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

Regulation – 2023

Academic Year 2025 – 26 (ODD SEMESTER)

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 Muti- 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.	State any one difference between GA and traditional optimization.	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.	Give an overview of various modern optimization methods with 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.	Illustrate the role of representation in Genetic Algorithms with a suitable 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 do you understand by "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.	How is Ant Colony Optimization used for solving 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 swarm intelligence.	BTL 1	Remembering
2.	What are the biological inspirations behind swarm intelligence?	BTL 1	Remembering
3.	List any two characteristics of swarm-intelligence systems.	BTL 1	Remembering
4.	What is ant foraging behavior?	BTL 1	Remembering
5.	State the role of pheromones in Ant Colony Optimization (ACO).	BTL 1	Remembering
6.	Define artificial ants in the optimization context.	BTL 1	Remembering
7.	Write any two real-world applications of ACO.	BTL 1	Remembering
8.	What is meant by self-organization in swarm systems?	BTL 1	Remembering
9.	Define combinatorial optimization with an example.	BTL 1	Remembering
10.	What is a heuristic in the context of ACO?	BTL 1	Remembering

11.	Differentiate between local search and global search.	BTL 2	Understanding
12.	What is meant by intensification in metaheuristics?	BTL 2	Understanding
13.	Compare natural ants with artificial ants.	BTL 2	Understanding
14.	Describe the basic working of the ACO algorithm.	BTL 2	Understanding
15.	What is meant by evaporation in ACO?	BTL 2	Understanding
16.	Explain the significance of a tabu list in Tabu Search.	BTL 2	Understanding
17.	What is simulated annealing?	BTL 2	Understanding
18.	List any two advantages of ACO over traditional methods.	BTL 2	Understanding
19.	Define metaheuristic. Give one example.	BTL 2	Understanding
20.	Explain S-ACO briefly.	BTL 2	Understanding
21.	List the components of the ACO metaheuristic.	BTL 2	Understanding
22.	What is stigmergy?	BTL 2	Understanding
23.	Compare ACO and Simulated Annealing.	BTL 2	Understanding
24.	What is the importance of exploration in swarm-based optimization?	BTL 2	Understanding
PART - B			
1.	Explain the biological foundations of swarm intelligence and how they influence algorithm design.	BTL 3	Applying
2.			
3.	Apply the principles of swarm intelligence to solve a basic optimization problem.	BTL 3	Applying
4.	Describe the working mechanism of the Ant Colony Optimization algorithm with a suitable example.	BTL 3	Applying
5.	Analyze how pheromone updating influences the behavior of ACO.	BTL 4	Analyzing
6.	Compare and contrast Ant Colony Optimization and Tabu Search.	BTL 4	Analyzing
7.	Explain the importance of stigmergy and self-organization in swarm-based systems.	BTL 4	Analyzing
8.	Illustrate the steps involved in solving a combinatorial optimization problem using ACO.	BTL 3	Applying
9.	Analyze the impact of parameter tuning on the performance of ACO.	BTL 4	Analyzing
10.	Evaluate the strengths and limitations of simulated annealing compared to ACO.	BTL 5	Evaluating
11.	Justify the need for hybridizing ACO with local-search techniques in solving complex problems.	BTL 5	Evaluating
12.	Evaluate the role of exploration and exploitation balance in ACO.	BTL 5	Evaluating
13.	Design an ACO-based framework for network routing.	BTL 6	Creating
14.	Propose a modification to traditional ACO for improving its convergence rate.	BTL 6	Creating
15.	Construct a model combining ACO and Simulated Annealing for multi-objective optimization.	BTL 6	Creating
16.	Create a case study using ACO for real-world scheduling problems.	BTL 6	Creating
17.	Analyze a scenario where ACO fails to find an optimal solution and suggest improvements.	BTL 4	Analyzing
18.	Apply swarm-intelligence concepts to solve a resource-allocation problem in IoT.	BTL 3	Applying

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