

PG (CBCS)
M.SC. Semester- IV Examination, 2026
APPLIED MATHEMATICS
PAPER: MTM 403
(SOFT COMPUTING)



Full Marks: 20

Time: 1 Hour

The figures in the right-hand margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP-A

1. Answer any **TWO** of the following questions: 2×2=4

a) Perform one point crossover (at 3) for the following Chromosomes

$$x_1 = 1010101010$$

$$x_2 = 0101010101$$

Perform two-point crossover (at 2 and 5) for the following Chromosomes

$$y_1 = 1110110100$$

$$y_2 = 1000101000$$

- b) What is the concept of unsupervised learning.
c) What are the differences between traditional and non-traditional optimization techniques?
d) Explain the architecture of a Single-layer feedforward network in Artificial Neural Networks (ANN).

GROUP-B

2. Answer any **TWO** of the following questions: 2×4=8

a) Let $X = \{1, 2, 3, 4\}$ and $Y = \{a, b, c, d\}$ be two universes of discourse. Also, let

$$\tilde{A} = \{(1, 0.2), (2, 0.5), (3, 0.7), (4, 1.0)\}, \tilde{B} = \{(1, 0.3), (2, 0.4), (3, 0.8), (4, 0.7)\},$$

And $\tilde{C} = \{(a, 0.1), (b, 0.6), (c, 0.9), (d, 0.6)\}$. Determine the fuzzy relation of the following fuzzy rule: "If x is $\tilde{A}$ AND y is $\tilde{B}$, THEN z is $\tilde{C}$."

- b) Write a short note on crossover. What is the role and importance of mutation in Genetic Algorithms?
c) Perform the selection procedure (roulette wheel selection) for the following Binary Coded Genetic Algorithm (GA): Maximize the function $f(x) = x$, where $0 \leq x \leq 25$. Given the following parameters: population size: $N = 5$, initial population: 11001, 01111, 01011, 10001, 11001, random numbers for selection: 0.67, 0.11, 0.83, 0.31, 0.54.

(P.T.O.)

- d) Explain Supervised learning. Suppose R and S be two fuzzy relations defined on $X \times Y$ and $Y \times Z$ respectively. Find the Max-Min composition of $R \circ S$, if

$$\begin{pmatrix} 0.44 & 0.86 & 0.00 \\ 0.93 & 0.50 & 0.80 \\ 0.90 & 0.16 & 0.77 \\ 0.91 & 0.00 & 0.80 \end{pmatrix}, \begin{pmatrix} 0.94 & 0.86 & 0.00 \\ 0.00 & 1.00 & 0.70 \\ 0.10 & 0.16 & 0.07 \\ 0.91 & 1.00 & 0.00 \end{pmatrix}$$

are the matrix representations of R and S respectively.

2+2

GROUP-C

3. Answer any ONE of the following questions:

1×8=8

- a) Realize the function AND logic using McCulloch-Pitts neuron model.
- b) Maximize $f(x) = x^2 + 1$; $0 \leq x \leq 10$ using binary coded GA (one iteration only). Given that population size $N = 6$; initial population $x_1 = 10011, x_2 = 10101, x_3 = 10110, x_4 = 11100, x_5 = 01010, x_6 = 01111$; random numbers for selection: 0.19, 0.63, 0.97, 0.11, 0.70, 0.51; cross-over probability, $p_c = 1$; random numbers for cross-over: 0.60, 0.85, 0.57, 0.37, 0.70, 0.32; mutation probability, $p_m = 0.05$ and random numbers for mutation: 0.21, 0.37, 0.02, 0.52, 0.07, 0.97, 0.04, 0.61, 0.17, 0.09, 0.14, 0.82, 0.08, 0.21, 0.37, 0.20, 0.25, 0.72, 0.24, 0.16, 0.47, 0.58, 0.49, 0.01, 0.18, 0.09, 0.82, 0.26, 0.43, 0.08.

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