Rajshahi University of Engineering & Technology
Computer Science & Engineering Department
Course No. CSE 2201 Course title: Computer Algorithms

Prerequisite courses:

- CSE 1201 (Data Structure)
- CSE 1101 (Computer Programming)/ CSE 1203 (Object Oriented Programming)

Course Objectives:

Computer algorithms are the building blocks in computer programming. This course will give students a comprehensive introduction of common data structures, algorithm design and analysis. Unlike programs, algorithms are not dependent on a particular programming language, machine, system, or compiler. They are mathematical entities, which can be thought of as running on some sort of idealized computer with an infinite random access memory and an unlimited word size. Algorithm design is all about the mathematical theory behind the design of good programs. It makes familiar with fundamental algorithms, algorithmic techniques and analyze the running time of a given algorithm.

Syllabus:

Contact hours/cycle: 3
Credits: 3.00

Asymptotic notations: Complexity analysis of algorithms, worst case, best case and average case.
Sorting algorithms: Divide and Conquer approach, Merge Sort and Quick Sort Algorithm, complexity analysis, worst and average case analysis, Heap Construction Algorithm, Heap sort, Application of Heap: Priority Queue, Decision tree model and (worst case) lower bound on sorting, Sorting in linear time - radix sort, bucket sort, counting sort, etc.
Graph algorithms: Representation of Graphs, Breadth First Search, Depth First Search, Minimum Spanning Tree, Kruskal and Prims Algorithm.
Shortest Path: Dijkstra‟s Algorithm, Bellman-Ford Algorithm. Floyd Warshall Algorithm.
Searching algorithms: Binary search trees, balanced binary search trees, AVL trees and red-black trees, B-trees, skip lists, hashing. Priority queues, heaps, Interval trees.
Dynamic Programming: Longest Common Subsequence (LCS), Matrix Chain Multiplication (MCM).
Greedy Algorithm: Greedy Algorithm, Activity Selection Problem, Huffman Codes and it's application, Knapsack problem, Traveling Salesperson Problem.
Recurrences & Backtracking: Recurrences, *NP*-Hard and *NP*-Complete Problems, Backtracking, *n*-Queen Problem, Branch and Bounds.
Reducibility between problems and NP-completeness: Lower bound theory, Discussion of different NP-complete problems like satisfiability, clique, vertex cover, independent set, Hamiltonian cycle, TSP, knapsack, set cover, bin packing, etc. Computational Geometry, Line Segment Properties, Convex Hull, Graham Scan Algorithm of Convex Hull.

Outline of the Course:

Cycle	Topics
1st	**Technique for analysis Algorithm:** Algorithm, Properties of good algorithm, Data Structure, Application Areas of Algorithm. Time and Space Complexity Analysis of Algorithms, Asymptotic Notations, Analysis a known algorithm as example (i.e. Insertion Sort and its Complexity Analysis).
2nd	**Divide and Conquer**: general method, binary search, finding the maximum and minimum, merge sort, quick sort, selection strassen's matrix multiplication, convex hull (computational geometry).
3rd	**Greedy Method:** general method, An activity-selection problem, knapsack problem,

	tree vertex splitting, job sequencing with deadline, minimum cost spanning tree, single source shortest path.
4th	**Dynamic Programming**: general method, longest common subsequence (LCS), matrix-chain multiplication (MCM), multistage graph, all pairs shortest paths: general weights, 0/1 knapsack.
5th	**Basic Traversal and Search Techniques**
6th	**Backtracking**: the general method, the 8-queen problem, sum of subsets, graph coloring, Hamiltonian cycles.
7th	**Branch and Bound**
8th	**Algebraic Simplification and Transformation,**
9th	**Lower Bound Theory**
10th	**NP-hard and NP-complete problems**
11th	**Reserve**
12th	**Reserve**

Reference:

- Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, “Fundamentals of Computer Algorithm”.
- Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction To Algorithms", Second Edition.