Code No: NR421401 **Set No.1**

IV B.Tech. I Semester Regular Examinations, April/May -2005
NEURAL NETWORKS & FUZZY LOGIC CONTROL
(Mechatronics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is the significance of momentum term in back propagation learning.
   (b) Why convergence is not guaranteed for the back propagation-learning algorithm.
2. Construct an energy function for a continuous Hopfield neural network of size $N \times N$ neurons. Show that the energy function decreases every time the neuron output is changed.
3. (a) Explain Kohenen self organizing maps with example.
   (b) Explain with neat block diagram ART network architecture.
4. (a) What are major issues arise in plant inverse identification. Explain.
   (b) Explain the neural network configuration for plant inverse identification.
5. Let X = { 1, 2, 3, . . . , 10}. Determine the cardinalities and relative cardinalities of the following fuzzy sets.
   (a) $\tilde{A} = \{(3, 10, (4, 0.2), (5, 0.3), (6, 0.4), (7, 0.6), (8, 0.8), (10, 1), (12, 0.8), (14, 0.6)\}$.
   (b) $\tilde{B} = \{(2, 0.4), (3, 0.6), (4, 0.8), (5, 1.0), (6, 0.8), (7, 0.6), (8, 0.4)\}$
   (c) $\tilde{C} = \{(2, 0.4), (4, 0.8), (5, 1.0), (7, 0.6)\}$
6. List the main components of fuzzy logic controller. Explain each of them in detail.
7. (a) Compare and contrast fuzzy logic control and classical control system.
   (b) Summarize in a point form the design steps of fuzzy logic control.
8. Design a fuzzy controller for a temperature control system of a room. Assume your own control actions due to which the temperature of the room may vary. Design in fuzzy rule-based system to keep the room at a comfortable temperature.

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Code No: NR421401 **Set No.2**

IV B.Tech. I Semester Regular Examinations, April/May -2005
NEURAL NETWORKS & FUZZY LOGIC CONTROL
(Mechatronics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. What is backpropagation?. Derive its learning algorithm with a schematic two-layer feedforward neural network.

2. Construct an energy function for a discrete Hopfield neural network of size $N \times N$ neurons. Show that the energy function decreases every time the neuron output is changed.

3. Explain architecture of Konen's self-organizing network. Explain the training algorithm of Kohonen's layer.

4. Explain the procedure of identification of dynamical system using neural networks.

5. (a) Consider the following matrix defining a fuzzy relation $\tilde{R}$ on $\tilde{A} \times \tilde{B}$

	y_1	y_2	y_3	y_4	y_5
x_1	.5	0	1	.9	.9
$\tilde{R} : x_2$	.1	.4	.5	.3	.1
x_3	.7	.8	0	.2	.6
x_4	.1	.3	.7	1	0

Give the first and the second projection with $\mu_{\overline{R}(1)}(x)$ and $\mu_{\overline{R}(2)}(y)$ and the cylindrical extensions of the projection relations with $\mu_{\overline{R}(1)L}$ and $\mu_{\overline{R}(2)L}$

(b) Explain the properties of the Min-Max Composition.

6. What are the main components of fuzzy logic controller? Explain each of them in detail.

7. Explain the step-by-step procedure in designing of a fuzzy logic controller.

8. A dynamical system is represented by $y^1 + (1/\tau)y = Ax(t)$

(a) Discretize the systems mathematical model into the form of a difference equation, i.e $y_{n+1} = f(x_n, y_n)$

(b) For A = 10.0, T = 0.1, and a sampling interval t = 0.01, design a fuzzy rule-based system that gives values of y_{n+1} and x_n for a given value of y_n. Assume that x_n is varying over an interval between 0 and 1.

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Code No: NR421401 **Set No.3**

IV B.Tech. I Semester Regular Examinations, April/May -2005
NEURAL NETWORKS & FUZZY LOGIC CONTROL
(Mechatronics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Give the brief operation of biological neural network.
   (b) Explain how biological neural network is superior over a conventional computer system.
2. (a) Explain the Hopfield network algorithm and its limitations.
   (b) Explain the Energy analysis of Discrete Hopfield Network.
3. (a) Explain Kohenen self organizing maps with example.
   (b) Explain with neat block diagram ART network architecture.
4. Define the problem of control of dynamical system and explain how to achieve them through neural networks.
5. (a) Determine all possible α- level sets and all strong -level for the following fuzzy sets:
      i. $\tilde{\mathrm{A}} = (3, 10, (4, 0.2), (5, 0.3), (6, 0.4), (7, 0.6), (8, 0.8), (10, 1), (12, 0.8), (14, 0.6)$.
      ii. $\tilde{\mathrm{B}} = \{(x, \mu_B(x) = ((1 + (x - 10)^2)^{-1}\}$ for $\alpha = 0.3, 0.5, 0.8$
      iii. $\tilde{\mathrm{C}} = \{(\mathrm{x}, \mu_{\tilde{\mathrm{C}}}(\mathrm{x}) | \mathrm{x} \in \mathrm{R}\}$ where $\mu_{\tilde{\mathrm{C}}}(\mathrm{x}) = 0 for x \leq 10$
      $\mu_{\tilde{\mathrm{C}}}(\mathrm{x}) = (1 + (\mathrm{x} - 10)^{-2})^{-1}$ for $x > 10$
   (b) Explain some basic set theoretic operations for Fuzzy sets.
6. (a) State the major implicit assumptions in a fuzzy control system design.
   (b) Explain the Inference mechanism.
7. Explain the step-by-step procedure in designing of a fuzzy logic controller.
8. (a) In reference to car speeds we have the linguistic variables "fast" and "slow" for speed.

   $$\text{Fast} = \left\{\frac{0}{0} + \frac{0.1}{10} + \frac{.2}{20} + \frac{.3}{30} + \frac{.4}{40} + \frac{.5}{50} + \frac{.6}{60} + \frac{.7}{70} + \frac{.8}{80} + \frac{.9}{90} + \frac{1}{100}\right\}$$

   $$\text{Slow} = \left\{\frac{1}{0} + \frac{0.9}{10} + \frac{.8}{20} + \frac{.7}{30} + \frac{.6}{40} + \frac{.5}{50} + \frac{.4}{60} + \frac{.3}{70} + \frac{.2}{80} + \frac{.1}{90} + \frac{0}{100}\right\}$$

   Using these variables, compute the membership function for the following linguistic terms
      i. Very fast
      ii. Very, very fast

iii. Highly fast (= minus very, very fast)
iv. Plus very fast
v. Fairly fast
vi. Not very slow and not very fast
vii. Slow or not very slow

(b) The following raw data were determined in a pair wise comparison of new premium car preferences in a poll of 100 people. When it was compared with a Porsche (P), 79 of those polled preferred a BMW (B), 85 preferred a Mercedes (M), 59 preferred a Lexus (L) and 67 preferred an Infinity (I). When a BMW was compared, the preferences were 21-P 23-M, 37-L and 45-I. When a Mercedes was compared, the preferences were 15-P, 77-B, 35-L and 48-I. When a Lexus was compared, the preferences were 41-P, 63-B, 65-M and 51-1. Finally, when an Infinity was an Infinity was compared, the preferences were 33-P, 55-B, 52-M and 49-L. using rank ordering, plot the membership function for "most preferred car".

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Code No: NR421401 **Set No.4**

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(Mechatronics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. With suitable diagram, derive the weight update equations in backpropagation algorithm for a multilayer feedforward neural network and explain the effect of learning rate, and momentum terms in weight update equations.

2. (a) Explain the Hopfield network algorithm and its limitations.
   (b) Explain the Energy analysis of Discrete Hopfield Network.

3. (a) Explain the architecture of self-organizing map network.
   (b) Explain the training algorithm of Kohonen's layer training algorithm.

4. Explain the procedure of identification of dynamical system using neural networks.

5. (a) Consider the following matrix defining a fuzzy relation $\tilde{R}$ on $\tilde{A} \times \tilde{B}$

	y_1	y_2	y_3	y_4	y_5
x_1	.5	0	1	.9	.9
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x_3	.7	.8	0	.2	.6
x_4	.1	.3	.7	1	0

   Give the first and the second projection with $\mu_{\overline{R}(1)}(x)$ and $\mu_{\overline{R}(2)}(y)$ and the cylindrical extensions of the projection relations with $\mu_{\overline{R}(1)L}$ and $\mu_{\overline{R}(2)L}$
   (b) Explain the properties of the Min-Max Composition.

6. Draw a block diagram of a possible fuzzy logic control system. Explain about each block.

7. (a) Compare and contrast fuzzy logic control and classical control system.
   (b) Summarize in a point form the design steps of fuzzy logic control.

8. Design and develop a pressure process control by FLC model. Formulate necessary membership functions and required fuzzy rules for the application.

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