COURSE CONTENT

BIO-INSPIRED COMPUTING								
V Semester: CSE / IT								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACSE23	**Elective**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Python Programming								

I. COURSE OVERVIEW:

Bio-Inspired Computing introduces computational techniques inspired by biological systems such as neural networks, evolutionary algorithms, and fuzzy logic systems. The course focuses on understanding how biological principles like learning, adaptation, evolution, and reasoning can be modeled computationally to solve complex real-world problems.

II. COURSE OBJECTIVES:

The students will try to learn

I. Understand the fundamentals and evolution of bio-inspired computing paradigms.
II. Learn principles of neural networks, genetic algorithms, and fuzzy logic.
III. Analyze optimization and performance of bio-inspired models.
IV. Design practical applications using bio-inspired techniques.

III. COURSE OUTCOMES:

At the end of the course, students should be able to:

CO1 Explain bio-inspired computing paradigms.
CO2 Design neural network models.
CO3 Apply genetic algorithms for optimization.
CO4 Develop fuzzy logic systems.
CO5 Integrate hybrid intelligent systems.
CO6 Analyze real-world case studies.

IV. COURSE CONTENT:

MODULE 1: INTRODUCTION TO BIO-INSPIRED COMPUTING (10)

Evolution of computational intelligence: Limitations of conventional computing, need for intelligent and adaptive systems; Biological motivation: Learning, adaptation, evolution and self-organization; Soft computing concepts; Bio-inspired computing paradigms: Neural networks, genetic algorithms and fuzzy logic systems; Characteristics of intelligent systems; Comparison of traditional AI and bio-inspired approaches; Applications of bio-inspired computing in optimization, pattern recognition, data mining, control systems and decision-making.

MODULE 2: NEURAL NETWORKS (09)

Neural network concepts: Biological neuron and artificial neuron models, mathematical representation of neuron; Network architectures: Single-layer and multi-layer feedforward networks, recurrent networks; Learning paradigms: Supervised, unsupervised and reinforcement learning; Perceptron model and learning algorithm; Limitations of single-layer perceptron; Multilayer perceptron (MLP); Backpropagation algorithm: Error computation, gradient descent, weight update; Learning rate and convergence issues; Overfitting and generalization; Applications of neural networks in classification, pattern recognition, prediction and function approximation.

MODULE 3: EVOLUTIONARY COMPUTATION AND GENETIC ALGORITHMS (10)

Evolutionary principles: Natural selection and survival of the fittest; Genetic algorithm framework; Chromosome representation: Binary, real-valued and permutation encoding; Fitness function design; Selection mechanisms: Roulette wheel, tournament selection; Genetic operators: Crossover techniques, mutation strategies; Elitism and population diversity; Constraint handling in genetic algorithms; Convergence behavior and performance analysis; Applications of genetic algorithms in optimization, scheduling, routing and search problems.

MODULE 4: FUZZY LOGIC SYSTEMS (09)

Fuzzy logic concepts: Limitations of classical crisp logic; Fuzzy sets and linguistic variables; Membership functions: Triangular, trapezoidal and Gaussian; Fuzzy set operations: Union, intersection and complement; Fuzzy relations and compositions; Fuzzy rule-based systems; Fuzzy inference systems: Mamdani and Sugeno models; Defuzzification methods; Design of fuzzy controllers; Applications of fuzzy logic in decision-making, control systems and expert systems.

MODULE 5: HYBRID BIO-INSPIRED SYSTEMS (10)

Hybrid intelligent systems: Motivation and advantages; Neuro-fuzzy systems: Architecture and learning mechanisms; Adaptive Neuro-Fuzzy Inference System (ANFIS); Genetic algorithms for neural network weight optimization; Genetic tuning of fuzzy membership functions and rule bases; Hybrid optimization approaches; Performance comparison of standalone and hybrid systems; Case studies in classification, optimization and control applications; Emerging trends and research directions in bio-inspired computing.

V. TEXT BOOKS:

1. Rajasekaran S. & Pai G.A.V., Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, PHI

VI. REFERENCE BOOKS:

1. Simon Haykin, Neural Networks and Learning Machines, Pearson

VII. ELECTRONICS RESOURCES:

1. www.smartzworld.com/notes/operatingsystems
2. www.scoopworld.in
3. www.sxecw.edu.in
4. www.technofest2u.blogspot.com

VIII. MATERIALS ONLINE

1. Course Outline Description
2. Lecture notes
3. PowerPoint presentation
4. Definitions and Terminology
5. Tutorial Question Bank
6. Case Studies
7. Real life Examples
8. Complex Engineering Problems
9. Tech Talk Topics
10. Concept Video Topics
11. Open-ended Exercises
12. Assignments
13. Model Question Paper – I
14. Model Question Paper – II
15. GATE Question Bank
16. Previous Question Papers and Solutions