B.Tech Even Semester Examination, May, 2025

Computer Science & Engineering
(6th Semester)

Course No: CSE-603(4)
(Soft Computing)

Full Marks: 70
Pass Marks: 28
Time: 3 hours

Note:
1. Attempt any five questions taking one from each unit.
2. Begin each answer in a new page
3. Answer parts of a question at a place
4. Assume reasonable data wherever required
5. The figure in the right margin indicates full marks for the question
6. All the mathematical symbols and abbreviations have their usual meanings.

UNIT-I

1. (a) Compare and contrast soft computing and hard computing paradigms. Explain with examples where each approach is more suitable. 7

   (b) Suppose you are designing a smart home automation system. Analyze how soft computing methods (like fuzzy logic or neural networks) would be more effective than hard computing methods for handling uncertainty and imprecision. 7

2. (a) Explain the architecture of a feedforward neural network and the role of activation functions. 7

(b) Derive the perceptron learning rule and explain its convergence properties for linearly separable problems. 7

UNIT-II

3. (a) Define membership functions. Compare triangular, trapezoidal, and Gaussian membership functions with diagrams and use cases. 7

(b) Design fuzzy rules for a simple fuzzy logic controller that controls fan speed based on temperature. Use fuzzy sets:

- Temperature: {Cold, Warm, Hot}
- Fan Speed: {Slow, Medium, Fast}

Define membership functions and write at least 3 fuzzy IF-THEN rules. 7

4. (a) Design triangular membership functions for input variable Speed with linguistic values:

· Slow (0–40),
· Moderate (30–70),
· Fast (60–100).

Draw the graph and write the membership function expressions. 7

(b) A fuzzy inference system has two inputs:

· Temperature (Low, High)
· Humidity (Dry, Wet)

Output: Fan Speed (Slow, Fast)

Given fuzzy values:

· Temp = Low (0.6), High (0.4)
· Humidity = Dry (0.3), Wet (0.7)

10. (a) Explain the backpropagation algorithm. What is the role of error gradient and weight adjustment in training a neural network7

(b) Given a simple 2-layer network with:

· Input = 0.6,
· Target output = 0.9,
· Weight = 0.5,
· Learning rate α=0.1\alpha = 0.1α=0.1,
· Activation function: Sigmoid.

Perform one iteration of weight update using the backpropagation formula:

$$\Delta w = \alpha \cdot (t - o) \cdot f'(net) \cdot x$$

(Use $f'(net) = o(1-o)$, where o is the output from sigmoid) 7

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Use fuzzy rules and apply fuzzy inference (min-max) to compute the fuzzy output set for Fan Speed. 7

UNIT-III

5. (a) Suppose a dataset has 5 features. Represent feature subsets using binary strings (e.g., 11010). Apply one iteration of GA for feature selection:

- Initial population: {10101, 11100, 00110, 01111}
- Fitness (accuracy): {0.76, 0.85, 0.62, 0.81}

Perform tournament selection and one-point crossover between top two chromosomes. 7

(b) Consider a problem with two objectives to minimize:

- f1(x)=x2,
- f2(x)=(x–2)2,

for x∈ [0,3].

List at least 5 candidate solutions and compute (f1, f2) values. Identify non-dominated solutions and plot an approximate Pareto front. 7

6. (a) Given the following individuals and their objective values:

Individual	F1	F2
A	3	9
B	4	8
C	2	10
D	6	5
E	7	3

Compute crowding distances for individuals in the first front. 7

(b) Suppose the true Pareto front lies along the curve f2=1/f1 for f1∈ [1,5]. Given an approximate set of solutions:

- S= {(1,1), (2,0.4), (3,0.33), (4,0.28), (5,0.2)}

Calculate the Inverted Generational Distance (IGD+) and hypervolume approximation (assume reference point = (6, 1.5)). 7

UNIT-IV

7. (a) What is the Neural Network Toolbox in MATLAB used for? Discuss the steps involved. 7

(b) What is a Fuzzy Logic Toolbox in MATLAB? Discuss the steps involved. 7

8. (a) Write down the MATLAB code (or explain GUI steps) to implement a feedforward ANN that maps input to output for AND logic. 7

(b) Create a fuzzy rule-based system using the fuzzy command to implement a 2-input, 1-output logic (e.g., Rainfall→ [Low, High]; Cloud→ [Low, High]; Output = Weather). 7

UNIT-V

9. (a) How many hidden layers can there be in a neural network? 2

(b) What is meant by epoch in training process? 2

(c) Explain the training algorithm of radial basis function network. 6

(d) Discuss bias and momentum. 4