

SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

QUESTION BANK



V SEMESTER

PAD101 – BIO INSPIRED OPTIMIZATION TECHNIQUES

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Prepared by

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SUBJECT CODE & NAME : PAD101 & BIO INSPIRED OPTIMIZATION TECHNIQUES

SEM / YEAR: V Sem / III Year

UNIT I – INTRODUCTION			
Optimization Techniques: Introduction to Optimization Problems – Single and Multi- objective Optimization – Classical Techniques – Overview of various Optimization methods – Evolutionary Computing: Genetic Algorithm and Genetic Programming: Basic concept – encoding – representation – fitness function – Reproduction – differences between GA and Traditional optimization methods – Applications – Bio- inspired Computing (BIC): Motivation – Overview of BIC – usage of BIC – merits and demerits of BIC.			
PART – A			
Q.No	Questions	BT Level	Competence
1.	Define optimization	BTL 1	Remembering
2.	List any two applications of optimization techniques.	BTL 1	Remembering
3.	Differentiate between single and multi-objective optimization.	BTL 2	Understanding
4.	What is the main goal of optimization?	BTL 1	Remembering
5.	Mention two classical optimization techniques.	BTL 1	Remembering
6.	Define objective function in optimization.	BTL 1	Remembering
7.	What is evolutionary computing?	BTL 2	Understanding
8.	List the basic operators used in Genetic Algorithms.	BTL 1	Remembering
9.	What is encoding in Genetic Algorithm?	BTL 2	Understanding
10.	Write any one point that differentiates Genetic Algorithms from traditional optimization methods.	BTL 2	Understanding
11.	What is a fitness function?	BTL 2	Understanding
12.	Define reproduction in Genetic Algorithms.	BTL 1	Remembering
13.	What is the significance of crossover and mutation?	BTL 2	Understanding
14.	Define genetic programming.	BTL 1	Remembering
15.	List any two real-time applications of GA.	BTL 1	Remembering
16.	What motivates bio-inspired computing?	BTL 2	Understanding
17.	Define bio-inspired computing.	BTL 1	Remembering
18.	Mention any two types of bio-inspired algorithms.	BTL 1	Remembering
19.	Write any one merit of bio-inspired computing.	BTL 1	Remembering
20.	Write any one demerit of bio-inspired computing.	BTL 1	Remembering
21.	Differentiate between GA and GP.	BTL 2	Understanding
22.	Why is representation important in GA?	BTL 2	Understanding
23.	List any two usage scenarios of BIC.	BTL 2	Understanding
24.	Mention the role of selection in Genetic Algorithms.	BTL 2	Understanding

PART – B			
1.	Explain the classification of optimization problems with suitable examples.	BTL 3	Applying
2.	Compare and contrast single-objective and multi-objective optimization problems.	BTL 4	Analyzing
3.	Describe classical optimization techniques and their limitations.	BTL 3	Applying
4.	Summarize various advanced optimization techniques and provide appropriate examples.	BTL 3	Applying
5.	Explain the structure and working of Genetic Algorithm with a sample problem.	BTL 3	Applying
6.	Discuss the encoding techniques used in Genetic Algorithms.	BTL 3	Applying
7.	Elaborate on fitness functions. How are they used in optimization?	BTL 3	Applying
8.	Describe the process of reproduction in GA. Mention the role of crossover and mutation.	BTL 3	Applying
9.	Compare Genetic Algorithm with traditional optimization techniques.	BTL 4	Analyzing
10.	Explain Genetic Programming and how it differs from Genetic Algorithm.	BTL 4	Analyzing
11.	Discuss the real-world applications of GA in engineering problems.	BTL 5	Evaluating
12.	Define Bio-inspired Computing. Explain the motivation behind BIC with examples.	BTL 3	Applying
13.	Summarize various types of bio-inspired computing methods.	BTL 3	Applying
14.	Discuss the advantages and disadvantages of Bio-Inspired Computing.	BTL 5	Evaluating
15.	How is BIC applied to solve optimization problems? Provide a use case.	BTL 4	Analyzing
16.	Explain the concept of representation in Genetic Algorithms and demonstrate it with a relevant example.	BTL 3	Applying
17.	Create a simple Genetic Algorithm to solve a given optimization problem.	BTL 6	Creating
UNIT II – SWARM INTELLIGENCE			
Introduction – Biological foundations of Swarm Intelligence – Swarm Intelligence in Optimization – Ant Colonies: Ant Foraging Behavior – Towards Artificial Ants – Ant Colony Optimization (ACO) – S-ACO – Ant Colony Optimization Metaheuristic: Combinatorial Optimization – ACO Metaheuristic – Problem solving using ACO – Other Metaheuristics – Simulated annealing – Tabu Search – Local search methods – Scope of ACO algorithms.			
PART – A			
1.	Define Swarm Intelligence.	BTL 1	Remembering
2.	What are the biological foundations of swarm intelligence?	BTL 2	Understanding
3.	Mention two optimization problems suitable for Swarm Intelligence.	BTL 2	Understanding
4.	Define ant foraging behavior.	BTL 1	Remembering
5.	What is the role of pheromone in ant colonies?	BTL 2	Understanding
6.	What is Ant Colony Optimization (ACO)?	BTL 1	Remembering
7.	List two characteristics of artificial ants.	BTL 1	Remembering
8.	Define S-ACO.	BTL 1	Remembering
9.	What is combinatorial optimization?	BTL 2	Understanding
10.	Write any two uses of ACO in real-world problems.	BTL 2	Understanding
11.	What do you mean by ACO metaheuristic?	BTL 2	Understanding
12.	Name any two ACO parameters.	BTL 1	Remembering
13.	Define metaheuristic.	BTL 1	Remembering
14.	What is simulated annealing?	BTL 1	Remembering
15.	Mention any two features of Tabu Search.	BTL 1	Remembering

16.	What is a local search method?	BTL 2	Understanding
17.	What is the difference between Tabu Search and ACO?	BTL 1	Remembering
18.	What is meant by the scope of ACO algorithms?	BTL 2	Understanding
19.	List two benefits of using swarm-based optimization.	BTL 1	Remembering
20.	Mention one limitation of ACO.	BTL 2	Understanding
21.	What is the role of probability in ACO path selection?	BTL 1	Remembering
22.	Define heuristic information in the context of ACO.	BTL 1	Remembering
23.	Mention one similarity between ACO and Simulated Annealing.	BTL 2	Understanding
24.	Name any two real-time applications of Swarm Intelligence.	BTL 1	Remembering
PART - B			
1.	Explain the biological foundations of Swarm Intelligence with examples.	BTL 3	Applying
2.	Describe the process of ant foraging behavior and relate it to ACO.	BTL 3	Applying
3.	Explain how Ant Colony Optimization (ACO) is applied to solve optimization problems.	BTL 3	Applying
4.	Explain the architecture and functioning of Artificial Ants.	BTL 3	Applying
5.	Discuss in detail the ACO Metaheuristic and its variants.	BTL 3	Applying
6.	Compare and contrast ACO with traditional optimization methods.	BTL 4	Analyzing
7.	Describe the S-ACO method and its applications.	BTL 3	Applying
8.	What is Combinatorial Optimization? Explain its relevance in ACO.	BTL 3	Applying
9.	Explain the scope and limitations of ACO algorithms in real-time systems.	BTL 5	Evaluating
10.	Illustrate how ACO is applied in routing and scheduling problems.	BTL 3	Applying
11.	Discuss the other metaheuristics: Simulated Annealing, Tabu Search, and Local Search.	BTL 3	Applying
12.	Compare ACO with Simulated Annealing in terms of mechanism and efficiency.	BTL 4	Analyzing
13.	Evaluate the effectiveness of Swarm Intelligence in optimization problems.	BTL 5	Evaluating
14.	Design a simple ACO algorithm to solve a sample combinatorial optimization problem.	BTL 6	Creating
15.	Analyze the significance of pheromone update rules in ACO.	BTL 4	Analyzing
16.	Explain how local search methods enhance the performance of ACO.	BTL 3	Applying
17.	Discuss the merits and demerits of using ACO in optimization problems.	BTL 5	Evaluating
UNIT III – NATURAL TO ARTIFICIAL SYSTEMS			
Biological Nervous Systems – artificial neural networks – architecture – Learning Paradigms – unsupervised learning – supervised learning – reinforcement learning – evolution of neural networks – hybrid neural systems – Biological Inspirations in problem solving – Behaviour of Social Insects: Foraging –Division of Labor – Task Allocation – Cemetery Organization and Brood Sorting – Nest Building – Cooperative transport.			
PART – A			
1.	Define biological nervous system.	BTL 1	Remembering
2.	What is an artificial neural network?	BTL 1	Remembering
3.	State the components of a neural network architecture.	BTL 1	Remembering
4.	Differentiate between supervised and unsupervised learning.	BTL 2	Understanding
5.	What is reinforcement learning?	BTL 1	Remembering
6.	List two applications of neural networks.	BTL 1	Remembering
7.	Explain the concept of hybrid neural systems.	BTL 2	Understanding
8.	What is meant by evolution of neural networks?	BTL 1	Remembering
9.	Identify two biological inspirations for problem solving.	BTL 2	Understanding
10.	Define the concept of foraging in social insects.	BTL 1	Remembering

11.	What is division of labor in swarm intelligence?	BTL 1	Remembering
12.	Mention the role of task allocation in insect colonies.	BTL 1	Remembering
13.	Define cemetery organization.	BTL 1	Remembering
14.	What is brood sorting in social insects?	BTL 1	Remembering
15.	State the significance of nest building behavior.	BTL 1	Remembering
16.	What do you mean by cooperative transport?	BTL 1	Remembering
17.	Compare biological neural systems with artificial neural networks.	BTL 2	Understanding
18.	List the advantages of reinforcement learning.	BTL 2	Understanding
19.	Give one example each for supervised and unsupervised learning algorithms.	BTL 2	Understanding
20.	Why are social insects considered a model for collective intelligence?	BTL 2	Understanding
21.	Explain the importance of learning paradigms in AI.	BTL 2	Understanding
22.	How does hybridization improve neural networks?	BTL 2	Understanding
23.	What is meant by division of labor in ants? Give an example.	BTL 2	Applying
24.	List the contribution of biological inspirations to AI problem solving.	BTL 2	Understanding
PART - B			
1.	Explain the biological nervous system and its influence on the development of artificial neural networks.	BTL 3	Applying
2.	Discuss the architecture of an artificial neural network with neat diagram.	BTL 3	Applying
3.	Differentiate in detail between supervised, unsupervised, and reinforcement learning with examples.	BTL 3	Applying
4.	Analyze the advantages and limitations of reinforcement learning in neural systems.	BTL 4	Analyzing
5.	Describe the evolution of neural networks with suitable examples.	BTL 3	Applying
6.	Explain hybrid neural systems and discuss their applications.	BTL 3	Applying
7.	How do biological inspirations contribute to problem solving in artificial intelligence? Justify with examples.	BTL 4	Analyzing
8.	Explain the behavior of social insects in foraging and its application in optimization problems.	BTL 3	Applying
9.	Analyze the role of division of labor in social insects and discuss its significance in developing multi-agent systems.	BTL 4	Analyzing
10.	Evaluate the mechanisms of task allocation in insect colonies and its computational analogies.	BTL 5	Evaluating
11.	Explain cemetery organization and brood sorting behavior with real-life biological examples.	BTL 3	Applying
12.	Discuss nest building in social insects and relate it with problem solving strategies.	BTL 3	Applying
13.	Analyze the cooperative transport behavior of ants and its relevance to distributed computing.	BTL 4	Analyzing
14.	Propose a hybrid model combining neural networks and swarm intelligence for solving optimization problems.	BTL 6	Creating
15.	Evaluate the impact of different learning paradigms on the performance of artificial neural networks.	BTL 5	Evaluating
16.	Design an artificial neural network model inspired by insect colony behavior for task allocation.	BTL 6	Creating
17.	Critically assess the role of biological systems as models for artificial computation.	BTL 5	Evaluating
18.	Explain the biological nervous system and its influence on the development of artificial neural networks.	BTL 3	Applying

UNIT IV - SWARM ROBOTICS

Foraging for food – Clustering of objects – Collective Prey retrieval – Scope of Swarm Robotics – Social Adaptation of Knowledge: Particle Swarm – Particle Swarm Optimization (PSO) – Particle Swarms for Dynamic Optimization Problems – Artificial Bee Colony (ABC) Optimization biologically inspired algorithms in engineering.

PART – A

1.	Define swarm robotics.	BTL 1	Remembering
2.	What is foraging in swarm robotics?	BTL 1	Remembering
3.	List two applications of swarm robotics in engineering.	BTL 1	Remembering
4.	Differentiate between clustering of objects and foraging.	BTL 2	Understanding
5.	What is collective prey retrieval?	BTL 1	Remembering
6.	State the scope of swarm robotics.	BTL 1	Remembering
7.	Explain the role of communication in swarm robotics.	BTL 2	Understanding
8.	What do you mean by social adaptation of knowledge?	BTL 1	Remembering
9.	Define Particle Swarm Optimization (PSO).	BTL 1	Remembering
10.	List the main components of a particle swarm.	BTL 1	Remembering
11.	Differentiate between PSO and traditional optimization methods.	BTL 2	Understanding
12.	What are dynamic optimization problems?	BTL 1	Remembering
13.	Mention one application of PSO in engineering.	BTL 2	Understanding
14.	What is Artificial Bee Colony (ABC) Optimization?	BTL 1	Remembering
15.	State the biological inspiration behind ABC optimization.	BTL 1	Remembering
16.	List two advantages of ABC over PSO.	BTL 2	Understanding
17.	Differentiate between swarm robotics and individual robot behavior.	BTL 2	Understanding
18.	Define clustering of objects in the context of swarm robotics.	BTL 1	Remembering
19.	Why is prey retrieval considered a collective behavior?	BTL 2	Understanding
20.	Explain the importance of dynamic optimization problems.	BTL 2	Understanding
21.	Define one real-world engineering problem solved using PSO.	BTL 2	Applying
22.	What is the role of ABC in solving optimization tasks.	BTL 2	Applying
23.	Identify the engineering benefits of biologically inspired algorithms.	BTL 1	Analyzing
24.	Name the contributions of swarm robotics to modern AI systems.	BTL 1	Analyzing

PART - B

1.	Explain the concept of foraging for food in swarm robotics with suitable examples.	BTL 3	Understanding
2.	Describe the clustering of objects mechanism in swarm robotic systems.	BTL 3	Understanding
3.	Discuss collective prey retrieval and its relevance to cooperative robotics.	BTL 3	Understanding
4.	Analyze the scope of swarm robotics in engineering and future research.	BTL 4	Analyzing
5.	Explain social adaptation of knowledge and its role in swarm robotics.	BTL 3	Applying
6.	Describe the working principles of Particle Swarm Optimization (PSO).	BTL 2	Understanding
7.	Compare PSO with genetic algorithms in terms of optimization strategies.	BTL 4	Analyzing
8.	Discuss the applications of PSO for solving dynamic optimization problems.	BTL 3	Applying
9.	Evaluate the performance of Particle Swarm Optimization (PSO) in engineering design problems.	BTL 5	Evaluating
10.	Explain the Artificial Bee Colony (ABC) Optimization algorithm with neat flow.	BTL 3	Understanding
11.	Analyze the biological inspiration of ABC and its computational analogy.	BTL 4	Analyzing
12.	Compare ABC and PSO in terms of performance and application areas.	BTL 4	Analyzing
13.	Design a swarm-based algorithm for solving a real-time optimization problem.	BTL 6	Creating

14.	Propose a hybrid optimization model combining PSO and ABC.	BTL 6	Creating
15.	Evaluate the role of biologically inspired algorithms in modern engineering.	BTL 5	Evaluating
16.	Critically assess the challenges in applying swarm robotics to real-world problems.	BTL 5	Evaluating
17.	Discuss the contributions of swarm robotics to artificial intelligence and robotics research.	BTL 4	Analyzing
UNIT V - CASE STUDIES			
Other Swarm Intelligence algorithms: Fish Swarm – Bacteria foraging – Intelligent Water Drop Algorithms – Applications of biologically inspired algorithms in engineering. Case Studies: ACO and PSO for NP-hard problems – Routing problems – Assignment problems – Scheduling problems – Subset problems – Machine Learning Problems – Travelling Salesman problem.			
PART – A			
1.	Define Fish Swarm Algorithm.	BTL 1	Remembering
2.	What is Bacteria Foraging Optimization?	BTL 1	Remembering
3.	State the principle behind Intelligent Water Drop Algorithm.	BTL 1	Remembering
4.	List any two applications of biologically inspired algorithms in engineering.	BTL 1	Remembering
5.	Differentiate between Fish Swarm and Bacteria Foraging.	BTL 2	Understanding
6.	What are the main components of Bacteria Foraging Optimization?	BTL 1	Remembering
7.	Explain chemotaxis in Bacteria Foraging.	BTL 2	Understanding
8.	What is the role of sediment transport in Intelligent Water Drop Algorithm?	BTL 2	Understanding
9.	Identify an engineering problem where the Water Drop Algorithm is applied.	BTL 1	Remembering
10.	What is NP-hard problem? Give an example.	BTL 1	Remembering
11.	Define the routing problem in optimization.	BTL 1	Remembering
12.	Differentiate between assignment problem and scheduling problem.	BTL 2	Understanding
13.	What is the subset problem in combinatorial optimization?	BTL 1	Remembering
14.	Mention the role of Ant Colony Optimization (ACO) in solving TSP.	BTL 2	Understanding
15.	State the advantages of PSO over traditional optimization in NP-hard problems.	BTL 2	Understanding
16.	Give an example of a machine learning problem solved using swarm intelligence.	BTL 2	Understanding
17.	Explain the significance of TSP in optimization research.	BTL 2	Understanding
18.	List two advantages of biologically inspired algorithms.	BTL 1	Remembering
19.	What is swarm-based routing?	BTL 1	Remembering
20.	Explain why NP-hard problems are computationally difficult.	BTL 2	Understanding
21.	Give one case where Fish Swarm is applied to engineering design.	BTL 2	Applying
22.	Define bacteria foraging in solving real-world optimization problems.	BTL 1	Applying
23.	List the importance of case studies in swarm intelligence.	BTL 2	Applying
24.	What is the role of ACO and PSO in solving scheduling problems.	BTL 1	Applying
PART - B			
1.	Explain the working principles of Fish Swarm Algorithm with suitable applications.	BTL 3	Understanding
2.	Describe Bacteria Foraging Optimization and its biological inspiration.	BTL 3	Understanding
3.	Discuss the Intelligent Water Drop Algorithm with neat illustration.	BTL 3	Understanding
4.	Analyze the engineering applications of biologically inspired algorithms.	BTL 4	Analyzing
5.	Compare Fish Swarm, Bacteria Foraging, and Intelligent Water Drop Algorithms.	BTL 4	Analyzing
6.	Apply Fish Swarm Algorithm to a simple optimization problem.	BTL 3	Applying

7.	Demonstrate the working of the Bacteria Foraging Optimization algorithm in solving a constrained optimization problem.	BTL 3	Applying
8.	Evaluate the role of Intelligent Water Drop Algorithm in engineering design.	BTL 5	Evaluating
9.	Discuss ACO and PSO as case studies for solving NP-hard problems.	BTL 4	Analyzing
10.	Explain routing problems and their solutions using swarm intelligence.	BTL 3	Understanding
11.	Describe assignment and scheduling problems in detail with examples.	BTL 3	Understanding
12.	Illustrate the subset problem and its significance in optimization research.	BTL 3	Applying
13.	Analyze the Travelling Salesman Problem and how ACO solves it.	BTL 4	Analyzing
14.	Evaluate the effectiveness of PSO in solving machine learning problems.	BTL 5	Evaluating
15.	Compare ACO and PSO in terms of performance for NP-hard problem solving.	BTL 4	Analyzing
16.	Propose a hybrid algorithm combining Fish Swarm and PSO for scheduling problems.	BTL 6	Creating
17.	Design a biologically inspired optimization model to solve TSP.	BTL 6	Creating
