

**Guidelines for B.Sc. (H) Computer Science Semester V (NEP UGCF 2022)****Algorithms and Advanced Data Structures**

| S. No.   | Topic                                                                                                | Content                                                                                                                                                                      | Reference | Hours |
|----------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------|
| <b>1</b> | Unit 1<br>Advanced Analysis of Algorithms                                                            | Ch 16 - 16.1, 16.2                                                                                                                                                           | [2]       | 10    |
|          | Intractability                                                                                       | Ch 8 - 8.1, 8.3, 8.4<br>(upto theorem 8.12)                                                                                                                                  | [3]       |       |
| <b>2</b> | Unit 2<br>String Matching: Brute Force, KMP algorithm                                                | Ch 12 - 12.3.1, 12.3.3,                                                                                                                                                      | [1]       | 13    |
|          | Tries: Standard Tries, Compressed Tries, Suffix Tries, Search Engines                                | Ch 12 - 12.5                                                                                                                                                                 | [1]       |       |
|          | Network Flows: Ford Fulkerson algorithm for the max flow problem                                     | Ch 7 - 7.1                                                                                                                                                                   | [3]       |       |
| <b>3</b> | Unit 3<br>More on Trees: B Trees, 2-4 Trees                                                          | Ch 7 - 7.1.1, 7.1.8 (upto the derivation of expression for relation between height and number of nodes in a 2-4 tree (excluding insertion, deletion and related operations)) | [4]       | 16    |
|          | More on Graphs: Bellman Ford Algorithm, Union Find Data Structures - application Kruskal's algorithm | Ch 6 - 6.8<br>Ch 4 - 4.6                                                                                                                                                     | [3]       |       |
| <b>4</b> | Unit 4<br>Randomization: Randomized Quicksort, Randomized Select, Skip lists                         | Ch 7 - 7.3, Ch 9 - 9.2                                                                                                                                                       | [2]       | 6     |
|          |                                                                                                      | Ch 9 - 9.4 (Intro, 9.4.1)                                                                                                                                                    | [1]       |       |

**Essential/Recommended readings**

1. Goodrich, M.T, Tamassia, R., & Mount, D. Data Structures and Algorithms Analysis in C++, 2nd edition, Wiley, 2011 (Note: An e-copy of this book can be procured from the publisher for the college library).

2. Cormen, T.H., Leiserson, C.E., Rivest, R. L., Stein C. Introduction to Algorithms, 4th edition, Prentice Hall of India, 2022.
3. Kleinberg, J., Tardos, E. Algorithm Design, 1st edition, Pearson, 2013.
4. Drozdek, A. Data Structures and Algorithms in C++, 4th edition, Cengage Learning. 2012.

### **Practical List (30 Hours)**

1. Write a program to sort the elements of an array using Randomized Quick Sort (the program should report the number of comparisons).
2. Write a program to find the  $i^{\text{th}}$  smallest element of an array using Randomized Select.
3. Write a program to determine the minimum spanning tree of a graph using Kruskal's algorithm.
4. Write a program to implement the Bellman-Ford algorithm to find the shortest paths from a given source node to all other nodes in a graph.
5. Write a program to implement a B-Tree.
6. Write a program to search a pattern in a given text using the KMP algorithm.
7. Write a program to implement a Suffix tree (bruteForceSuffixTrie method given in Ref. 4 at page 712).