



# BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani

## Pilani Campus

### Course Handout (Part II)

Date: 17/08/2020

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

<b>Course No.</b>	<b>: BITS F312</b>
<b>Course Title</b>	<b>: Neural Networks and Fuzzy Logic</b>
<b>Instructor-in charge</b>	<b>: Bijoy Krishna Mukherjee</b>
<b>Team of Instructors</b>	<b>: Surekha Bhanot</b>

**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 Objectives**

- Understand concept, techniques, applications, future of the field of “Artificial Intelligence”
- Understand the concepts, mathematics, techniques to implement fuzzy logic in various engineering applications
- Understand basic concepts, mathematics, different 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 used, application, impact of this new emerging area called “AI”, “soft computing”
- 2) Design of Expert Systems
- 3) Implement different learning algorithms used in Artificial neural networks to apply in applications such as modeling, control, prediction etc.
- 4) Understand mathematics behind fuzzy sets, implement fuzzy logic systems for decision making, control, classification etc.
- 5) Design Hybrid AI techniques and evolutionary optimization techniques.

### **3. Prescribed Text/ Reference Books**

1. Artificial neural networks, B Yegnanarayana, Prentice Hall
2. Introduction to Soft Computing, Samir Roy, Udit Chakraborty, Pearson



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3. Process control: principles and applications, Surekha Bhanot, Oxford University Press
4. Fuzzy Logic with engineering application, Timothy J Ross
5. Intelligent Systems and Control Laxmidhar behera , Indrani Kar
6. Nature-inspired metaheuristic algorithms, Xin-She Yang, Luniver Press
7. Neural Network Design, Martin D Hagen et al - <http://hagan.okstate.edu/NNDesign.pdf>
8. 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
9. Fundamentals of Neural networks, architecture, algorithms and applications, Laurene Fausett, Pearson Education
10. Artificial Intelligence, a modern approach. Stuart J Russell, Peter Norvia, Pearson
11. Soft Computing-Fundamentals and Applications, Dilip K. Pratihar, Narosa Publishers
12. Engineering Optimization, 4<sup>th</sup> Ed., S.S. Rao, John Wiley & Sons

### 4. Course Plan

Module Number	Lecture session/Tutorial Session.	Reference	Learning Outcome
1. Introduction to AI, intelligent systems, soft computing	L1.1. Machine learning, Intelligent Systems, soft computing, achievements, future directions		Get an overview of field of artificial intelligence and the techniques for implementing AI, future implications
2. Fuzzy Logic	L2.1 Fuzzy Set theory, fuzzy set operations, fuzzy relations,	R2: Ch2, 3 &4 R4: part of Ch1, 2, 3, 4,11,13 + Class notes	Understanding of mathematics behind Fuzzy Logic, sets, operations, relations.  Classification using C means, Fuzzy C means
	L2.2 Fuzzy applications in classification, pattern recognition,	R4: Ch10 + Class Notes	Design of fuzzy logic control system and its implementation in Matlab
	L2.3 Fuzzy applications in control, Matlab implementation	R3: Ch18 + Class notes	



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3. Artificial neural networks, learning algorithms, ANN for modeling, control, function approximation, prediction	L3.1 model of artificial neuron, Architecture ,Learning methods: Supervised, Unsupervised, Reinforcement,	R2: Ch6 & 10 R3: Ch17 + Class notes	Get an understanding of different learning algorithms in ANNs, applications of ANNs for modeling, control, classification, prediction etc, Matlab implementation
	L3.2 Perceptron, Back propagation, Hebbian, Hopfield, dynamic, competitive, RBF networks, Convolution networks, Deep learning	R2: Ch6 & 10 R3: Ch17 R6: part of Ch2, 3, 4, 7, 11, 14, 15, 16, 17, 21, 23-27 + Class notes	
	L3.3 ANN applications in function approximation, modeling, pattern recognition, prediction, modeling & control	R7: Ch5 &6 R8: Ch1,2,3,4,5,6 +Class Notes	
4. Nontraditional or Evolutionary Optimization Techniques	L4.1 Introduction to traditional optimization; Lagrange multiplier method; Gradient descent method	R12: Ch2 & 6 + Class Notes	Understanding a few popular evolutionary optimization algorithms and appreciating the advantages they offer over the traditional techniques.  Understanding how the different members of the Soft Computing family can be combined for performance improvement.
	L4.2 Introduction to nontraditional optimization; Genetic Algorithm; Particle Swarm Optimization	R11: Ch3 R12: Ch13 +Class Notes	
	L4.3 Neuro-Fuzzy- Evolutionary hybridization	R11: Ch9 & 11 + Class Notes	



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### 5. Evaluation Scheme:

Evaluation Component	Marks	Date & Time	Remarks
Test-1	45 M	Sept. 10 to 20	
Test-2	45 M	Oct. 09 to 20	
Test-3	30 M	Nov. 10 to 20	
Compre	90 M	Dec. 21	
Coding Assignments	30 M		
Research Paper Assignments	60 M		
Total	300 M		

**Closed Book Test:** No reference material of any kind will be permitted inside the exam hall.

**Open Book Exam:** Use of any printed / written reference material (books and notebooks) will be permitted inside the exam hall. Loose sheets of paper will not be permitted. Computers of any kind will not be allowed inside the exam hall. Use of calculators will be allowed in all exams. No exchange of any material will be allowed.

**6. Chamber Consultation Hour:** Tuesday, 17:00 to 18:00 hrs.

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

**8. Make-up Policy:** Make-up will be allowed only to exceptional cases with strong reasons.

### 9. Note:

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.

(Bijoy Krishna Mukherjee)  
Instructor In charge  
BITS F312

