# 20AD41E5 - NATURE INSPIRED COMPUTING FOR DATA SCIENCE

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| Course Category: | Professional Elective | Credits: | 3 |
| Course Type: | Theory | Lecture-Tutorial-Practical: | 3-0-0 |
| Prerequisite: | Design and analysis of algorithms. | Sessional Evaluation:  Univ. Exam Evaluation:  Total Marks: | 40  60  100 |
| Objectives: | * To establish basic knowledge in Nature inspired techniques and understand the need for approximation algorithms. * Design algorithms that utilize the collective intelligence of simple organisms to solve problems. | | |

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| Course Outcomes | Upon successful completion of the course, the students will be able to: | |
| CO1 | Understanding the basis of natural inspired algorithms. |
| CO2 | Identify the Nature Inspired Computing Techniques and their classifications. |
| CO3 | Design and modify different classical Nature Inspired algorithms in terms of Initialization, Processing and Stopping Criteria. |
| CO4 | Develop basic knowledge of PSO Nature Inspired Computing Technique and their working principle. |
| CO5 | Understanding basic knowledge of Firefly Nature Inspired Computing Technique and their working principle. |
| CO6 | Describe the different Hybrid algorithms and their working principle. . |
| Course Content | UNIT-I  **Introduction**: What is an Algorithm, Newton’s Method, Optimization, Gradient-Based Algorithms, Hill Climbing with Random Restart, Search for Optimality, No-Free-Lunch Theorems, NFL Theorems, Choice of Algorithms, Nature-Inspired Meta heuristics, A Brief History of Meta heuristics  UNIT-II  **Analysis of Optimization Algorithms:** Algorithm as an Iterative Process, An Ideal Algorithm? A Self-Organization System, Exploration and Exploitation, Evolutionary Operators, Nature-Inspired Algorithms, Simulated Annealing, Genetic Algorithms, Differential Evolution, Ant and Bee Algorithms, Particle Swarm Optimization, The Firefly Algorithm, Cuckoo Search, The Bat Algorithm, Harmony Search, The Flower Algorithm,  UNIT-III  **Steel Annealing Algorithm:** Annealing and Boltzmann Distribution, Parameters, Unconstrained Optimization, Basic Convergence Properties, SA Behaviour in Practice, Stochastic Tunnelling.  **Genetic Algorithms:** Introduction, Role of Genetic Operators, Choice of Parameters, GA Variants, Schema Theorem, Convergence Analysis.  UNIT-IV  **PSO Algorithm:** Swarm Intelligence, PSO Algorithm, Accelerated PSO, Implementation, Convergence Analysis, Dynamical System, Markov Chain Approach, Binary PSO.  UNIT-V  **Firefly Algorithm:** Firefly Behaviour, Standard Firefly Algorithm, Variations of Light Intensity and Attractiveness, Controlling Randomization, Algorithm Analysis, Scalings and Limiting Cases, Attraction and Diffusion, Special Cases of FA, Implementation.  UNIT-VI  **Ant Algorithms:** Ant Behaviour, Ant Colony Optimization, Virtual Ant Algorithms.  **Bee-Inspired Algorithms:** Honeybee Behaviour, Bee Algorithms, Honeybee Algorithm, Virtual Bee Algorithm, Artificial Bee Colony Optimization.  **Harmony Search:** Harmonics and Frequencies, Harmony Search, Hybrid Algorithms, Other Algorithms. | |
| Text Books &  Reference  Books | **TEXT BOOKS:**   1. Xin-She Yang, “Nature-Inspired optimization algorithms”, Elsevier, published in 2014.   **REFERENCE BOOKS:**   1. Xin-She Yang, “Nature-Inspired Computation and Swarm Intelligence Algorithms, Theory and Applications”, Elsevier, Academic Press, 2020. 2. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008. | |
| E-Resources | 1. <https://nptel.ac.in/courses> 2. <https://www.youtube.com/watch?v=I10PcKfLSwI&list=PLVLAu9B7VtkbbkvAV2w8zY9HLOjrgHXyG> | |