Code No: RR411301 **Set No.1**

IV B.Tech. I Semester Regular Examinations, November -2005
NEURAL NETWORKS & FUZZY LOGIC CONTROL
(Common to Electronics & Control Engineering and Instrumentation & Control Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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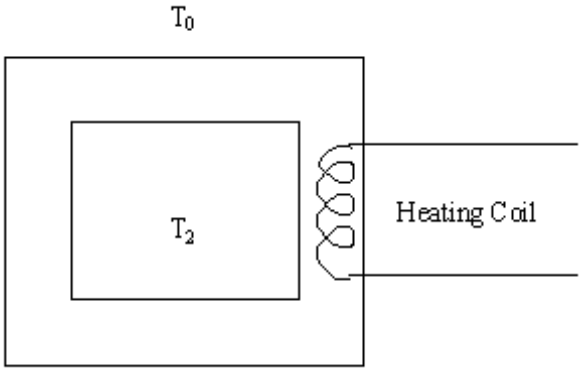
1. (a) Give the brief operation of biological neural network.
   (b) Explain how biological neural network is superior over a conventional computer system. [8+8]
2. (a) Explain the Hopfield network algorithm and its limitations.
   (b) Explain the Energy analysis of Discrete Hopfield Network. [8+8]
3. (a) Explain Kohenen self organizing maps with an example.
   (b) Explain with neat block diagram the ART network architecture. [8+8]
4. Define the problem of process identification. What are the possible neural network configurations for plant identification? Explain each of them. [16]
5. (a) Let $A = \{\alpha_1, \alpha_2\}$, B = $\{\beta_1,\beta_2\}$andC = $\{\gamma_1,\gamma_2,\gamma_3\}$ The relation R from A to B is given by $R = 0.1/(\alpha_1,\beta_1)+0.2/(\alpha_1,\beta_2)+0.4/(\alpha_2,\beta_2)$, and relation S from B to C is given by $S = 0.2/(\beta_1,\gamma_1)+0.4/(\alpha_1,\beta_2)+0.2/(\beta_2,\gamma_1)+0.8/(\beta_1,\gamma_2)+0.1/(\beta_2,\gamma_3)$. Construct a fuzzy arrow diagram to show the relations S and R.
   (b) Give possible reasons for triangular membership functions being used, particularly when the height of intersection of each two successive fuzzy sets is equal to one-half. [8+8]
6. Write short notes on the following.
   (a) Fuzzification interface.
   (b) Knowledge base in fuzzy logic controller. [8+8]
7. Explain the step-by-step procedure in designing of a fuzzy logic controller. [16]
8. The interior temperature of an electrically heated oven is to be controlled by varying the heat input, u, to the jacket. The oven is shown in fig. below. Let the heat capacities of the oven interior and of the jacket be c_1 and c_2, respectively. Let the interior and the exterior jacket surface areas be a_1 and a_2, respectively. Let the radiation coefficients of the interior and exterior jacket surfaces be r_1 and r_2, respectively. Assume that there is uniform and instantaneous distribution of temperature throughout, and the rate of loss of heat is proportional to area and the excess of temperature over that of the surroundings. If the external temperature is T_0, the jacket temperature is T_1, and the oven interior temperature is T_2, then we

have

$c_1 \dot{T}_1 = - a_2 r_2 (T_1 - T_0) - a_1 r_1 (T_1 - T_2) + u$

$c_2 \dot{T}_2 = a_1 r_1 (T_1 - T_2)$



Formulate the FAM table using the initial conditions of $x_1(0) = 80^O$, and $x_2(0) = 85^O$. [16]

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Code No: RR411301 **Set No.2**

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Give the brief operation of biological neural network.
   (b) Explain how biological neural network is superior over a conventional computer system. [8+8]
2. (a) Explain the Hopfield network algorithm and its limitations.
   (b) Explain the Energy analysis of Discrete Hopfield Network. [8+8]
3. (a) Explain ART network algorithm.
   (b) Explain the following terms with respect to Neural networks.
      i. Stability
      ii. Plasticity
      iii. Learning
      iv. Architecture. [8+8]
4. (a) What are the major issues arise in plant inverse identification. Explain.
   (b) Explain the neural network configuration for plant inverse identification. [8+8]
5. (a) Given that A=0.2/3 + 0.5/4 + 0.8/5 and B=0.3/3 + 0.2/4 + 0.7/5 + 0.6/6, determine the algebraic product of the two sets.
   (b) Discuss the reflexivity properties of the following fuzzy relation:

$\tilde{R}$	X_1	X_2	X_3
X_1	1	.7	.3
X_2	.4	.5	.8
X_3	.7	.5	1

   [8+8]
6. Write short notes on the following
   (a) Knowledge base in fuzzy logic control system.
   (b) Decision making logic in fuzzy logic control system. [8+8]
7. Explain the step-by-step procedure in designing of a fuzzy logic controller. [16]

8. A printer drum is driven by a brushless DC motor. The moment of inertia of the drum is $J = 0.00185kg.m^2$. The motor resistance is $R = 1.12\Omega$. The torque constant for the motor is $K_T = 0.0363Nm/A$. The back EMF constant is k = 0.0363 V/(rad/s). The equation of the system is
   $j\,\theta = \frac{K_T(V-\theta\ k)}{R}$
   where $= \frac{(V-\theta\ k)}{R}$ = I = motor current
   $\theta = rotational\ angle$
   $V = motorcontrol\ voltage$
   Using the initial conditions of $x_1 = 7.5^o$ and $x^2 = 150rad/s$ and forming the difference equations, design the fuzzy controller. [16]

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Code No: RR411301 **Set No.3**

IV B.Tech. I Semester Regular Examinations, November -2005
NEURAL NETWORKS & FUZZY LOGIC CONTROL
(Common to Electronics & Control Engineering and Instrumentation & Control Engineering)

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. [8+8]

2. What are the modes of operation of a Hopfield network?. Explain the algorithm for storage of information in a Hopfield network. Similarly explain the recall algorithm. [16]

3. Explain architecture of Konens self-organizing network. Explain the training algorithm of Kohonens layer. [16]

4. (a) What are the major issues arise in plant inverse identification. Explain.
   (b) Explain the neural network configuration for plant inverse identification.[8+8]

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. [10+6]

6. List the main components of fuzzy logic controller. Explain each of them in detail. [16]

7. Explain the step-by-step procedure in designing of a fuzzy logic controller. [16]

8. A dynamical system is represented by $y^1 + (1/\tau)y = Ax(t)$
   (a) Discretize the system's 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. [8+8]

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Code No: RR411301 **Set No.4**

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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. [8+8]

2. A Hopfield network is designed to store the two fundamental memory patterns (+1, +1, -1, +1, +1) and (+1, -1, +1, -1, +1). The synaptic matrix of the network is given by

$$W = \begin{bmatrix} 0 & 0 & 0 & 0 & 2 \\ 0 & 0 & -2 & 2 & 0 \\ 0 & -2 & 0 & -2 & 0 \\ 0 & 2 & -2 & 0 & 0 \\ 2 & 0 & 0 & 0 & 0 \end{bmatrix}$$

   (a) The sum of the eigen values of the matrix W is zero. Why?
   (b) The state space of the network is a subspace of R^5. Specify the configuration of this subspace. [8+8]

3. (a) Explain Kohenen self organizing maps with an example.
   (b) Explain with neat block diagram the ART network architecture. [8+8]

4. Explain the procedure for identification of dynamical system using neural networks. [16]

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+5+5]

6. Write short notes on the following.
   (a) Fuzzification interface.
   (b) Knowledge base in fuzzy logic controller. [8+8]

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+8]

8. Given the discretized form of the fuzzy variables X, Y, Z_1, Z_2, Z_3.

$$X = \left\{\frac{0}{0} + \frac{.5}{1} + \frac{1}{2} + \frac{.5}{3} + \frac{0}{4}\right\}$$
$$Y = \left\{\frac{0}{2} + \frac{.5}{3} + \frac{1}{4} + \frac{.5}{5} + \frac{0}{6}\right\}$$
$$Z_1 = \left\{\frac{0}{5} + \frac{.5}{6} + \frac{1}{7} + \frac{.5}{8} + \frac{0}{9}\right\}$$
$$Z_2 = \left\{\frac{0}{10} + \frac{.5}{11} + \frac{1}{12} + \frac{.5}{13} + \frac{0}{14}\right\}$$
$$Z_3 = \left\{\frac{0}{20} + \frac{.5}{21} + \frac{1}{22} + \frac{.5}{23} + \frac{0}{24}\right\}$$

(a) Form analogous continuous membership functions for X, Y, Z_1, Z_2, and Z_3.

(b) A system is described by a set of three rules, using the foregoing fuzzy variables. All the rules have to be satisfied simultaneously for the system to work. The rules are these:

i. If X and Y then Z_1,

ii. If X and Y then Z_2,

iii. If X and Y then Z_3,
Determine the output of the system by graphical inference, using the max-min technique, if x = 3 and y = 4, use the centroid method for defuzzification.

(c) What would be the output of the system if, for the system to work, either of the rules just described may be satisfied. [6+6+4]

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