



**Vidya Pratishthan's Kamalnayan Bajaj
Institute of Engineering and Technology,
Baramati**

Department of Artificial Intelligence and Data Science

S.Y. B. Tech Syllabus 2024-25 (As per NEP 2020)

Syllabus: HONORS Artificial Intelligence and Data Science
w. e. f. AY: 2024-2025
SEMESTER-IV

Honors in Computational Intelligence

SEM	Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	Activity	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
IV	AI23291	Soft Computing: Intelligent Problem-Solving Techniques	2	2	-	10	20	50	20	20		120	2	1		3


Dept. Academic Coordinator

Mr. P.N. Shendage


Head of Department

Dr. C. S. Kulkarni


Dean Academic

Dr. S. M. Bhosle


Principal

Dr. S. B. Lande

Principal

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering & Technology, Baramati
 Vidyanagari, Baramati-413133

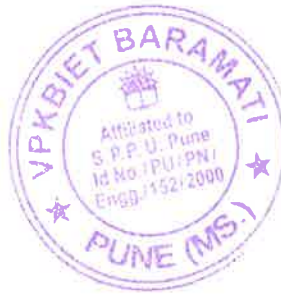


Bucket of HONORS DEGREE

HONORS DEGREE

(only for students having CGPA ≥ 7.5)

AI23291:Soft Computing: Intelligent Problem-Solving Techniques





Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology, Baramati
(Autonomous Institute)

AI23291- Soft Computing: Intelligent Problem-Solving Techniques

Teaching Scheme: Theory: 2 Hours/Week Practical: 2 Hour/Week	Credits 03	Examination Scheme: Activity: 10 Marks ISE: 20 Marks ESE: 50 Marks Term Work: 20 Marks Practical: 20 Marks
---	-----------------------------	---

Prerequisites: Python Programming

Course Objectives:

- To explain the concept of soft computing techniques with their applications in product design. Manufacturing and operations with case studies.
- To expose students to the concept of fuzzy logic and their applications in mechanical system.
- To familiarize the deep learning model development using artificial neural network.
- To introduce the concept of genetic algorithm and various advanced algorithms.
- To apply Markov models for system and process modeling and optimization

Course Outcomes (COs): The students will be able to learn:

1. Apply soft fuzzy logic approach for solving different problems in absence of sufficient data and using expert judgments.
2. Develop deep learning model using artificial neural network.
3. Apply genetic algorithms other random search procedures useful while seeking global optimum in self-learning situations.
4. Apply reinforcement and deep learning models for different data sets and optimize the system performance

Course Contents

Unit I: Fuzzy Logic (07 Hours)

Fuzzy Systems Fuzzy set theory: Fuzzy sets, Operations, Membership Functions, Fuzzy relations and their composition, Measures, Rules, Propositions, Implications, and inferences, Defuzzification techniques, Logic controller design, Some applications of fuzzy logic.

Unit II: Artificial Neural Network (7 Hours)

Artificial Neural Network (ANN) Neuron, Nerve structure and synapse, Biological and artificial neurons, Architectures – single layer and multilayer feed forward networks, recurrent networks. Back propagation algorithm, Working principle, Types of ANN, Activation functions – linear, Sigmoid, Tanh, supervised and unsupervised learning, Training techniques for ANNs, Applications, advantages, and limitations.

Unit III: Genetic Algorithms (07 Hours)

Basic Genetics, Concepts, Working Principle, Creation of Offspring, Encoding, Fitness Function. Selection Functions, Genetic Operators-Reproduction, Crossover, Mutation; Genetic Modeling, Advantages, limitations and applications, Comparison between GA and traditional algorithms.

Unit IV: Reinforcement Learning (RL) and Deep Learning (07 Hours)

What is reinforcement learning? Terms used; Key features; Working process; Approaches – value-based, policy-based, and model-based; Elements – policy, reward signal, value function, model of the environment; The Bellman equation; Types – positive and negative; RL algorithms; Q-learning; Comparison between RL and supervised learning.



Text Books:

1. Neural Networks: A Comprehensive Foundation by S. Haykin, Pearson.
2. Fuzzy Logic with Engineering Application by T. J. Ross, John Wiley and Sons.
3. Evolutionary Computation by D.B. Fogel, IEEE Press.
4. D. K. Pratihari, Soft Computing, Narosa Publishing House, 2008.
5. An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press).

Reference books:

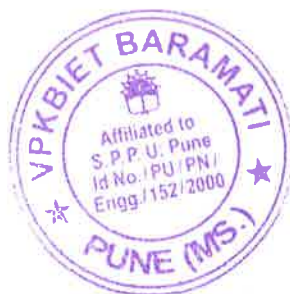
1. Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collo, Lament, Veldhnizer (Springer).
2. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley).
3. Neural Networks and Learning Machines Simon Haykin (PHI).
4. Sivanandam, Deepa, Principles of Soft Computing, Wiley.
5. Jang J.S.R, Sun C.T. and Mizutani E, "Neuro-Fuzzy and soft computing", Prentice Hall. 6. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill

E-Resources:

1. <https://nptel.ac.in/courses/106102220>
2. https://onlinecourses.nptel.ac.in/noc23_cs87/preview
3. https://onlinecourses.nptel.ac.in/noc22_ee21/preview

List of Assignments

1. Design triangular, trapezoidal, Gaussian, and sigmoid membership functions for a given problem (e.g., temperature classification: Cold, Warm, Hot). Plot these membership functions and analyze their behavior. **Tools:** Python libraries like skfuzzy, MATLAB.
2. Implement a simple neural network to solve the non-linear XOR problem. **Task:** Use an MLP with at least one hidden layer to classify the XOR dataset. Train the network using back-propagation. Compare the results with and without activation functions (e.g., ReLU, Sigmoid). **Tools:** Python libraries - NumPy, TensorFlow/Keras.
3. Build a neural network to classify handwritten digits. **Task:** Load the MNIST dataset. Design and train a feedforward neural network with multiple hidden layers. Experiment with different optimizers (e.g., SGD, Adam). Visualize training loss and accuracy over epochs. **Tools:** Keras, TensorFlow, Matplotlib
4. Optimize the selection of items to maximize value while respecting weight constraints. **Task:** Implement a genetic algorithm to solve the 0/1 knapsack problem. Define chromosomes as binary strings where 1 indicates selecting an item. Apply selection, crossover, and mutation operations. Compare results with a greedy algorithm. **Tools:** Python libraries: NumPy, Matplotlib.
5. Implement Q-Learning, a model-free RL algorithm. **Task:** Create a 4x4 grid world with obstacles and a goal state. Implement Q-Learning to learn the optimal policy. Visualize the Q-table, optimal actions, and rewards after convergence. **Tools:** Python libraries: NumPy, Matplotlib.



Vidya Pratishthan's

Kamalnayan Bajaj Institute of Engineering and Technology, Baramati

Department of Artificial Intelligence and Data Science

Plan for Activity (10 Marks)

Course Name: - Soft Computing: Intelligent Problem-Solving Techniques

Course Code: AI23291

Year: - SY

Branch: - AI&DS

Semester: - IV

The course **Soft Computing: Intelligent Problem-Solving Techniques** at the second-year level, Semester IV of the Artificial Intelligence and Data Science program, includes the following evaluation scheme:

SEM	Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	Activity	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
IV	AI23291	Soft Computing: Intelligent Problem-Solving Techniques	2	2	-	10	20	50	20	20		120	2	1		3

The evaluation under the “**Activity**” component, worth 10 marks, will consist of a **quiz** featuring Multiple Choice Questions from various categories. The distribution of questions will be as follows: 20% difficult questions (from the Evaluate and Create categories of Bloom's Taxonomy), 40% medium questions (from the Apply and Analyze categories), and 40% easy questions (from the Remember and Understand categories). The schedule for this activity will be communicated via email, noticeboard, or the department website well in advance.

Students who fail to attend this activity but have a genuine reason will be accommodated with a rescheduled quiz, which will also be announced through email, noticeboard, or the department website well in advance, using a different set of questions from the specified categories.


Course Coordinator




Dr. C. S. Kulkarni

HoD
Head
Department of Artificial Intelligence
& Data Science,
VPKBIET, Baramati 413 133