NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	MTech CSE (Data Science)
Course Code:	6CS268ME25
Course Title:	Soft Computing
Course Type:	Department Elective-III
Year of Introduction:	2025-26

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Course Learning Outcomes (CLO):

At the end of the course, the students will be able to:

1. define different soft computing techniques (BL2)
2. apply soft computing to solve problems for various application domains (BL3)
3. analyse different soft computing techniques (BL4)
4. solve single-objective and multi-objective optimization problems using soft computing and evolutionary techniques. (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction to Soft Computing:** Introduction to computing systems, State space search, Heuristic search techniques, Characteristics of soft computing and applications, Heuristic search techniques vs Soft computing techniques	06
Unit-II	**Fuzzy logic:** Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Applications of Fuzzy logic	06
Unit-III	**Introduction to Evolutionary Computation:** Generic Evolutionary Algorithm, Representation, Initial Population, Fitness Function, Selection, Reproduction Operators, Stopping Conditions, Evolutionary Computation versus Classical Optimization	08
Unit-IV	**Genetic Algorithms & Differential Evolution:** Crossover, Mutation, Control parameters, Genetic Algorithm Variants, Basic Differential Evolution, DE/x/y/z, Applications	06
Unit-V	**Swarm Intelligence (SI):** Introduction to Swarm Intelligence, Basic Particle Swarm Optimization, Social Network Structures, Basic Variations, Basic PSO Parameters, Ant Colony Optimization Metaheuristic, Cemetery Organization, Applications	15
Unit-VI	**Multi-objective Optimization Problem Solving:** Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA) and applications	04

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

1. Andries P. Engelbrecht, Computational Intelligence: An Introduction, Wiley
2. F. Martin, Mc neill, and Ellen Thro, Fuzzy Logic: A Pratical approach, AP Professional
3. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Willey
4. Nikola K. Kasabov, Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering, MIT Press
5. Ahmed M. Ibrahim, Fuzzy Logic for Embedded Systems Applications, Elsevier Press
6. Melanie Mitchell, An Introduction to Genetic Algorithms, MIT Press
7. David E. Goldberg, Genetic Algorithms In Search, Optimization And Machine Learning, Pearson
8. Randy L. Haupt and sue Ellen Haupt, Practical Genetic Algorithms, John Willey & Sons
9. S. Rajasekaran, and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logis and Genetic Algorithms: Synthesis, and Applications, Prentice Hall
10. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Neuro-Fuzzy and Soft Computing, PHI Learning
11. Simon Haykin, Neural Networks and Learning Machines, PHI Learning.

Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	Hours
1	Study different libraries for Evolutionary Algorithms	02
2	Study different libraries for Swarm Intelligence	02
3	Implement Genetic Algorithm for Symmetric Travelling Salesman Problem	04
4	Implement Genetic Algorithm for Clustering Problem	02
5	Implement Differential Evolution for Symmetric Travelling Salesman Problem	02
6	Implement Differential Evolution for Clustering Problem	02
7	Implement Particle Swarm Optimization for Clustering Problem	04
8	Implement Ant Colony Optimization for Symmetric Travelling Salesman Problem	04
9	Implement Ant Algorithm for Clustering Problem	04
10	Implement a Genetic Algorithm for any Multi-objective problem.	04