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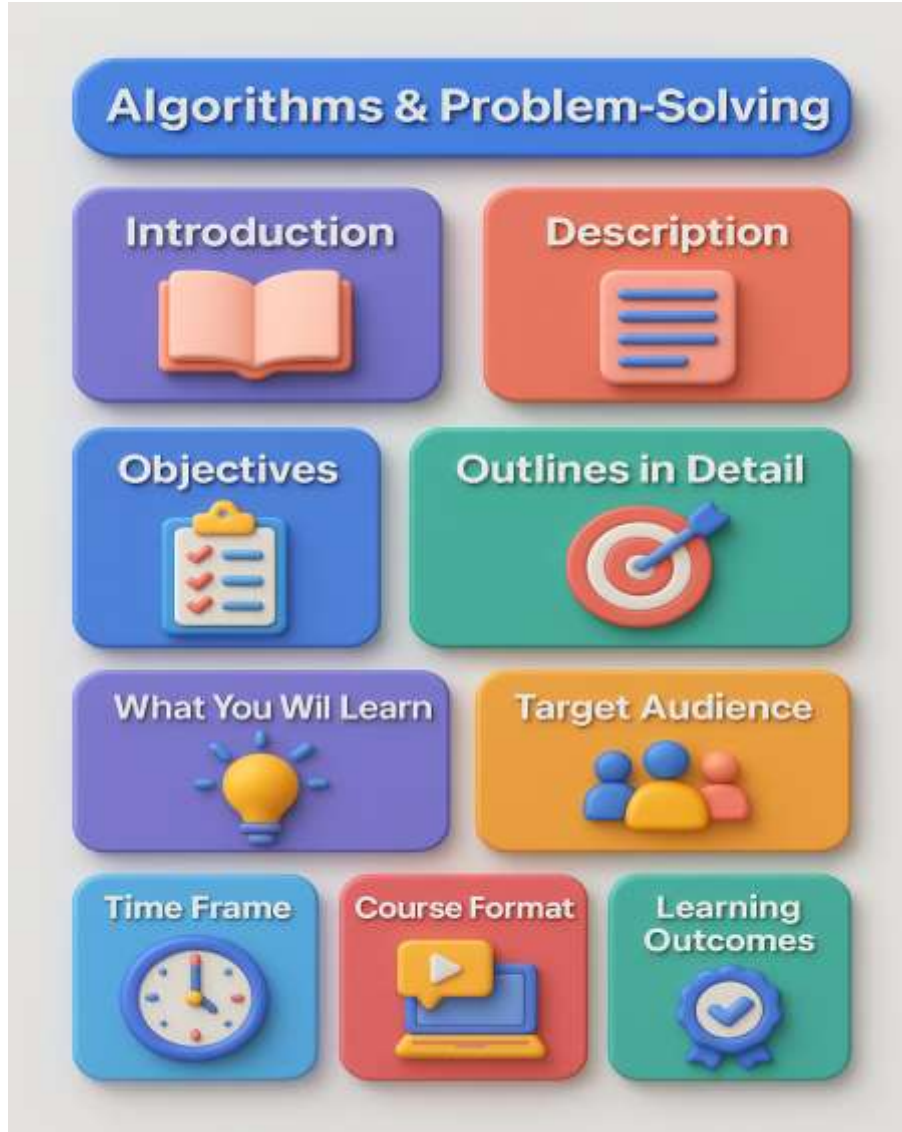
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المعهد الهندسي لخدمات التكنولوجيا والبرمجيات



Engineering office for Technology and Software Services

# Course: Algorithms & Problem-Solving



**Code: 21063-CS**

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, El Siouf \_Alexandria

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## Introduction

Algorithmic thinking and problem-solving are fundamental skills in computer science, mathematics, and engineering. This course provides a comprehensive introduction to algorithms and systematic problem-solving approaches, enabling students to develop robust solutions to computational problems using proven methods.

## Description

This course covers the principles of algorithms, their design, analysis, and applications to practical problems. It explores classic algorithmic strategies such as recursion, divide-and-conquer, dynamic programming, and greedy methods. Through lectures, interactive exercises, and real-world examples, learners gain the ability to conceptualize and implement efficient algorithms.

## Objectives

- To introduce the theoretical and practical aspects of algorithms and problem-solving.
- To develop skills for analyzing the complexity and efficiency of algorithms.
- To enable students to design, implement, and evaluate solutions to computational problems.
- To foster critical thinking and systematic approaches to solving novel problems.

## Outlines in Detail

1. **Introduction to Algorithms**
  - Definition and significance
  - Historical context
  - Types of algorithms
2. **Algorithmic Problem-Solving Approaches**

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- Problem analysis
- Problem decomposition
- Abstraction and modeling

### 3. Algorithm Design Paradigms

- Brute-force algorithms
- Greedy algorithms
- Divide-and-conquer
- Dynamic programming
- Backtracking and branch-and-bound

### 4. Complexity Analysis

- Time and space complexity
- Big O, Big  $\Omega$ , and Big  $\Theta$  notations
- Analyzing best, average, and worst-case scenarios

### 5. Data Structures in Algorithm Design

- Arrays, lists, stacks, queues
- Trees and graphs
- Hash tables and heaps

### 6. Practical Problem-Solving

- Algorithm implementation in pseudocode and programming languages
- Debugging and testing
- Case studies and real-world applications

### 7. Algorithmic Thinking in Research and Industry

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- Current trends
- Ethical considerations

## What You Will Learn

- Fundamental concepts of algorithms and their role in computer science.
- Systematic approaches to problem analysis and solution design.
- Core algorithmic paradigms and when to apply them.
- Methods for evaluating and comparing algorithmic efficiency.
- Practical skills in writing, testing, and debugging algorithms.
- Application of algorithms to real-world and research problems.

## Target Audience

- Undergraduate and graduate students in computer science, engineering, mathematics, or related fields.
- Professionals seeking to enhance algorithmic thinking and problem-solving abilities.
- Anyone interested in the foundational principles of computational problem-solving.

## Materials

- Textbook: "Introduction to Algorithms" (Cormen et al., 2009)
- Supplementary readings from review articles and peer-reviewed journals
- Lecture slides and recorded videos
- Online coding platforms (e.g., LeetCode, HackerRank)

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- Sample problem sets and solutions

## Instruction Methods

- Interactive lectures with multimedia presentations
- In-class and online problem-solving workshops
- Collaborative group assignments
- Case study analyses
- Formative and summative assessments

## Time Frame

- Total duration: 8 weeks
- Weekly commitment: 3 hours (2 hours lecture, 1 hour workshop/problem-solving session)

## Course Format

- **Hybrid:** Combination of in-person and online sessions
- **Modules:** 8 weekly modules, each focused on specific topics
- **Assessment:** Quizzes, assignments, midterm project, and final exam
- **Support:** Online discussion forums and office hours

## Learning Outcomes

Upon completion of this course, students will be able to:

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1. Explain fundamental concepts and paradigms of algorithm design.
2. Analyze and compare algorithmic solutions for efficiency and correctness.
3. Design and implement algorithms to solve a range of computational problems.
4. Critically evaluate algorithmic solutions in real-world contexts.
5. Demonstrate enhanced problem-solving and critical-thinking abilities in computational settings.

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