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**FIRST SEMESTER 2023-2024**

Course Handout Part II

Date: 11-08-2023

In addition to Part I (General Handout for all courses appended to the timetable), this portion gives further specific details regarding the course.

Course No. : **BITS F312**

## Course Title : **Neural Network and Fuzzy Logic**

## Instructor-in-Charge : **K. Srinivasa Raju**

Chamber No. : **D-107**

1. **Scope and Objective of the Course:**

The aim of this course is twofold: **1**. Provide a thorough understanding of the basics; **2.** Bring the students face-to-face with an application in Fuzzy Logic and Neural Networks and related approaches. In addition, every student is required to work on a project, as part of the course, involving an application of Fuzzy Logic and Neural Networks. Further, the project work provides an opportunity to learn about the latest developments in this upcoming field. The unified approach will enable students to tackle real-life problems in a more comprehensive manner and provide a broader view of the subject.

**Course Level Outcomes:** After successful completion of this course, the student will be able to:

1. Explain the philosophy behind neural networks and allied fields
2. Explain the mechanism behind fuzzy logic
3. Understand the role of fuzzy logic and neural networks in the decision making
4. Analyze fuzzy logic and neural networks from a holistic perspective
5. **Text Book:**

**T1**. T.J. Ross Fuzzy Sets and Fuzzy Logic with Engineering Applications, Wiley, 2021

**3. Reference books**

**R1.** SN Sivanandam, SN Deepa (2021) Principles of Soft Computing, Wiley

**R2**. Raju KS, Nagesh Kumar D (2014) Multicriterion Analysis in Engineering and Management, PHI Learning Private Limited.

**4. Course Plan:**

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| **Lecture No.** | **Learning Objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 1-2 | Neural Networks, Fuzzy Logic | Introduction to Neural networks, Fuzzy Logic, Neuro-Fuzzy | Ch-1 (T1)  Ch-1 (R1) |
| 3-5 | Fundamental concepts and Basic Models | Artificial Neural Networks (ANN), Biological Neural Networks, Comparison, Basic models of ANN, important terminologies, Linear separability, Hebb Network | Ch-2 (R1)  Supplementary material |
| 6-9 | Introduction to back propagation network | Back Propagation network (BPN) of ANN, Selection of Parameters in BPN, Tuning of Parameters, Variation of Standard Back Propagation Algorithms | Ch-3 (R1) Supplementary material |
| 10-12 | Unsupervised Learning networks | Kohonen Self-Organizing feature maps, Learning vector quantization, Case studies | Ch-5 (R1), Supplementary material |
| 13-15 | Classical and fuzzy relations | Crisp set theory, fuzzy set theory, Introduction to classical and fuzzy relations, value assignments | Ch-3 (T1) |
| 16-17 | Fuzzification using Membership functions | Linear, Triangular, Trapezoidal, Hyperbolic, Exponential Membership functions | Ch-4 (T1)  Supplementary material |
| 18-20 | Defuzzification | Lambda cuts, different methods of defuzzification | Ch-4 (T1) |
| 21-24 | Fuzzy rule based and approximate reasoning | Various types of reasoning, Linguistic Hedges, Mamdani and Sugeno Fuzzy Rule based systems, Adaptive Neuro-Fuzzy Inference System (ANFIS) | Ch-5 (T1)  Supplementary material |
| 25-27 | Decision-making with fuzzy information | Similarity Analysis, PROMETHEE, TOPSIS, VIKOR, Analytical Hierarchy Process, Group Decision Making, Fuzzy Extensions | Ch-6,7 (R2), Supplementary material |
| 28-30 | Classification | Binary classifiers: Logistic Regression, K-Nearest Neighbourhood  Equivalence Relations, K-Means, Fuzzy C-Means, Cluster Validity Indices, Principal Component Analysis | Ch-7(T1)  Supplementary Material |
| 31-34 | Various Approaches to Fuzzy Logic | Optimization, Cognitive Mapping, their fuzzy extensions | Ch-11 (T1)  Supplementary material |
| 35-37 | Understanding the potentiality of Deep Learning with selected algorithms | Deep Learning, Convolutional Neural Networks, Long Short-Term Memory | Supplementary material |
| 38-39 | Analyzing selected nature-based optimization algorithms | Introduction to Bio-inspired optimization algorithms | Supplementary material |
| 40 | Understanding basic definitions of control theory, Mathematical philosophy behind control theory | Concepts in control systems, stability, state variable, controllability, Control system design problem, Simple fuzzy logic controllers  Fuzzy Engineering Process control, Classical feedback control, classical PID control, Fuzzy control, MIMO control systems | Ch-6(T1) |

**\*Supplementary material/sources will be provided wherever required.**

**5. Evaluation Scheme:**

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| **Component** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of Component** |
| Mid-Semester Examination | 90 min | 30 | 11/10 - 4.00 - 5.30PM | Closed Book |
| Course related Project | -------- | 30 | Continuous | Open Book |
| Comprehensive Examination | 180 min | 40 | 13/12 AN | Closed Book |

1. **Chamber Consultation Hour: MONDAY 5-6 P.M**
2. **Notices:** Notices concerning this course will be uploaded on Google Classroom Page for this course.
3. **Make-up Policy:** Make-ups will not be granted under any circumstances.
4. **Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**INSTRUCTOR-IN-CHARGE**

**BITS F312**