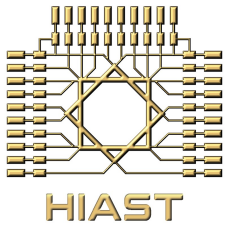
Syrian Arab Republic

Higher Institute for Applied Sciences and Technology



Course Specification Document

Title	Algorithms and Data Structures

Credits	5 ECTS

Aims	This course aims to provide the student with the fundamental knowledge necessary to understand and analyze algorithms, as well as to equip them with the mental skills required to utilize abstract data structures in problem-solving and algorithm design.

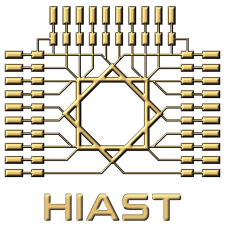
Intended learning outcomes

On successful completion of this course, the student will be able to:

- Understand algorithm structure and recognize methods for analyzing algorithms.
- Identify sorting, ordering, and comparison algorithms.
- Comprehend abstract data structures, their use, and differences between them.
- Grasp the structure of graphs and understand how to interpret problems as graph-related problems.
- Understand algorithms used for traditional graph problems (finding the shortest path in a graph, finding maximum flow).
- Understand algorithms used to deal with traditional graph problems (finding the shortest path in a graph, computing minimum spanning trees).
- Calculate the time complexity of an algorithm and prove algorithms correctness.
- Implement abstract data structures and master fundamental operations on abstract data structures.

Syllabus

- **Basic concepts in algorithms:** Algorithm structure, best-case, worst-case, and average-case complexities, asymptotic function growth.
- **Algorithm analysis:** General concepts in algorithm analysis, loop invariants, recurrence relations, master theorem.
- **Search and sorting algorithms:** Search algorithms, sorting and ordering algorithms.
- **Abstract data structures:** Linked lists, stacks, queues, heaps.
- **Hash tables:** Concepts of hash tables and operations, open and closed hash tables.
- **Tree structures:** Tree representation, binary trees, binary search trees, balanced binary trees, and operations on them.
- **Basic concepts in graphs:** Fundamental definitions, data representation, breadth-first and depth-first traversal algorithms, spanning trees and algorithms to find them.



- **Shortest path algorithms:** Problem description and practical applications, solution algorithms for different cases: Dijkstra, Bellman-Ford, Floyd-Warshall.
- **Maximum flow algorithms:** Maximum flow problem and its applications, concept of cuts, solution algorithms, applications in matching and assignment problems.