very low and fairly low.

==========