COURSE CONTENT

NATURE INSPIRED COMPUTING								
II Semester: CSE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
2225823	**Foundation**	3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisites: Basic knowledge of mathematics, probability, algorithms, and programming is required.								

Course Overview:

This course introduces computational techniques inspired by natural systems such as evolution and swarm behavior. It covers optimization methods using algorithms like Genetic Algorithms, Ant Colony Optimization, Particle Swarm Optimization, and Artificial Bee Colony. Students learn heuristic and meta-heuristic approaches to solve complex problems, along with real-world applications and case studies. Overall, the course develops skills to design efficient, intelligent optimization solutions.

Course Objectives:

1. To understand the fundamental concepts and principles of nature-inspired computing techniques and intelligent systems.
2. To study evolutionary algorithms, swarm intelligence, and optimization methods inspired by natural processes.
3. To learn genetic algorithms and their applications in solving complex optimization problems.
4. To analyze various swarm-based algorithms such as Ant Colony Optimization, Particle Swarm Optimization, and Artificial Bee Colony algorithms.
5. To develop the ability to apply nature-inspired computing techniques for real-world problem solving and optimization applications.

Course Outcomes: After Completion of the Course, Students should be able to

1. Analyze the behavior and self-organization of swarm and evolutionary models.
2. Implement genetic algorithms using operations such as selection, crossover, and mutation.
3. Evaluate the effectiveness of ACO algorithms through case studies and performance metrics.
4. Evaluate the performance and efficiency of PSO and ABC algorithms across different applications.
5. Evaluate the suitability and performance of selected algorithms through case studies and empirical results.

UNIT - I:

Models of Life and Intelligence - Fundamentals of bio-inspired models and bio-inspired computing. Evolutionary models and techniques, Swarm models and its self-organization, swarm and evolutionary algorithms. Optimisation problems – single and multi-objective optimisation, heuristic, meta-heuristic and hyper heuristic functions.

UNIT - II:

Genetic algorithms - Mathematical foundation, Genetic problem solving, crossover and mutation. genetic algorithms and Markov process, applications of genetic algorithms

UNIT - III:

Ant Colony Algorithms - Ant colony basics, hybrid ant system, ACO in combinatorial optimisation, variations of ACO, case studies.

UNIT - IV:

Particle Swarm algorithms - particles moves, particle swarm optimisation, variable length PSO, applications of PSO, case studies. Artificial Bee Colony algorithms - ABC basics, ABC in optimisation, multi-dimensional bee colony algorithms, applications of bee algorithms, case studies.

UNIT - V:

Selected nature inspired techniques - Hill climbing, simulated annealing, Gaussian adaptation, Cuckoo search, Firey algorithm, SDA algorithm, bat algorithm, case studies. Other nature inspired techniques - Social spider algorithm, Cultural algorithms, Harmony search algorithm, Intelligent water drops algorithm, Artificial immune system, Flower pollination algorithm, case studies.

TEXT BOOKS:

1. Albert Y. Zomaya - "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006
2. Floreano, D. and C. Mattiussi -"Bio-Inspired Artificial Intelligence: Theories, methods, and Technologies" IT Press, 2008

REFERENCES:

1. Leandro Nunes de Castro - " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
2. Marco Dorrigo, Thomas Stutzle -" Ant Colony Optimization", Prentice Hall of India, New Delhi, 2005
3. Vinod Chandra S S, Anand H S - "Machine Learning: A Practitioner's Approach", Prentice Hall of India, New Delhi, 2020

ELECTRONIC RESOURCES:

1. https://www.coursera.org/courses?query=evolutionary%20algorithms
2. https://www.mathworks.com/products/global-optimization.html
3. http://www.scholarpedia.org/article/Ant_colony_optimization
4. https://pyswarms.readthedocs.io/
5. https://github.com/search?q=nature+inspired+algorithms

MATERIALS ONLINE:

1. Course template
2. Tutorial question bank
3. Tech talk and Concept Video topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. E-Learning Readiness Videos (ELRV)