

CS660 FUZZY SET THEORY AND EVOLUTIONARY ALGORITHMS**Course Objectives:**

Provide an understanding of the basic mathematical elements of the theory of fuzzy sets. Provide an emphasis on the differences and similarities between fuzzy sets and classical sets theories. The main objective of this course is to establish thorough background knowledge on evolutionary algorithms in post graduate students and enable them to pursue individual research in solving real world optimization problems like Constrained, Multimodal, Multi objective and Combinatorial Optimizations.

Course Outcomes:

At the end of the course, students should:

- *Be able to distinguish between the crisp set and fuzzy set concepts through the learned differences between the crisp set characteristic function and the fuzzy set membership function.*
- *Be able to draw a parallelism between crisp set operations and fuzzy set operations through the use of characteristic and membership functions respectively.*
- *Become aware of the use of fuzzy inference systems in the design of intelligent or humanistic systems.*

UNIT - I

Fuzzy sets: Basic Definitions, α -level sets, Convex fuzzy set, Basic operations on fuzzy sets, types of fuzzy sets, Extensions: Types of fuzzy sets, Further operations on fuzzy sets, Cartesian product, Algebraic products, Bounded sum and Difference, t-norm & t-conorm.

UNIT II

Extension principle and applications: Zadeh extension principle, image and inverse image of fuzzy sets, fuzzy numbers, algebraic operations with fuzzy numbers, extended operation and its properties, Special extended operation, addition, subtraction, product and division of fuzzy numbers.

UNIT III

Simple Evolutionary Algorithms : Simple Genetic Algorithm, Evolution Strategy and Evolutionary Programming, Direction-based Search.

UNIT IV

Advanced Evolutionary Algorithms: Problems We Face, Encoding and Operators, Selection Methods, Replacement and Stop Criteria, Parameter Control, Performance Evaluation of Evolutionary Algorithms.

UNIT V

Multiobjective Optimization: Introduction . Preference-based Approaches, Vector-evaluated Genetic Algorithm . Considerations for Designing Multiobjective Evolutionary Algorithms, Classical Multiobjective Evolutionary Algorithms, Cutting Edges of Multiobjective Evolutionary Algorithms, Swarm Intelligence, Introduction, Ant Colony Optimization, Particle Swarm Optimization.

TEXT BOOKS :

1. H.J. Zimmermann, "Fuzzy set theory and its Applications "Allied Publishers Ltd., New Delhi, 1991 (For Units I & II).
2. Yu, Xinjie, Gen, Mitsuo, "Introduction to Evolutionary Algorithms", Springer, ISBN 978-1-84996-129-5.

REFERENCE BOOKS:

1. T.J. Ross, John Wiley & Sons, "Fuzzy Logic with Engineering Applications", IInd Ed., 2005.
2. M.C. Bhuvaneshwari, "Application of Evolutionary Algorithms for Multi-objective Optimization in VLSI and Embedded Systems", Springer, 2014.
3. Ashlock, D. (2006), "Evolutionary Computation for Modeling and Optimization", Springer, ISBN 0-387-22196-4.