



# FUZZY LOGIC AND NEURAL NETWORKS

## PROF. DILIP KUMAR PRATHIHAR

Department of Multidisciplinary

IIT Kharagpur

**INTENDED AUDIENCE :** Students belonging to all disciplines of Engineering, Researchers and practicing Engineers can take this course.

**INDUSTRIES APPLICABLE TO :** RDCIS, Ranchi CMERI, Durgapur Reliance Industries, Mumbai C-DAC, Kolkata, and others

## COURSE OUTLINE :

This course will start with a brief introduction to fuzzy sets. The differences between fuzzy sets and crisp sets will be identified. Various terms used in the fuzzy sets and the grammar of fuzzy sets will be discussed, in detail, with the help of some numerical examples. The working principles of two most popular applications of fuzzy sets, namely fuzzy reasoning and fuzzy clustering will be explained, and numerical examples will be solved. Fundamentals of neural networks and various learning methods will then be discussed. The principles of multi-layer feed forward neural network, radial basis function network, self-organizing map, counter-propagation neural network, recurrent neural network, deep learning neural network will be explained with appropriate numerical examples. The method of evolving optimized fuzzy reasoning tools, neural networks will be discussed with the help of some numerical examples. Two popular neuro-fuzzy systems will be explained and numerical examples will be solved. A summary of the course will be given at the end.

## ABOUT INSTRUCTOR :

Prof. Dilip Kumar Prathihar received BE (Hons.) and M. Tech. from REC (NIT) Durgapur, India, in 1988 and 1994, respectively. I obtained my Ph.D. from IIT Kanpur, India, in 2000. I received University Gold Medal, A.M. Das Memorial Medal, Institution of Engineers' (I) Medal, and others. I completed my post-doctoral studies in Japan and then, in Germany under the Alexander von Humboldt Fellowship Programme. I received Shastri Fellowship (Indo-Canadian) in 2019 and INSA Teachers' Award 2020. I am working now as a Professor (HAG scale) of IIT Kharagpur, India. My research areas include robotics, soft computing and manufacturing science. I have published more than 275 papers and book-chapters. I have written the textbooks on "Soft Computing" and "Fundamentals of Robotics", co-authored another textbook on "Analytical Engineering Mechanics", edited a book on "Intelligent and Autonomous Systems", co-authored reference books on "Modeling and Analysis of Six-legged Robots"; "Modeling and Simulations of Robotic Systems Using Soft Computing"; "Modeling and Analysis of Laser Metal Forming Processes by Finite Element and Soft Computing Methods" and "Multibody Dynamic Modeling of Multi-legged Robots". My textbook on "Soft Computing" had been translated into Chinese language in 2009. I have guided 22 Ph.D.s. I am in editorial board of 10 International Journals. I have been elected as FIE, MASME and SMIEEE. I have completed a few sponsored (funded by DST, DAE, MHRD) and consultancy projects. I have filed two patents.

## COURSE PLAN :

**Week 1 :** Introduction to Fuzzy Sets

**Week 2 :** Introduction to Fuzzy Sets (contd.); Fuzzy reasoning

**Week 3 :** Fuzzy reasoning (contd.); Fuzzy clustering

**Week 4 :** Fuzzy clustering (contd.); Fundamentals of Neural Networks

**Week 5 :** Multi-layer Feed-Forward Neural Network; Radial Basis Function Network

**Week 6 :** Self-Organizing Map; Counter-Propagation Neural Network; Recurrent Neural Networks; Deep Learning Neural Network

**Week 7 :** Genetic-Fuzzy system; Genetic-Neural System

**Week 8 :** Neuro-Fuzzy System; Concepts of Soft Computing and Computational Intelligence; Summary of the Course