



# GUJARAT TECHNOLOGICAL UNIVERSITY

## Bachelor of Engineering Syllabus

Subject Code : 3174508

Subject Name : Nature Inspired Optimization Algorithms

WEF Academic Year :	2021 - 22
Semester :	7
Category of the Course :	Open Elective

<b>Prerequisite :</b>	Algorithm Design and Analysis
<b>Rationale :</b>	Natural Computation is the study of computational systems that use ideas and get inspiration from a variety of natural systems. Describe different nature-inspired search and optimization methods and explain how they are applied to solve real world problems.

### Course Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

### Course Content :

Sr. No.	Course Content	No. of Hours	% of Weightage
1	<b>INTRODUCTION :</b> From Nature to Nature Computing, Philosophy, Three Branches: A Brief Overview, Individuals, Entities and agents - Parallelism and Distributivity Interactivity, Adaptation, Feedback-Self-Organization-Complexity, Emergence and Bottom-up Vs Top-Down- Determination, Chaos and Fractals.	5	10
2	<b>COMPUTING INSPIRED BY NATURE :</b> Evolutionary Computing, Hill Climbing and Simulated Annealing, Darwin's Dangerous Idea, Genetics Principles, Standard Evolutionary Algorithm-Genetic Algorithms, Reproduction-Crossover, Mutation, Evolutionary Programming, Genetic Programming.	6	25
3	<b>SWARM INTELLIGENCE :</b> Introduction - Ant Colonies, Ant Foraging Behavior, Ant Colony Optimization, SACO and scope of ACO algorithms, Ant Colony Algorithm (ACA), Swarm Robotics, Foraging for food, Social Adaptation of Knowledge , Particle Swarm Optimization (PSO).	5	15



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering Syllabus

Subject Code : 3174508

Subject Name : Nature Inspired Optimization Algorithms

4	<b>GENETIC ALGORITHM :</b> Representation – Reproduction – Crossover and Mutation Operators – Crossover and Mutation rates – Selection mechanisms – Fitness proportionate – ranking and tournament selection – Building Block – Hypothesis and Schema Theorem.	4	15
5	<b>IMMUNO COMPUTING :</b> Introduction- Immune System, Physiology and main components, Pattern Recognition and Binding , Immune Network Theory- Danger Theory, Evaluation Interaction Immune Algorithms , Introduction – Genetic algorithms , Bone Marrow Models , Forest's Algorithm, Artificial Immune Networks.	5	25
6	<b>COMBINATORIAL OPTIMIZATION :</b> Travelling Salesman Problem (TSP), Graph Coloring Problem, Job Scheduling problem, Network Routing Problem.	3	10
<b>Total</b>		<b>28</b>	<b>100</b>

## Text Book :

1. Nature-Inspired Optimization Algorithms By Vasuki A.
2. Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007.

## Reference Book :

1. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008.
2. Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006.
3. Evolutionary Optimization Algorithms by Dan Simon Latest Edition, Wiley.
4. Nature Inspired Optimization Algorithm by Xin-She Yang First Edition, Elsevier.
5. Swarm Intelligence and Bio-Inspired Computing by Yang , Cui, Xlao, Gandomi, Karamanoglu First Edition, Elsevier.

## Course Outcome :

After Completion of the Course, Student will able to :

No.	Course Outcomes	RBT Level*
01	Describe the natural phenomena that motivate the algorithm.	UN
02	Apply nature-inspired algorithms to optimization.	AP
03	Select the appropriate strategy or optimal solution based on bio-inspired algorithms.	EL
04	Apply algorithms to solve combinatorial problems.	AN

\*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering Syllabus

Subject Code : 3174508

Subject Name : Nature Inspired Optimization Algorithms

---

## Practical List :

(List of Practical are suggestive in nature and can be expanded as per the course content requirement.)

1. Implement Travelling salesman problem algorithm.
2. Implement Simplex method algorithm.
3. Implement 0-1 knapsack problem using dynamic programming.
4. Implement Particle Swarm optimization algorithm.
5. Implement Differential Evolution algorithm.
6. Implement the Firefly Algorithm.
7. Implement Cuckoo search algorithm.
8. Implement Cuckoo binary search algorithm.
9. Implement Bat optimization algorithm.
10. Implement Flower Pollination algorithm.

## List of Laboratory/Learning Resources Required :

### 1. List of Hardware :

- Computer System with latest configuration
- 

### 2. Suggested Software :

- Any High level programming language like python, R or java
- Python IDLE, R studio, MATLAB

\*\*\*\*\*