Banasthali Vidyapith
Department of Computer Science
Course Handout: M.Tech. (Computer Science) I Semester
July – December 2025

Date: 7 July 2025

Course Code: CS 433 **Course Name: Soft Computing**

Credit Points: 4 **Max. Marks: 100 (CA: 40 + ESA: 60)**

Course Instructor:

- **Dr. Rajiv Singh, Associate Professor, Computer Science**

Course Outcomes:

On completion of the course, the student will be able to:

CO 1 Understand the concepts of Neural Networks and its applications.
CO 2 Learn supervised and unsupervised neural network models.
CO 3 Use the concepts of Fuzzy logic and Fuzzy sets for implementation of real-life problems.
CO 4 Apply the concepts of evolutionary computations on different problems.
CO 5 Able to design hybrid intelligent systems using soft computing techniques.

Section A

Introduction to Soft Computing, Neural Networks: Introduction and Applications, Biological and Artificial Neural Network, Types of Neural Network Architectures, McCulloch-Pitts Neuron, Learning in Neural Networks – Supervised, Unsupervised and Reinforcement, Hebbian, Competitive and Delta Learning, Perceptron, Multilayer Perceptron, Backpropagation, Radial Basis Functions, Self-Organizing Maps, Learning Vector Quantization, Recurrent Neural Networks, Hopfield Networks, Boltzmann Machine.

Section B

Introduction to Fuzzy Logic and Fuzzy Sets: Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzification, Defuzzification, Fuzzy Rule based Systems and Linguistic Variables, Fuzzy Extension Principle, Fuzzy Inference Systems (FIS)-Mamdani, Sugeno and Tsukamoto, Applications of Fuzzy logic.

Section C

Evolutionary Computing: Introduction, Variants of Evolutionary Computing-Genetic Algorithms (GA), Evolutionary Programming, Learning Classifier Systems, Genetic Programming. Foundations of Genetic Algorithms-Basic Terminologies, Operators in GA. Schema Theorem, Hybrid Systems (Neuro-Fuzzy, Genetic-Neuro, Fuzzy-Genetic).

Suggested Books:

R1. Haykin, S. (2009). *Neural networks: a comprehensive foundation*. Prentice Hall PTR.
R2. Goldberg, D. E. (2007). *Genetic algorithms in search optimization and machine learning*. Pearson.
R3. Zimmermann, H. J. (1996). *Fuzzy set theory and applications*. Allied Publishers,1996.
R4. Rajasekaran, S., & Pai, G. V. (2003). *Neural networks, fuzzy logic and genetic algorithm: synthesis and applications*. PHI Learning Pvt. Ltd.
R5. Ross, T. J. (2005). *Fuzzy logic with engineering applications.* John Wiley & Sons.
R6. Eiben, A. E., & Smith, J. E. (2003). *Introduction to evolutionary computing*. Springer.
R7. Sivanandam, S. N., & Deepa, S. N. (2007). *Principles of Soft Computing*. John Wiley & Sons.

Book Recommended by Sir

Suggested E-Learning Material:

E1. Neuro-Fuzzy and Soft Computing
http://www.cs.nthu.edu.tw/~jang/nfsc.htm
E2. Introduction to Soft Computing
https://nptel.ac.in/courses/106105173/
E3. Neural Networks and Deep Learning
https://www.coursera.org/courses?query=neural%20networks

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(MTech-CS).

Assessment Schedule:

Component	Marks	Submission/ Examination date	Allotment
Home assignment 1**	10	17 August, 2025	Topics shall be allotted in the class by 1 August 2025
Periodical test I	10	29 August - 1 September, 2025*	Lecture No. 01 to 36
Home assignment II**	10	19 September, 2025	Topics shall be allotted in the class by 3 September, 2025
Periodical test II	10	12-16 October, 2025*	Lecture No. 37 to 60
Semester Examination	60	1-19 December, 2025*	Lecture No. 01 to 75 (Entire Syllabus)

**Subject to change*
***Evaluation is based on written document, test, viva and any other component(s) as decided by the instructor(s) on regular basis*

Lecture-Wise Schedule:

Lecture Number	Topics to be Covered	Suggested Readings
	Section A	
L1	Introduction to Soft Computing	R1, E1, E2
L2	Neural Networks: Introduction and Applications	R1, R2, E1
L3 – L4	Biological and Artificial Neural Network, Activation functions and nonlinearity in neural network	R1, R2, E1
L5	Types of Neural Network Architectures, McCulloch-Pitts Neuron	R1, R2, E1
L6 – L12	Learning in Neural Networks – Supervised, Unsupervised and Reinforcement, Hebbian, Competitive and Delta Learning	R1, R2, E1
L13 – L14	Perceptron, Multilayer Perceptron	R1, R2, E1
L15 – L16	Backpropagation, Radial Basis Functions	R1, R2, E1
L17 – L18	Self-Organizing Maps, Learning Vector Quantization	R1, R2, E1
L19 – L20	Recurrent Neural Networks, Hopfield Networks, Boltzmann Machine	R1, R2, E1
	Section B	
L21	Introduction to Fuzzy Logic and Fuzzy Sets	R1, R3, E2
L22 – L24	Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions	R1, R3, E2
L25 – L26	Fuzzification, Defuzzification	R1, R3, E2
L27– L29	Fuzzy Rule based Systems and Linguistic Variables, Hedges	R1, R3, E2
L30 – L31	Fuzzy Extension Principle	R1, R3, E2
L32 – L35	Fuzzy Inference Systems (FIS)- Mamdani, Sugeno and Tsukamoto, Applications of Fuzzy logic	R1, R3, E2
	Section C	
L36 – L38	Evolutionary Computing: Introduction, Variants of Evolutionary Computing- Genetic Algorithms (GA)	R1, R4, E2
L39 – L42	Foundations of Genetic Algorithms-Basic Terminologies, Operators in GA	R1, R4, E2
L43 – L46	Evolutionary Programming, Learning Classifier Systems, Genetic Programming	R1, R4, E1
L47	Mathematical foundations of Schema Theorem	R1, R4, E1
L48 – L50	Hybrid Systems (Neuro-Fuzzy, Genetic-Neuro, Fuzzy-Genetic)	R1, R4, E1

(Rajiv Singh)