COMSATS INSTITUTE OF INFORMATION TECHNOLOGY (ISLAMABAD)
BS-COMPUTER SCIENCE (COURSE DESCRIPTION FORM)

CSC301 – DESIGN AND ANALYSIS OF ALGORITHMS

Number of Credit Hours:	☑ 3 credits	❑4 credits	
Number of Lecture Hours per Week:	❑ 1 hour	❑ 2 hours	☑ 3 hours
Number of Lab Hours per Week:	☑ none	❑ 2 hours	❑ 3 hours
Number of Tutorial Hours per Week:	☑ none	❑ 1 hour	❑ 2 hours

Catalog Description:
This course is designed to provide comprehensive knowledge of algorithms with an understanding of the principles and techniques used in the design and analysis of algorithms. The topics covers include: Problem solving: Proving correctness of algorithm using Loop Invariants; Asymptotic Notations: Worst, Best and Average Case Behavior of Algorithms; Big O notation; Complexity Classes i.e. Constant, Linear, Quadratic; Empirical Measurements of Performance; Time and Space Tradeoffs in Algorithms; Recurrence Algorithms; Analysis of Iterative and Recurrence Relations; Master Theorem; Divide and Conquer; Recursive Backtracking; Worst Case Quadratic Sorting Algorithms, Worst or Average Case Sorting Algorithms (Quick, Heap & Merge Sort); Representation of Graphs, Depth First and Breadth First Traversal; Brute Force Algorithms; Greedy Algorithms; Approximation Algorithms; Dynamic Programming; Branch-and-Bound Techniques; Heuristics; Reductions: Transform and Conquer; Basic Computability: The Complexity Classes P and NP; Introduction to NP Complete Problems.

Prerequisites:
CSC211-Data Structures and Algorithms

Text Book:
1. Introduction to Algorithms, Cormen, T. H.,Leiserson, C.E., Rivest, R.L.& Stein, C., 3rd Edition (2009), MIT Press.

Reference Books:
1. An Introduction to the Analysis of Algorithms, Sedgewick, R.& Flajolet, P., 2nd Edition (2012), Addison-Wesley.
2. Foundation of Algorithms Using C++ Pseudocode, Neapolitian, R., 6th Edition (2013), Jones & Bartlett Learning .
3. Introduction to the Design and Analysis of Algorithms, Levitin, A., 3rd Edition (2012), Pearson.

Assessment Plan for the Course:

Evaluation methods	**Theory Weight (%)**
Quizzes (4)	15
Assignments (4)	10
Sessional exam(I and II)	10 and 15
Terminal Exam	50
Total	**100**

Major Topics Covered in the Course:

Unit	**Topic**	**No of teaching hours**
1.	The concept and properties of algorithms, Fundamentals of algorithmic problem solving.	3
2	Proving correctness of algorithms, Pre-condition, Post-condition, correctness of iterative algorithm using loop invariants, correctness of recursive algorithm using mathematical induction.	4.5
3	Asymptotic Notations: Big O Notation, Sigma Notation, Theta Notation, Worst, Best and Average Case Behavior of Algorithms; Complexity Classes i.e. Constant, Linear, Quadratic; analysis of iterative algorithms, Empirical Measurements of Performance; Time and Space Tradeoffs in Algorithms.	6
4.	Divide and Conquer; Solving recurrences: substitution method, recurrence tree method and master method, Analysis of Merge and Quick and heap Sort Algorithms, Recursive Backtracking.	7.5
5.	Brute – force Algorithms and their analysis.	3
7.	Dynamic programming, Comparison of DP and Divide and Conquer, Various Examples.	6
6.	Graphs Terminology, representation techniques, and traversal algorithms, Graph Greedy Algorithms.	4.5
7.	Heuristics, Branch-and-Bound Techniques, Approximation Algorithms.	3
8.	Basic Computability: The Complexity Classes P and NP; Introduction to NP Complete Problems.	4.5
Total Contact Hours		**42**

Course Learning Outcomes:

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

C1	Identify the properties and prove correctness of an algorithm.
C2	Compute time complexity of algorithms.
C3	Compare sorting algorithms.
C4	Develop algorithms for computational problems using various algorithmic design paradigms.
C5	Describe the basics of computability.

Relationship between Course Learning Outcomes and Program Learning Outcomes:

Course Learning Outcomes	**Unit of the syllabus**	**Possible artifacts**	**Level**	**Program Learning Outcomes**
C1	1-2	Quizzes, Assignments, Sessional Exams	L	a-1, a-2
C2	3	Quizzes, Assignments, Sessional Exams	M	a-2, c-3
C3	4	Quizzes, Assignments, Sessional Exams	H	a-2, c-3
C4	5-7	Quizzes, Assignments, Terminal Exam	H	j-2
C5	8	Quizzes, Assignments, Terminal Exam	L	a-1

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