

III B.Tech I Semester

23A05504b	SOFT COMPUTING (Professional Elective-I)	L	T	P	C
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Course Objectives:

- Understand the concepts of soft computing techniques and how they differ from traditional AI techniques.
- Introduce the fundamentals of fuzzy logic and fuzzy systems.
- Familiarize with artificial neural networks and their architectures.
- Learn genetic algorithms and their role in optimization.
- Explore hybrid systems integrating fuzzy logic, neural networks, and genetic algorithms.

Course Outcomes:

After completion of the course, students will be able to:

- Understand the components and applications of soft computing.
- Apply fuzzy logic concepts to real-world problems.
- Build and train various neural network models.
- Implement genetic algorithms for problem-solving and optimization.
- Design hybrid systems using soft computing techniques.

UNIT I: Introduction to Soft Computing and Fuzzy Logic

Introduction to Soft Computing: Definition, Components, Differences with Hard Computing, Applications of Soft Computing, Fuzzy Logic: Crisp Sets vs Fuzzy Sets, Membership Functions, Fuzzy Set Operations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems: Mamdani and Sugeno Models, Defuzzification Techniques.

UNIT II: Artificial Neural Networks – I

Introduction to Neural Networks: Biological Neurons vs Artificial Neurons, Architecture of Neural Networks: Feedforward, Feedback, Learning Rules: Hebbian, Delta, Perceptron Learning Rule, Single Layer Perceptron and its Limitations, Multi-Layer Perceptron: Backpropagation Algorithm, Applications of Neural Networks

UNIT III: Artificial Neural Networks – II

Hopfield Networks and Associative Memories, Radial Basis Function Networks, Self-Organizing Maps (SOM), Recurrent Neural Networks (RNNs) – Basic Concepts, Convolutional Neural Networks (CNNs) – Overview and Applications, Practical Use Cases in Image and Pattern Recognition,

UNIT IV: Genetic Algorithms and Optimization

Introduction to Genetic Algorithms, GA Operators: Selection, Crossover, Mutation, Fitness Function and Evaluation, Schema Theorem, Elitism, Applications in Function Optimization, Scheduling, and Robotics, Introduction to Particle Swarm Optimization (PSO).

UNIT V: Hybrid Systems and Advanced Topics

Hybrid Systems: Neuro-Fuzzy Systems, Fuzzy-GA, GA-ANN, ANFIS: Architecture and Learning, Case Studies on Hybrid Systems, Introduction to Deep Learning in Soft Computing, Real-World Applications: Forecasting, Control Systems, Medical Diagnosis, Image Processing.

Textbooks:

1. S. N. Sivanandam, S. N. Deepa, “Principles of Soft Computing”, Wiley India, 3rd Edition
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley, 4th Edition
3. S. Rajasekaran and G. A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications”, PHI

Reference Books:

1. Laurene Fausett, “Fundamentals of Neural Networks: Architectures, Algorithms and Applications”, Pearson
2. David E. Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Pearson
3. Simon Haykin, “Neural Networks and Learning Machines”, Pearson, 3rd Edition
4. Bart Kosko, “Neural Networks and Fuzzy Systems”, Prentice Hall

Online Learning Resources:

1. NPTEL – Soft Computing by Prof. S. Sengupta (IIT Kharagpur)
2. Coursera – Neural Networks and Deep Learning (Andrew Ng)