



BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
AUGS/ AGSR Division

SECOND SEMESTER 2020-21
COURSE HANDOUT

Date: 04.01.2021

In addition to part I (General Handout for all courses appended to the Time table) this portion gives further specific details regarding the course.

Course No : BITS F312
Course Title : Neural Networks and Fuzzy Logic
Instructor-in-Charge : Dr. B.K. Mukherjee
Instructor(s) : Dr. B.K. Mukherjee and Prof. S. Bhanot
Tutorial/Practical Instructors: NA

1. Course Description: This course aims to introduce basic concepts, mathematics, application of AI techniques mainly neural networks, fuzzy logic, expert systems, evolutionary algorithms in modeling, control, classification, clustering, prediction problems.

2. Scope and Objective of the Course:

- Understand concept, techniques, applications, future of the field of “Artificial Intelligence”
- Understand the concepts, mathematics, techniques to implement fuzzy logic in clustering, control applications
- Understand basic concepts, mathematics, different architectures and learning algorithms in ANNs
- Understand Evolutionary algorithms for optimization like GA, PSO etc.

After completing this course the students will be able to

- 1) Understand the techniques, applications, impact of this new emerging area “AI”/ “soft computing”
- 2) Implement different learning algorithms used in Artificial neural networks to apply in applications such as modeling, control, classification, prediction etc.
- 3) Understand mathematics behind fuzzy sets, implement fuzzy logic systems for decision making, control, classification, clustering etc.
- 4) Design Hybrid AI techniques and use evolutionary optimization techniques like GA, PSO etc.

3. Text Books: No single textbook

4. Reference Books:

1. Artificial neural networks, B Yegnanarayana, Prentice Hall
2. Process control: principles and applications, Surekha Bhanot, Oxford University Press



BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
AUGS/ AGSR Division

3. Fuzzy Logic with engineering application, Timothy J Ross
4. Intelligent Systems and Control Laxmidhar behera , Indrani Kar
5. Nature-inspired metaheuristic algorithms, Xin-She Yang, Luniver Press
6. Neural Network Design, Martin D Hagen et al - <http://hagan.okstate.edu/NNDesign.pdf>
7. A first course in Fuzzy and Neural Control, By Hung T Nguyen, N R Prasad, C L Walker, E A Walker Chapman & Hall/CRC Press Company
8. Fundamentals of Neural networks, architecture, algorithms and applications, Laurene Fausett, Pearson Education
9. Elements of artificial neural networks by Kisham Mehrotra, C K Mohan & Sanjay Ranka, Penram International Publishing
10. Soft Computing-Fundamentals and Applications, Dilip K. Pratihari, Narosa Publishers
11. Engineering Optimization, 4th Ed., S.S. Rao, John Wiley & Sons

5. Course Plan:

Module No.	Lecture Session	Reference	Learning outcomes
1. Introduction to AI, intelligent systems, soft computing (Lec 1-3)	Machine learning, Intelligent Systems, soft computing, achievements, future directions	Class notes and web resources	Get an overview of field of artificial intelligence and the techniques for implementing AI, future implications
2. Nontraditional Optimization Techniques (Lec 4-9)	Introduction to traditional optimization; Lagrange multiplier method; Gradient descent method; Introduction to nontraditional optimization; Genetic Algorithm; Particle Swarm Optimization	R11 (Ch 2, 6, 13), R10 (Ch 3), + Class Notes	Understanding a few popular evolutionary optimization algorithms such as GA and PSO and appreciating the advantages they offer over the traditional techniques.
3. Artificial neural networks, learning algorithms, ANN for modeling, control, function approximation, prediction	Model of artificial neuron, Architecture ,Learning methods: Supervised, Unsupervised, Reinforcement, Perceptron, Back propagation, Hebbian, Hopfield, dynamic, competitive, RBF networks, Recurrent neural networks,	R9 (Ch1) R8 (Ch 1,2,3,4) R2 (Ch 17) R4 (Ch 2)	Get an understanding of different learning algorithms in ANNs, applications of ANNs for modeling, control, classification, prediction etc, Matlab implementation



BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
AUGS/ AGSR Division

(Lec 10-31)	LSTMs/GRUs, Convolution networks, Deep learning and their applications in function approximation, modeling, pattern recognition, prediction, modeling & control	R7 (Ch 1 to 6) + Class notes	
4. Fuzzy Logic (Lec 32-40)	Fuzzy Set theory, fuzzy relations, Mamdani and Sugeno inference, Introduction to Type-2 fuzzy logic, Neur-Fuzzy-GA Hybrid systems Fuzzy logic applications in PID control Fuzzy logic applications in clustering	R3, R4 + Class notes	Understanding the mathematics behind Type-1 and Type-2 Fuzzy Reasoning process Learning how to combine neural net, fuzzy logic and nontraditional optimization techniques Understanding Control and Clustering applications of fuzzy logic

6. Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of component (Close Book/ Open Book)
Mid-Semester Test	90 Min.	30%	<TEST_1>	OB
Comprehensive Examination	2 Hrs.	40%	<TEST_C>	OB
Coding Assignments		10%		OB
Research Paper Assignment		20%		OB

7. Chamber Consultation Hour: To be announced in the class

8. Notices: All notices regarding the course will be posted on NALANDA

9. Make-up Policy: Makeup will be granted to extremely genuine cases only.

10. Note (if any): It shall be the responsibility of the individual student to be regular in maintaining the self study schedule as given in the course handout, attend lectures and assignment submission as per the schedule announced in Nalanda. Mid Semester Test and Comprehensive Examination are according to the Evaluation Scheme given above.

Instructor-in-charge
Course No. BITS F312