

(Time: $2\frac{1}{2}$ hours)

[Total Marks: 60]

- N. B.: (1) All questions are compulsory.
 (2) Make suitable assumptions wherever necessary and state the assumptions made.
 (3) Answers to the same question must be written together.
 (4) Numbers to the right indicate marks.
 (5) Draw neat labeled diagrams wherever necessary.
 (6) Use of Non-programmable calculator is allowed.

1. Attempt any two of the following:

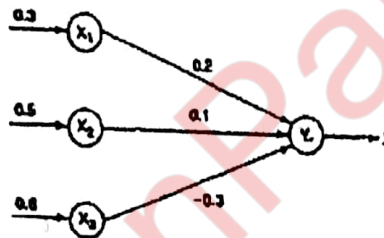
- What is soft computing? State its applications.
- Give comparison between soft and hard computing.
- Explain the structure of neural network with suitable model.
- What is probabilistic reasoning? Explain.

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2. Attempt any two of the following:

- Explain perceptron learning rule with suitable example.
- List and explain different activation functions in neural networks.
- For the given network calculate the output y neuron, for given inputs and weights.
 $[x_1, x_2, x_3] = [0.3, 0.5, 0.6]$ $[w_1, w_2, w_3] = [0.2, 0.1, -0.3]$

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- Explain training and testing algorithm for auto associative neural net.
3. Attempt any two of the following:
- Explain the mechanism for Kohonen self-organizing maps.
 - Give the outline of Adaptive Resonance Theory I algorithm.
 - Construct a Max net with four neurons and inhibitory weights $E=0.25$ when given the initial activations. The initial activations are $a_1(0)=0.1$, $a_2(0)=0.3$, $a_3(0)=0.4$, $a_4(0)=0.7$.
 - Explain the Boltzman machine.

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4. Attempt any two of the following:

- Explain classical sets and fuzzy sets with an example.
- Discuss in detail the operations and properties of fuzzy sets.
- The elements in two sets A and B are given as $\{2,4\}$ and $\{a,b,c\}$. Find the various Cartesian products of these two sets.
- Explain tolerance and equivalence relation with suitable example.

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5. Attempt any two of the following:

- List and explain basic logic operations over the propositions.
- What are four modes of approximate reasoning? Explain.
- Give the outline of genetic algorithm.
- Explain in detail about various operators involved in genetic algorithm.

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Max

Instructions:

- 1) All Questions have equal weightage.
- 2) Scientific calculator is allowed.
- 3) Draw proper diagram and figure to describe your answers.

- Q.1 Attempt any two questions.
- A Describe the working of Biological neural network. 6
- B Distinguished between Soft computing and Hard computing. 6
- C Write a short note on Fuzzy logic. 6
- D Compare the human Brain vs. Computer with justification. 6
- Q.2 Attempt any two questions.
- A List and explain various types of activation function with example. 6
- B Using the linear separability concepts, obtain the response for OR function. (take bipolar inputs and bipolar targets) 6
- C Describe about the perceptron learning along with perceptron learning algorithm. 6
- D From mathematical point of view, what is the process of learning in supervised learning? Draw the flow chart of Back-propagation learning 6
- Q.3 Attempt any two questions.
- A Differentiate between Auto associative and Hetero associative networks. 6
- B Write a short note on ART neural network. 6
- C Construct and test an LVQ net with five vectors assigned to two classes. 6
- The given vectors along with the classes are as shown in table.

| Vectors | Class |
|-----------|-------|
| [0 0 1 1] | 1 |
| [1 0 0 0] | 2 |
| [0 0 0 1] | 2 |
| [1 1 0 0] | 1 |
| [0 1 1 0] | 1 |

- D What is winner takes all or clustering principle or competitive learning? 6
- Q.4 Attempt any two questions.
- A What is Fuzzy set? Explain about various operation related to Fuzzy sets. 6
- B For the two given fuzzy sets 6
- $$A = \{(0,0.1), (1,0.2), (2,0.4), (3,0.6), (4,1)\}$$
- $$B = \{(0,1), (1,0.5), (2,0.7), (3,0.3), (4,0)\}$$
- Find the following (a) $B \cup \bar{A}$ (b) $\bar{A} \cup B$ (c) $B \cup \bar{B}$
- C Consider the following two Fuzzy sets: 6
- $$A = \{(x_1, 0.3), (x_2, 0.7), (x_3, 1)\}$$
- $$B = \{(y_1, 0.4), (y_2, 0.9)\}$$
- Perform the Cartesian products over these given Fuzzy sets.
- D For the Fuzzy sets given $A = \{(x_1, 0.5), (x_2, 0.2), (x_3, 0.9)\}$ 6
- $$B = \{(y_1, 1), (y_2, 0.5), (x_3, 1)\}$$
- Find relation R by performing Cartesian product over the given Fuzzy sets.

- Q.5 Attempt any two questions.
- | | | |
|---|--|---|
| A | Define membership's functions and state its importance in Fuzzy logic. | 6 |
| B | Write short note on lambda cut for Fuzzy sets. | 6 |
| C | What the various types of crossover and mutation techniques. | 6 |
| D | Describe the various methods of genetic coding methods. | 6 |

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1. Attempt any two of the following: 12
 - a. Discuss in detail on artificial neural network and binary sigmoidal activation function.
 - b. Describe genetic algorithm.
 - c. Write in detail on hard computing and soft computing.
 - d. Explain about content addressable memory.
2. Attempt any two of the following: 12
 - a. Give the details on perceptron network.
 - b. Write in detail about the tree neural networks.
 - c. Explain in detail on bidirectional associative memory.
 - d. Implement ANDNOT function using McCulloch - Pitts neuron. Consider binary data and the excitatory weight as 1 and inhibitory weight as -1.
3. Attempt any two of the following: 12
 - a. Describe adaptive resonance theory 1 (ART1).
 - b. Explain about Kohonen self-organizing feature maps.
 - c. Discuss about simulated annealing network.
 - d. Write in detail on the architecture of spiking neural networks.
4. Attempt any two of the following: 12
 - a. Explain about fuzzy equivalence and fuzzy tolerance relation in detail.
 - b. Define the following: (i) core (ii) support (iii) boundary (iv) normal fuzzy set (v) subnormal fuzzy set (vi) convex fuzzy set
 - c. What is defuzzification? List and explain any 2 methods of defuzzification.
 - d. Consider the two fuzzy sets

$$\tilde{A} = \left\{ \frac{1}{2} + \frac{0.3}{4} + \frac{0.5}{6} + \frac{0.2}{8} \right\} \quad \tilde{B} = \left\{ \frac{0.5}{2} + \frac{0.4}{4} + \frac{0.1}{6} + \frac{1}{8} \right\}$$
 Perform union, intersection, difference and complement over fuzzy sets A and B.
5. Attempt any two of the following: 12
 - a. Using a suitable example explain the single-point and two-point crossover technique.
 - b. Write in detail on categorical reasoning.
 - c. What are the classifications of neuro-fuzzy hybrid systems? Explain in detail any one of the neuro-fuzzy hybrid systems.
 - d. Explain the basic architecture of a fuzzy logic controller system in detail.

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1. Attempt any two of the following: 12
- Explain in short, about various types of soft computing techniques.
 - Define associative memory. Explain different operations that can be performed on it. Describe its types with neat diagrams.
 - Explain Adaptive Resonance Theory with its parameters and neat diagram.
 - Write various applications of soft computing.
2. Attempt any two of the following: 12
- List and explain all activation functions used in ANN.
 - Write the training algorithm / flowchart of McCulloch-Pitts neuron.
 - Explain with neat diagram Linear separability concept in detail considering a single layer network to separate the input space into regions based on positive or negative network response.
 - Which function is used by Radial basis Function network? Draw and explain its architecture.
3. Attempt any two of the following: 12
- With an architectural diagram, explain the probabilistic neural network.
 - What is Mexican hat? Draw and explain its structure.
 - Define Learning vectors quantization. Explain its architecture with neat diagram.
 - How is Convolutional Neural Networks build? What is its key advantage? How are the neurons arranged in CNN model? Explain with neat diagram
4. Attempt any two of the following: 12
- How Fuzzy relations relate elements of one universe (say X) to those of another universe (say Y)? Explain with the help of matrix representation and graphical representation.
 - Explain Fuzzy Equivalence Relation with neat diagram.
 - What are various methods of membership value assignments? Explain Angular fuzzy sets in detail.
 - How is an interval analysis obtained in fuzzy arithmetic?
5. Attempt any two of the following: 12
- Explain Fuzzy Inference Systems in detail.
 - Describe architecture and operation of Fuzzy Logic Control system.
 - Explain The schema theorem with appropriate examples.
 - Write a short note on Neuro – fuzzy hybrid.