

**NIRMA UNIVERSITY**

|                              |                             |
|------------------------------|-----------------------------|
| <b>Institute:</b>            | Institute of Technology     |
| <b>Name of Programme:</b>    | BTech (CSE)                 |
| <b>Course Code:</b>          | 3CS109ME24                  |
| <b>Course Title:</b>         | Soft Computing              |
| <b>Course Type:</b>          | Disciplinary Minor-Elective |
| <b>Year of Introduction:</b> | 2024-25                     |

| L | T | Practical Component |    |   |   | C |
|---|---|---------------------|----|---|---|---|
|   |   | LPW                 | PW | W | S |   |
| 3 | 0 | 2                   | -  | - | - | 4 |

**Course Learning Outcomes (CLO):**

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

1. identify the application of fuzzy logic (BL3)
2. assess optimization problems using Multi-Objective Evolutionary algorithms (MOEAs) (BL5)
3. solve problems in a variety of application domains using soft computing techniques (BL6)
4. propose various solutions for optimization problems using genetic algorithms. (BL6)

| Unit     | Contents   | Teaching Hours<br>(Total 45) |
|----------|--|------------------------------|
| Unit-I   | <b>Introduction to Soft Computing:</b> Concept of computing systems, soft competing versus Hard computing, Characteristics of Soft computing, Some applications of soft computing techniques   | 05                           |
| Unit-II  | <b>Fuzzy logic:</b> Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques., Fuzzy logic controller design, Some applications of Fuzzy logic.                     | 10                           |
| Unit-III | <b>Genetic Algorithms:</b> Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc. Solving single-objective optimization problems using GAs.   | 12                           |
| Unit-IV  | <b>Multi-objective Optimization Problem Solving:</b> Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs. | 13                           |
| Unit-V   | <b>Artificial Neural Networks:</b> Biological neurons and their working, Simulation of biological neurons to problem-solving, Different ANNs architectures, Training techniques for ANNs, Applications of ANNs to solve some real-life problems.   | 05                           |

**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 contents



**Suggested Readings/ References:**

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley.
2. S N Sivanadam and S N Deepa, Principles of Soft Computing, Wiley
3. Siman Haykin, Neural Networks, Prentice Hall of India.
4. S. Rajasekaran, G.A. Vijayalakshmi Pai, Neural Networks, fuzzy logic, and genetic algorithms - Genetic Algorithm, Prentice Hill India.
5. F. Martin, Mc Neill, and Ellen Thro, Fuzzy Logic: A Practical Approach, AP Professional.
6. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley
7. Nikola K. Kasabov, Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering, MIT Press
8. Ahmed M. Ibrahim, Fuzzy Logic for Embedded Systems Applications, Elsevier
9. Melanie Mitchell, An Introduction to Genetic Algorithms, MIT Press
10. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Pearson Education
11. Randy L. Haupt and sue Ellen Haupt, Practical Genetic Algorithms, John Willey & Sons
12. S. Rajasekaran, and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logis and Genetic Algorithms: Synthesis, and Applications, Prentice Hall of India
13. D. K. Pratihar, Soft Computing, Narosa

**Suggested List of Experiments:**

| <b>Sr.<br/>No.</b> | <b>Title</b>   | <b>Hours</b> |
|--------------------|--|--------------|
| 1                  | Introduction to Python and its environment to set up Soft Computing Practical. | 02           |
| 2                  | Introduction to fuzzy logic packaging  | 02           |
| 3                  | Implement any one application to demonstrate the use of fuzzy logic            | 04           |
| 4                  | Introduction to Genetic Algorithm Packaging                                    | 02           |
| 5                  | Implement one application to demonstrate the use of a Genetic Algorithm        | 04           |
| 6                  | Demonstrate various selection strategies of genetic algorithm                  | 02           |
| 7                  | Introduction to Neural Network packages  | 02           |
| 8                  | Implement one application to demonstrate the use of Neural Networking          | 04           |
| 9                  | Test Performance of various architecture on any application                    | 04           |
| 10                 | Demonstrate the effect of various parameters on Neural Network                 | 04           |