SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

Year: B. Tech III (Semester V)

Subject Name: Bio-Inspired Computing **Subject Code:** BTAI14501
Type of course: Professional Elective Course
Prerequisite (if any): Data Structures, Design and Analysis of Algorithms

Rationale: Bio-Inspired Computing course provides a systematic introduction to all major nature-inspired algorithms for optimization**.** These algorithms have become increasingly popular in recent years, and most of these metaheuristic algorithms based on swarm intelligence, such as particle swarm optimization, firefly algorithms and cuckoo search etc. have been found to be very efficient and useful in solving tough problems in optimization, computational intelligence, and engineering design applications.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	0	3	60	25	15	0	0	100

CA1: Continuous Assessment (assignments / projects / open book tests / closed book tests) CA2: Sincerity in attending classes / class tests / timely submissions of assignments / self-learning attitude / solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work / Quality of work submitted / Active participation in lab sessions / viva on practical skills learned in course.

Contents:

Sr. No.	Contents	Total Hrs
1.	**Introduction to Biologically-Inspired Computation:** Biology applied to computation, Why Do Bio-inspired Computation, popular natural systems	03
2.	**Artificial Neural Networks (ANN)**: from biological to the artificial neurons, logical computations with neurons-McCulloch-Pitts Neural model, Perceptron, Activation functions, Neural Networks Architectures– Single and Multilayer feed forward ANNs, Backpropagation Networks, Recurrent networks, Learning Methods in Neural Networks, Taxonomy Of Neural Network Systems, Applications of Neural Network	09
3.	**Random Walk and Simulated Annealing:** Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters - SA algorithm - Stochastic Tunneling	05

4.	**Genetic Algorithms (GA) and Differential Evolution:** Introduction, Encoding schemes, GA Operators - Parent selection, Mutation, Crossover; Fitness, Application of GA, Function optimization, Travelling Salesman Problem, Genetic Based machine learning, Classifier systems, introduction to differential evolution - variants - choice of parameters - convergence analysis,	**12**
5.	**Swarm Optimization and Firefly Algorithm** Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation	**06**
6.	**Ant Colony Optimization:** From Real to Artificial Ants**,** Combinatorial Optimization, Metaheuristic, ACO Algorithms for the Traveling Salesman Problem	**05**
7.	**Overview of other bio-inspired algorithms:** Cuckoo Search, Bat Algorithms, Flower Pollination Algorithm, Ant Algorithms, Bee-Inspired Algorithms	**05**

Suggested Specification table with Marks (Theory): (For B.Tech. only)

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	25	10	0	0	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

Note: Refer latest edition of following reference books.

Sr No.	**Title of book /article**	**Author(s)**	**Publisher and details like ISBN**
1	Nature-Inspired Optimization Algorithms	Xin-She Yang	Elsevier, 9780124167452
2.	An Introduction to Genetic Algorithms	Melanie Mitchell	The MIT Press
3.	Ant Colony Optimization	Marco Dorigo, Thomas Stützle	The MIT Press
4.	Particle Swarm Optimization	Adam Slowik	CRC Press
5.	Soft Computing	Samir Roy and Udit Chakraborty	Pearson India

Note: Students should refer to the latest editions of books

Course Outcomes:

Sr. No.	CO statements	Marks % weightage
CO-1	Compare the working of the natural system and corresponding nature-inspired computational algorithms	15%
CO-2	Decide and make use of appropriate neural network architecture to solve implement decision making problem	25%
CO-3	Demonstrate the working of genetic algorithm to solve some combinatorial problems	30%
CO-4	Apply Ant Colony Optimization, Particle swarm optimization, and other bioinspired algorithms to solve some suitable optimization problems	30%

Open-Source Learning Resources:

1. https://www.oreilly.com/library/view/neural-networks-and/9781492037354/ch01.html