Jaypee Institute of Information Technology, Noida
T2 Examination, April 2022
B.Tech IV Semester

Course Title: Algorithms and Problem Solving
Course Code:15B11CI411

Max. Marks: 20
Max. Time: 1 Hour

C214.1 Analyze the complexity of different algorithms using asymptotic analysis.
C214.2 Select an appropriate data structure and apply related operations for a given problem.
C214.3 Apply algorithmic principles for solving a given problem.
C214.4 Identify, formulate, and design an efficient solution to a given problem using appropriate data structure and algorithm design technique.

Q1. [6 Marks C214.4] In a game of mixing the chemicals, 4 chemicals are given which are arranged in a row. Each chemical has one of 100 different colors (Colors are numbered from 0 to 99). One has to mix these chemicals altogether. The chemicals are in order C1, C2, C3, and C4 having colors 40, 60, 20, and 30 respectively. Follow the below rules for mixing the chemicals:

  a) At each step, one can mix only two chemicals that stand next to each other, and put the resulting mixture in their place.
  b) After mixing two chemicals of colors 'a' and 'b' the resulting chemical have the color number (a+b) mod 100.
  c) Also, in the process of mixing two chemicals at each step, some amount of smoke is generated i.e. equals to a*b.

There are many possibilities a person can mix these chemicals. However, the person who generates the minimum amount of smoke is going to win this game. Using an efficient approach, find out how much smoke will be generated by the winner?

Q2. [5 Marks C214.4] Ali is a merchant and generally travels by flight. He has 5 precious items which he needs to carry along with him without breaking anyone. According to the rules of domestic flights, Ali can only carry 5 KG of weight in the cabin. However, the total weight of five items, which Ali is carrying, is greater than the weight allowed in the cabin. So, he decided to leave a few items (cheapest) based on their value. Consider the items, weights, and values given as follows:

Items	1	2	3	4	5
Weight	1.5	0.5	2.5	0.5	1.5
Value	500	125	35	240	350

a) Write an efficient pseudo code (Based on a top-down approach) to find the maximum value Ali can get by selecting the items.
b) How many distinct recursive function calls will be used for solving the problem with DP?

Q3. [5 Marks C214.3] A file contains text comprising six characters. The frequency of each character in the file is, (A 20, B 30, C 10, D 20, E 15, F 5). The number of characters in the file is 100. The file needs to be compressed so that it requires less storage memory.

  a.   Use Shannon-Fano coding scheme to find the code of each character.
  b.   Use Huffman coding scheme to find the code of each character.
  c.   Compare Shannon-Fano and Huffman in terms of the number of bytes required for file storage.

Q4. [4 Marks C214.3] A group of students assembled at house X of a fellow student for the distribution of emergency kits and food items to all the households that are connected through concrete roads. Their goal is to visit each such house only once and come back to X house. Suggest an algorithm, and data structures and also show the working of the algorithm i.e. intermediate steps for finding all the sequences in which the houses can be visited so that different teams be made for distribution. Following is the representation of the concrete road connection between individual houses. Note: Do not use the brute force method.