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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
B.Tech Degree S8 (R,S) Examinations April 2026 (2019 Scheme)

Course Code: CST444
Course Name: SOFT COMPUTING

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

Marks

- 1 What are the major differences between Artificial Neurons and Biological Neurons? (3)
- 2 What are the different types of learning in neural networks? (3)
- 3 State the Perceptron Learning Rule and describe how it updates the weights. (3)
- 4 Explain the Delta Rule used in ADALINE. (3)
- 5 Given two fuzzy sets: (3)

$$\tilde{A} = \{(x_1, 0.4), (x_2, 0.7), (x_3, 0.9)\}$$

$$\tilde{B} = \{(x_1, 0.6), (x_2, 0.5), (x_3, 0.8)\}$$

Compute (a) $\tilde{A} \cup \tilde{B}$ (b) $\tilde{A} \cap \tilde{B}$.

- 6 What is the importance of support, core, and boundary in a membership function? (3)
- 7 Describe (i) Single-point crossover (ii) Two-point crossover in Genetic Algorithm. (3)
- 8 What are the common stopping conditions used in Genetic Algorithms? (3)
- 9 Explain the principles of Multi-Objective Optimization. (3)
- 10 What are the properties of Genetic-Neuro Hybrid Systems? (3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

- 11 a) Explain how weight updation occurs in Hebb Network. (4)
- b) A Hebb network is trained with the following patterns: (10)
 - $(1,1) \rightarrow 1$
 - $(-1,-1) \rightarrow 1$
 - $(1,-1) \rightarrow -1$

- $(-1,1) \rightarrow -1$

Compute the final weight vector using Hebb rule.

OR

- 12 a) Given an artificial neuron with three inputs $(X_1, X_2, X_3) = (1, -2, 0)$ and weights $(W_1, W_2, W_3) = (0.5, -1, 2)$. The weight value associated with bias input is 0.9. Compute the output using (i) binary sigmoid function (ii) bipolar sigmoid function. (7)
- b) Implement AND function using McCulloch-Pitts neuron (take binary data). (7)

Module II

- 13 a) Find the weight required to perform the following classification using perceptron network. The vectors $(1, 1, 1, 1)$ and $(-1, 1, -1, -1)$ are belonging to the class (so have target value 1), vectors $(1, 1, 1, -1)$ and $(1, -1, -1, 1)$ are not belonging to the class (so have target value -1). Assume learning rate as 1 and initial weights as 0. (10)
- b) Describe the testing algorithm employed in perceptron networks. (4)

OR

- 14 a) Draw the architecture and explain training algorithm of Back Propagation network. (8)
- b) Implement one epoch of Adaline algorithm for OR logic function with bipolar inputs and targets. Initial weights are $w_1 = w_2 = 0.1$, $b = 0.1$ and learning rate $\alpha = 0.1$. (6)

Module III

- 15 a) How does the inference-based method differ from the intuition-based method of Membership Value Assignment? (8)
- b) Determine the λ -cut sets for the given fuzzy sets: (6)

$$\tilde{X} = \frac{0}{0} + \frac{0.5}{20} + \frac{0.65}{40} + \frac{0.85}{60} + \frac{1}{80} + \frac{1}{100}$$

$$\tilde{Y} = \frac{0}{0} + \frac{0.45}{20} + \frac{0.6}{40} + \frac{0.8}{60} + \frac{0.95}{80} + \frac{1}{100}$$

Express the following for $\lambda = 0.5$.

$$(a) \tilde{\tilde{X}} \quad (b) \tilde{\tilde{Y}} \quad (c) \overline{\tilde{X} \cup \tilde{Y}}$$

OR

- 16 a) Given two fuzzy relation: $R = \begin{bmatrix} 0.2 & 0.5 \\ 0.6 & 0.8 \end{bmatrix}$ $S = \begin{bmatrix} 0.4 & 0.7 \\ 0.5 & 0.9 \end{bmatrix}$. Compute the (i) Max-Min composition (ii) Max-product composition (10)
- b) Explain the concept of defuzzification in fuzzy logic. Describe any one defuzzification methods. (4)

Module IV

17 a) Illustrate the block diagram of a Fuzzy Inference System and provide an explanation. (8)

b) Describe the basic steps involved in a Genetic Algorithm. (6)

OR

18 a) A Mamdani fuzzy system controls a fan speed based on temperature (T) and humidity (H) using the rules: (10)

- Rule 1: IF T is High AND H is Low, THEN Speed is Fast.
- Rule 2: IF T is Medium AND H is Medium, THEN Speed is Normal.
- Rule 3: IF T is Low OR H is High, THEN Speed is Slow.

Given:

- $\mu_{\text{High}}(T)=0.8$, $\mu_{\text{Medium}}(T)=0.5$, $\mu_{\text{Low}}(T)=0.2$
- $\mu_{\text{Low}}(H)=0.6$, $\mu_{\text{Medium}}(H)=0.4$, $\mu_{\text{High}}(H)=0.7$

Using the min-max method, determine the fuzzy output for Speed.

b) Given a population of 6 individuals, their fitness scores are {8, 12, 15, 5, 20, 10}. (4)

Perform Tournament Selection with a tournament size of 2.

Module V

19 a) What are the different types of Neuro-Fuzzy Hybrid Systems? (8)

b) Explain the concept of weak dominance, strict dominance, and non-dominance in (6)

Pareto optimization.

OR

20 a) Draw and explain the block diagram of Genetic-Neuro Hybrids. (10)

b) What are optimality conditions in Multi-Objective Optimization (MOO)? (4)
