**NATIONAL UNIVERSITY OF MODERN LANGUAGES ISLAMABAD**

**DEPARTMENT OF SOFTWARE ENGINEERING**

**ANALYSIS OF ALGORITHMS (SEAA-242)**

**COURSE OUTLINE - BSSE PROGRAM**

1. **Course Details**

|  |  |
| --- | --- |
| **Credit Hours:** | 3 (3+0) |
| **Pre-requisites:** | Discrete Structures, Data Structures & algorithms |
| **Instructor:** | Ms. Iqra Shahzad |
| **Recommended Book(s):** | Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, MIT press, Third Edition, 2009 |
| **Reference Books:** | * + - 1. Data Structures and Algorithm Analysis in C++ by Mark Allen Weiss, Fourth Edition, 2013       2. Algorithms by Robert Sedgewick and Kevin Wayne, 4th Edition 2011 |

1. **Course Learning Outcomes (CLO)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CLOs** | **Description** | **Domain** | **Taxonomy level** | **PLOs** | **Assessment Artifacts** |
| **CLO1** | **Explain** what is meant by “best”, “expected”, and “worst” case behavior of an algorithm and logic formation | C | 2 | 2 | A1, Q1, Mid Term, Final Term |
| **CLO2** | **Illustrate** informally and formally the time and space complexity of simple and advanced data structures and algorithms | C | 3 | 3 | A2, Q2, Mid Term , Final Term |
| **CLO3** | **Demonstrate** problem solving for Real-world problems using the strategies(brute-force, greedy, divide-and conquer, and dynamic programming) to solve an appropriate problem | C | 3 | 3 | A3, Q3, Final Term, Final Term |

1. **Course Assessment**

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| --- | --- |
| **Evaluation Methods** | **Weight (%)** |
| Quizzes | 15 |
| Assignments | 10 |
| Presentations/project | 10 |
| Mid Term | 25 |
| Final Term | 40 |
| **Total** | **100** |

1. **Grading Policy**

For students admitted in Fall 2021 and onwards

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Grade** | **A+** | **A** | **B+** | **B** | **C+** | **C** | **D+** | **D** | **F** |
| **%age** | >=90 | 80-89 | 75-79 | 70-74 | 65-69 | 60-64 | 55-59 | 50-54 | <50 |
| **GPA** | 4.00 | 4.00 | 3.50-3.99 | 3.00-3.49 | 2.50-2.99 | 2.00-2.49 | 1.50-1.99 | 1.00-1.49 | 0.00 |

For students admitted before Fall 2021

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Grade** | **A1** | **A2** | **A3** | **B1** | **B2** | **B3** | **C1** | **C2** | **D** | **F** |
| **%age** | >=90 | 80-89 | 77-79 | 74-76 | 70-73 | 67-69 | 64-66 | 60-63 | 50-59 | <50 |
| **GPA** | 4.00 | 4.00 | 3.66 | 3.33 | 3.00 | 2.66 | 2.33 | 2.00 | 1.50 | 0.00 |

1. **Course Contents**

Introduction; Asymptotic notations; Recursion and recurrence relations; Divide-and-conquer approach; Sorting; Search trees; Heaps; Hashing; Greedy approach; Graph algorithms; Shortest paths; Network flow; Disjoint Sets; Polynomial and matrix calculations; String matching; NP complete problems; Approximation algorithms

1. **Weekly Breakdown**

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| --- | --- | --- | --- |
| **Week No.** | **CLO Mapped** | **Topics** | **Chapters** |
| 1 | CLO1 | Introduction to analysis of algorithm, Complexity Analysis, Primitive operations, Time Efficiency, Time efficiency of Find-Max element in array algorithm Complexity Analysis: Space efficiency, Correctness | Chapter 1, chapter 2 |
| 2 | CLO2 | Order of Growth, Array Searching algorithms, Growth functions, standard growth functions, Asymptotic Analysis, Analysis of Bubble, Selection and Insertion Sort | Chapter 2, chapter 3 |
| 3 | Recursive functions ,Time complexity analysis of Recursive algorithm using recurrence relation back substitution, Master theorem | Chapter 4 |
| 4 | Recursion tree, Time complexity analysis of recursive algorithms using Recursion tree | Chapter 4 |
| 5 | CLO1 | Divide and Conquer Approach, Quick sort, Merge Sort and their time complexities | Chapter 4 , chapter 7 |
| 6 | CLO2 | Binary Search Tree and its algorithms (Insertion, deletion, search, min, max, predecessor. Successor, BST Traversal) | Chapter 12 |
| 7 | CLO1 | Asymptotic analysis. Big O , Big Omega, Big Theta, little o, little omega. Mathematical concepts | Chapter 3 |
| 8 | CLO2 | Heap & its Properties, Make heap using Insert, Increase Key, Max and Extract max, Heapify, | Chapter 6 |
| 9 | Heap Sort, analysis of Heap Sort, Stable/unstable nature of Heap Sort | Chapter 6 |
| 10 | Red black Trees and Properties, Insertion, deletion operations, Space and Time complexity | Chapter 13 |
| 11 | CLO3 | Graph theory, Elementary graph algorithms and their analysis | Chapter 22 |
| 12 | Greedy Algorithms: Introduction to Greedy Algorithms, analysis of minimum & maximum spanning tree, Kruskal, Prims | Chapter 16  Chapter 23 |
| 13 | Greedy Algorithms: analysis Dijkistra’s algorithm for single source shortest path, Graph traversal BFS & DFS | Chapter 25 |
| 14 | All Pair Shortest path problem and analysis & Bellman Ford Algo for shortest path | Chapter 25  Chapter 24 |
| 15 | Introduction to dynamic programming strategy, Its difference with greedy and divide & conquer | Chapter 15 |
| 16 | String Matching Algorithm: Naïve String Matching Algorithm, KMP, Rabin Karp | Chapter 32 |