Course Description

# Title of Course: Fuzzy Systems and Applications Course Code: 18B14MA544 L-T-P Scheme: 3-0-0 Course Credits: 3

**Course Objectives**

This course aims to develop students' abilities in using some contemporary approaches in solving problems which are fuzzy in nature..

It will enable students to appreciate the advantages and limitations of fuzzy systems and their potential impacts and applications in intelligent control and automation;

**Learning Outcomes:** Student shall be able to-

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| **Course Outcome** | **Description** |
| CO1 | Get **familiar** with fuzzy sets and relations |
| CO2 | Identify and describe Fuzzy Logic techniques in building intelligent machines. |
| CO3 | Apply Fuzzy Logic models to handle uncertainty and solve engineering problems. |
| CO4 | Recognize the feasibility of applying probabilistic and fuzzy model for a particular problem. |
| CO5 | Apply fuzzy logic to extend the capabilities for efficient and  effective problem solving methodologies. |

**Course content:**

**Unit-1**

Introduction to classical set theory, Relation, Functions. fuzzy set theory: representation, capturing uncertainty, examples. Fuzzy Set: Fuzzy membership, graphic interpretation of fuzzy sets, empty space.

**Unit -2**

Fuzzy Operations: inclusion, comparability, equality. Complement, Union, Intersection, Difference. Fuzzy Properties: Related to union – Identity, Idempotence, Associatively, Commutativity. Related to Intersection – Absorption, Indentity, Idempotence, Associatively. Additional properties – Distributivity. Law of excluded middle, law of contradiction, Cartesian product.

**Unit -3**

Introduction to probability, Axiomatic definition of probability, properties of probability, conditional probability, independence, total probability, Bayes' rule, One dimensional random variables: cumulative distribution function, probability mass function, probability density functions; Functions of a random variable; expectation - mean, variance, characteristic functions; Two dimensional random variables, Joint distribution and density functions; Special probability distributions- Binomial, Poisson, geometric distributions.

**Unit 4**

Fuzzy Relations – Definition of Fuzzy Relation, examples. Forming Fuzzy Relations – Membership matrix, graphical form, Projections of fuzzy relations- first, second and global, Max-Min and Min-Max compositions.

**Unit -5**

Fuzzy Systems : Fuzzy system elements : Input vector, Fuzzification, Fuzzy Rule Base, Membership function, Fuzzy Inferencing, Defuzzyfication, Output vector. Statement, Symbols, Tautology, Membership functions from facts, Modus Ponens and Modus Tollens; Fuzzy logic : Proposition, Connectives, Quantifiers. MCDM, Fuzzy Entropies.

# Evaluation Scheme:

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| **Exams** | **Marks** | **Coverage** |
| Test-1 | 15 Marks | Based on Unit-1, Unit-2 |
| Test-2 | 25 Marks | Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1 |
| Test-3 | 35 Marks | Based on Unit-5 around 30% from coverage of Test-2 |
| Assignment | 10 Marks |  |
| Tutorials | 5 Marks |  |
| Quiz | 5 Marks |  |
| Attendance | 5 Marks |  |
| **Total** | **100 Marks** |  |

**Books:**

1. “Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence” by Kosko, Bart
2. “Neural Networks, Fuzzy Logic, and Genetic Algorithms” by S. Rajasekaran, G.A. Vijayalakshmi Pai, (Prentice-Hall of India Private Ltd.)
3. Ross, T. J. (2009). Fuzzy Logic with Engineering Applications: Wiley
4. An Introduction to Fuzzy Logic for Practical Applications by by Kazuo Tanaka
5. Fuzzy Sets and Fuzzy Logic: Theory and Applications by George J. Klir Bo Yu