COMSATS University Islamabad
Department of Computer Science
Course Description Form (CDF)

Course Information

Course Code: **CSC301** | Course Title: **Design and Analysis of Algorithms**
Credit Hours: **3(3, 0)** | Lecture Hours/Week: **3**
Lab Hours/Week: **0** | Pre-Requisites: **CSC211-Data Structures**

Course Objective

- To develop an ability to analyze the asymptotic performance of algorithms;
- To discuss rigorous correctness proofs for algorithms;
- To explain the major algorithms and data structures;
- To apply important algorithmic design paradigms and methods of analysis;
- To highlight the significance of NP complete problems.

Course Content

This course is designed to provide knowledge of the principles and techniques used in the design and analysis of algorithms. Topics cover: Overview of Algorithm; Designing Techniques: Brute Force, Decrease and Conquer, Divide and Conquer, Transform and Conquer Technique, Dynamic Programming, Greedy Approach, Correctness of Algorithms, Analyzing Time Complexity of Iterative and Recursive Algorithms; and Computability.

Unit wise Major Topics:

Unit	Topic	No. of Teaching Hours
1.	Overview of Algorithm: Concepts, Properties, The Role of Algorithms in Computing, Algorithm Design & Analysis Process, Iterative Algorithm Design Issues, Top-Down Design, Design using Recursion.	4.5
2.	Brute Force (BF) Technique: Designing Algorithms for Sorting problem, Pattern Matching, Closest-Pair, and Convex-Hull Problems.	3
3.	Decrease and Conquer: Designing Algorithms for Sorting problem, Graph Traversal, Topological Sorting, Algorithms for Generating Combinatorial Objects, Decrease by -a-Constant Factor Algorithms, Variable Size Decrease Algorithms.	4.5
4.	Divide and Conquer Technique: Designing Algorithms for Sorting problem, Closest-Pair, and Matrix Multiplication Problem.	4.5
5.	Transform and Conquer Technique: Transformation to more convenient instance, Transformation to different representation, and Problem Reduction.	3
6.	Dynamic Programming (DP) Technique: Component & Properties; Designing Algorithms for Edit Distance; Longest Common Subsequence (LCS); Knapsack; and Matrix Chain Multiplication Problems.	6
7.	Greedy Approach: Algorithm for Data Compression, Coin Change Problem.	3
8.	Correctness of Algorithms: Pre-conditions, Post-conditions, Loop Invariant, Correctness of Iterative & Recursive Algorithms.	4.5

9.	Analysis of Algorithms: RAM Model, Asymptotic Notations, Worst, Best & Average Case Behavior of Algorithms; Complexity Classes; Solving Recurrence Relations: Substitution Method, Recurrence Tree Method, Master Method and Time & Space Tradeoffs.	7.5
10.	Computability: The Complexity Classes P & NP; and Introduction to NP Complete Problems.	4.5
Total Contact Hours		**45**

Mapping of CLOs and GAs

Sr.#	Unit #	Course Learning Outcomes	Blooms Taxonomy Learning Level	GA
CLO-1	1-2	Demonstrate an algorithmic approach to a given problem.	*Understanding*	2
CLO-2	3-7	Design new algorithms for different computational problems.	*Creating*	2-4
CLO-3	8	Prove correctness of an algorithm using loop invariant and induction.	*Applying*	2
CLO-4	9	Analyze best, average, and worst-case behaviors of an algorithm.	*Analyzing*	3
CLO-5	10	Explain the concept of various complexity classes with examples.	*Understanding*	2

CLO Assessment Mechanism

Assessment Tools	CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Quizzes	Quiz 1	Quiz 2	Quiz 3	Quiz 4	
Assignments		Assignment 1&2	Assignment 3	Assignment 4	
Mid Term Exam	Mid Term Exam	Mid Term Exam	-	-	
Final Term Exam	Final Term Exam				

Text and Reference Books

Textbook:

1. Introduction to the Design and Analysis of Algorithms, Levitin, A., Pearson, 2017.

Reference Book:

1. Introduction to Algorithms, Cormen, T. H., Leiserson, C.E., Rivest, R.L. & Stein, C., MIT Press, 2022.