Course Objective and Outcome Form
Department of Electrical and Computer Engineering
School of Engineering and Physical Sciences
North South University, Bashundhara, Dhaka-1229, Bangladesh

1. **Course Number and Title:** CSE 373 Design and Analysis of Algorithms

2. **Number of Credits:** 3

3. **Type:** Core

4. **Prerequisites:** CSE 225 - Data Structure and Algorithms, MAT 361 - Probability and Statistics

5. **Contact Hours:** 3 Hours (Theory)

6. **Course Summary:**

   This course introduces basic methods for the design and analysis of efficient algorithms emphasizing methods useful in practice. Different algorithms for a given computational task are presented and their relative merits evaluated based on performance measures. The following important computational problems will be discussed: sorting, searching, elements of divide-and-conquer, dynamic programming and greedy algorithms, advanced data structures, graph algorithms (shortest path, spanning trees, tree traversals), string matching, NP completeness.

7. **Course Objectives:**

   The objectives of this course are to

   a. analyze the asymptotic performance of algorithms.
   b. write rigorous correctness proofs for algorithms.
   c. demonstrate a familiarity with major algorithms and data structures.
   d. apply important algorithmic design paradigms and methods of analysis.
   e. synthesize efficient algorithms in common engineering design situations.

8. **Course Outcomes (COs):**

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

Sl.	**CO Description**	**Weightage (%)**

CO1	analyze time complexity of algorithms using asymptotic analysis.	20
CO2	apply different algorithm paradigms for a given problem	35
CO3	explain the major graph algorithms and their analyses to model engineering problems.	35
CO4	explain the classes P, NP, and NP-Complete .	10

9. **Mapping of CO-PO:**

Sl.	CO Description	POs	Bloom's taxonomy domain/level	Delivery methods and activities	Assessment tools
CO1	**Analyze** time complexity of algorithms using asymptotic analysis.	**b**	Cognitive/ Analyze	Lectures, Notes	Quiz/ assignment/ exam
CO2	**Apply** different algorithm paradigms for a given problem	**a**	Cognitive/Apply	Lectures, Notes	Quiz/Exam /assignment
CO3	**Explain** the major graph algorithms and their analyses to model engineering problems.	**a**	Cognitive/ Understand	Lectures, Notes	Quiz/Exam
CO4	**Explain** the classes P, NP, and NP-Complete.	**a**	Cognitive/ Understand	Lectures, Notes	Quizzes, Exam

10. **Resources**

Text books:

No	Name of Author(s)	Year of Publication	Title of Book	Edition	Publisher's Name	ISBN
1	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein	2009	Introduction to Algorithms	3rd	MIT Press	9780262033848

Reference books:

No	Name of Author(s)	Year of Publication	Title of Book	Edition	Publisher's Name	ISBN
1	Robert Sedgewick and Kevin Wayne	2011	Algorithms	4th	Addison-Wesley	9780321573513

Online resources:

11. **Weightage Distribution among Assessment Tools**

Assessment Tools	**Weightage (%)**
Class Performance	5
Quizzes	20
Assignment	10
Midterm	25
Final Exam	40

12. **Grading policy:** As per NSU grading policy available in

http://www.northsouth.edu/academic/grading-policy.html

Semester Plan

Course Topics
Introduction to Algorithm and Flowchart. Illustrate best and worst case running time analysis of algorithm using Insertion Sort as an example
Asymptotic analysis of algorithms: Big Oh, Big Omega, and Big Theta notations Analyse worst case running times of different algorithms
Introduction to divide and conquer algorithms. Describe different divide & conquer (D&C) algorithms: (i) Binary Search (ii) Merge Sort, (iii) Quick Sort, (iv) Selection algorithm to compute i-th smallest number in an array, and (v) Two D&C algorithms for multiplying two n-bit binary numbers. Demonstrate the correctness proof of algorithms using loop invariants. Introduction to recurrence relations and its closed form solutions. Using recurrence relations for representing running time of D&C algorithms.

Methods for solving recurrence relations: substitution methosds and recursion tree method. Master Method. [Programming Assignment]
Heap data structure and its operations/applications: MaxHeapify, BuildMaxHeap, HeapSort, etc. Analyzing running time of these algorithms. Heap based implementation of Priority Queue and it operations; especially, ExtractMax and Insert. Analysing the running time of these algorithms.
Lower bound on the running time of comparison sorts. Linear time sorting algorithms: (i) Counting Sort, (ii) Radix Sort, (iii) Bucket Sort. Applicability and running time analysis of these algorithms [Proof Assignment]
Types of computational problems: Decision/Search/Counting/Optimization problems. Describe greedy algorithms, its properties and its analysis. Activity Selection, Fractional Knapsack, and Huffman Coding problems. [Programming Assignment]
Describe dynamic programming (DP) algorithms, its properties and contrast them with greedy problems. Top down and bottom up approaches of DP. Rod Cutting, Matrix Chain Multiplication, and Longest Common Subsequence problems and analysis of their related algorithms [Programming Assignment]
Explain major graph algorithms: BFS, DFS, TopologicalSorting, MST-KrusKal, MST-Prims, Dijkstra's, BellmanFord and FloydWarshall algorithms. Implementation and analysis [Programming Assignment]
Unsolvable vs. Intractable problems, P vs. NP, Basic theory of NP Completeness, common NP-complete problems