Reg. No. | | | | | | | | | |

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
END SEMESTER EXAMINATIONS, NOVEMBER 2019

SOFT COMPUTING [ELE 4026]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 21, November 2019** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Graph sheet shall be supplied if necessary.
- Missing data may be suitably assumed.

1A. A bipolar sigmoidal neural network has the initial weight vector $W^{(0)} = [1\ -1\ 0\ 0.5]^t$.

Two sets of training inputs and respective desired response are as given below:

$X_1 = [1\ -2\ 0\ -1]^t$, $X_2 = [\ 0\ 1.5\ -0.5\ -1]^t$, $d_1 = -1$ and $d_2 = 0.5$.

Using delta learning rule obtain new vector $W^{(1)}$ after one iteration. Assume learning constant $c = 1.5$ and function constant $\lambda = 1.2$. ***(04)***

1B. Design a discrete bipolar neural network to perform the following classification:

Class A – $X_1 = (-0.5, 2)$ $X_2 = (2, -1)$ output $d_A = -1$

Class B – $X_3 = (2, 0.5)$ $X_4 = (-0.5, -1)$ output $d_B = 1$ ***(03)***

1C. State with reasons whether the statements given below are correct or not. If not, write possible correct statement.

(i) If energy level of a Hopfield network is positive, it is unstable state.

(ii) Unipolar signum activation function is a special case of sigmoidal activation functions, if $\lambda = 1$.

(iii) Delta learning rule is not applicable for discrete neural network. ***(03)***

2A. Design and draw the schematic of a Hopfield network to store the following bit patterns:

$S_1 = [1\ -1\ 1\ -1]^t$ $S_2 = [\ -1\ 1\ -1\ 1]^t$ and $S_3 = [-1\ -1\ 1\ 1]^t$.

Obtain the stored pattern of the above network at the end of one iteration when an arbitrary input $[-1\ 1\ 1\ 1]^t$ is initially applied to the network using energy function concept in asynchronous mode. ***(04)***

2B. Design a discrete neural network such that any point INSIDE the triangle is the solution for the pattern shown in **Fig. Q2B**. Draw complete neural network required. ***(06)***

3A. Define the following terms used in fuzzy system:
(i) support (ii) alpha-cut (iii) convex ***(03)***

3B. Three output fuzzy sets are defined as given below in a universe of discourse X [0:9]:
A = trapezoidal (1, 3, 4, 6), B = triangular (3, 5, 7) and C = triangular (5, 7, 9)
The truncation levels of A, B and C are 0.6, 0.25 and 0.25 respectively during fuzzy rule implication. Determine the crisp output by centroid method. ***(04)***

3C. Relations R1 and R2 are as shown below:

$$R_1 = \begin{bmatrix} 0.2 & 0.3 & 0.5 & 0.8 & 0.9 & 0.1 \\ 0.4 & 0.8 & 1.0 & 0.7 & 0.5 & 0.3 \\ 0.9 & 0.4 & 0.5 & 0.8 & 0.1 & 0.6 \\ 0.3 & 0.6 & 0.9 & 0.8 & 0.5 & 0.2 \end{bmatrix} \qquad R_2 = \begin{bmatrix} 0.7 & 0.8 & 1.0 & 0.15 \\ 0.1 & 0.6 & 0.2 & 0.3 \\ 0.6 & 0.4 & 0.8 & 0.5 \\ 0.4 & 0.67 & 0.2 & 0.0 \\ 0.5 & 0.2 & 0.7 & 0.4 \\ 0.3 & 0.7 & 0.4 & 0.1 \end{bmatrix}$$

Obtain the composition Q = R_1 **o** R_2 by Mamdani max-min operation. ***(03)***

4A. Two linguistic variables A and B are defined as given below:

$$A = \left\{\frac{0.5}{10} + \frac{0.6}{20} + \frac{0.2}{30}\right\} \qquad B = \left\{\frac{0.75}{100} + \frac{0.9}{200}\right\}$$

and $\overline{\mathbf{B}}$ = YAGER compliment of B with $\omega = 1.5$

Given fuzzy inference,

Y is $\overline{\mathbf{B}}$

IF X is **A** *THEN* Y is **B**

X is $\overline{\mathbf{A}}$

Find (i) unary fuzzy set $\overline{\mathbf{A}}$ using (a) Dieness-Rescher implication (b) Zadeh implication

(ii) Crisp value of $\overline{\mathbf{A}}$ using weighted average method in each implication ***(04)***

4B. A fuzzy controller is to be designed for a washing machine. For a given weight of cloths and amount of dirt on cloths, the quantity of water required is to be determined. The universe of discourse are WEIGHT [0:5] in Kg, DIRT [0:1] in per unit and WATER [0: 10] in litre. The design shall include

(i) Linguistic values and respective equation for triangular membership functions for all linguistic variables considered

(ii) List of IF-THEN rules required

Calculate crisp value of quantity of water for a sample input of 3.5 Kg of cloth and 25% dirt using mean of maximum method of defuzzification. ***(06)***

5A. Explain the terms with relevant illustrations as applied in Genetic Algorithm:

(i) Fitness (ii) Crossover ***(04)***

5B. Using Genetic Algorithm, the function f(x, y) = $1.5x^2 - 3xy$ with boundary conditions of $6 \leq x \leq 10$ and $-1 \leq y \leq 5$ is to be optimized. Obtain ranking, crossover, mutation and replacement for the first iteration. Use a population size of 4 and 5-bit binary string representation of chromosome. ***(06)***

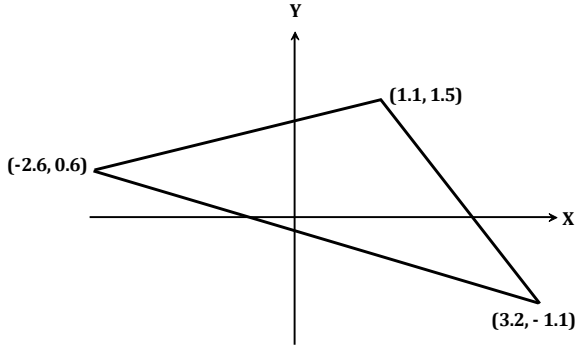

Fig. Q2B