Course Description Form

1. Course Name: Optimization Theory and Algorithms
2. Course Code:
3. Semester / Year: First Semester/ Ph.D. Studies
4. Description Preparation Date:2025-2026
5. Available Attendance Forms: Full time
6. Number of Credit Hours (Total) / Number of Units (Total):30 hour\ 2 units
7. Course administrator's name (mention all, if more than one name)
Name: Ass. Prof.Dr.Nadia Fadhil AL-Bakri Email: nadia.f.al-bakri@nahrainuniv.edu.iq
8. Course Objectives

Course Objectives	○ Understand fundamental concepts of optimization theory and different types of optimization problems. ○ Develop the ability to formulate real-world problems as optimization models. ○ Gain knowledge of unconstrained and constrained optimization techniques. ○ Apply linear programming methods, including the simplex algorithm, to solve optimization problems. ○ Analyze and implement nonlinear optimization methods, particularly gradient-based approaches. ○ Explore stochastic and nature-inspired optimization algorithms. ○ Understand and apply multi-objective optimization techniques. ○ Gain practical knowledge of evolutionary programming methods. ○ Apply optimization techniques in various areas such as machine learning, control systems, data mining, logistics, and finance. ○ Develop skills in implementing optimization algorithms using appropriate software tools.

9. Teaching and Learning Strategies

Strategy	○ **Lectures:** Deliver core theoretical concepts and mathematical foundations optimization. ○ **Interactive Discussions:** Encourage critical thinking and problem-solv through class discussions. ○ **Problem-Solving Sessions:** Practice solving optimization problems manu and computationally.

	○ **Case Studies:** Analyze real-world applications in areas like machine learning a logistics. ○ **Hands-on Programming:** Implement optimization algorithms using softw tools and programming languages. ○ **Group Work:** Promote collaborative learning through team-based assignme and projects. ○ **Research-Based Learning:** Assign recent research papers to explore advan optimization techniques. ○ **Presentations:** Students present topics such as evolutionary algorithms multi-objective optimization. ○ **Assignments and Projects:** Apply theoretical knowledge to pract optimization problems. ○ **Self-Directed Learning:** Encourage independent study using textbooks a recent publications.

10. Course Structure

Week	Hours	Required	Unit or subject name	Learning method	Evaluation method
1	2 theory		Introduction to Optimization: Basic concep types of optimization problems and challenges. Derivatives and Gradients	Formal Lectures	Class Activity
2	=		Linear Programming and Application in Lin Programming Graphical method (Geometric Approach). 2- Simplex method. Modelling LP problems Convex sets	Formal Lectures	Class Activity and Quiz
3	=		Stochastic Gradient Descent (SGD) Stochastic and mini-batch gradient descent	Formal Lectures	Class Activity
4	=		Optimization algorithms	Formal Lectures	Class Activity
5	=		Metaheuristics	Formal Lectures	Class Activity
6	Mid1 exam				
7	=		Multi Objective Optimization Concepts	Formal Lectures	Class Activity
8	=		Pareto optimization	Formal Lectures	Class Activity
9			Salp Swarm algorithm Genetic Algorithm for Diamond Extraction Optimization	Formal Lectures	Class Activity and Quiz
10	=		Pelican Optimization Algorithm	Formal Lectures	Class Activity

					and Quiz
11	Mid2				
12,13	=		Honey Badger Algorithm Swift Optimization Algorithm	Formal Lectures	Class Activity
14,15	=		Nature-Inspired Optimization Algorithm Hunger Game Search	Formal Lectures	Class Activity

11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	1-Global Optimization Algorithms–Theory and Application 2-OPTIMIZATION Algorithms and Applications. 3-Algorithms for Optimization. 4-Linear Programming. 5-Introduction to the Theory of Nonlinear Optimization. 6-Optimization Theory.
Main references (sources)	
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	