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

2. **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:**

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:

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

6. **Chamber Consultation Hour: MONDAY 5-6 P.M**

7. **Notices:** Notices concerning this course will be uploaded on Google Classroom Page for this course.

8. **Make-up Policy:** Make-ups will not be granted under any circumstances.

9. **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