**Birla Institute of Technology & Science, Pilani**

**Work-Integrated Learning Programmes Division**

**First Semester 2020-2021**

**M.Tech (DSE)**

**End -Semester Test (EC-3 Make up)**

Course No. : DSECLZG519

Course Title : DATA STRUCTURE ALGORITHMS AND DESIGN

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| No. of Pages = 2 No. of Questions = 11 |

Nature of Exam : Open Book

Weightage : 40%

Duration : Min

Date of Exam : 11-04-2021(AN)

Note:

1. Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
2. All parts of a question should be answered consecutively. Each answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.
4. You are the manager of Grand Budapest Hotel. You are given the arrival and departure time of each guest. But your cleaning staff is lazy. So you have to instruct them to clean minimum number of rooms. If there are two guests and their stay in the hotel does not coincide then you need only one cleaned room because after 1st guest leaves you can give the same room to 2nd guest. So for given arrival and departure time of each guest design optimal algorithm to return minimum number of rooms to be cleaned by the cleaning staff. Analyse the time complexity of the algorithm. You may assume departure time is strictly greater than arrival time and all time instances provided are distinct. [4M]
5. Recursion tree method. Prove tight upper and lower bounds on the functions T(n) defined by [4M]
6. Hash table-double hashing, with a hash table of size 8 to store values between 0 to 9999, we use the following hash functions: given a value x= d3d2d1d0, we compute the value (d3+1) (d2+1) (d1+1) (d0+1). This result takes no more than 13 or 14 bits.so the primary hash function (the one to determine the bin) is the value b4 b3 b2, where bn is the bit n of the result, with the contention that b0 is the least-significant bit. The jump size (the secondary hash function) is given by the value b6b51.insert, in the given order the value 3836,7206,2373,9412,6950. [4M]
7. Design a dynamic programming algorithm for the following problem: Given a sequence a1 o1 a2 o2 . . . an-1 on-1 an , in which each ai is a positive integer and each oi is ‘+’ or ‘-’, compute a parenthesization of the expression such that the resulting value is the maximum possible. It suffices to compute the resulting value instead of the parenthesization. Estimate the time complexity of the algorithm. For example, if the given sequence is 3-4-5, ((3-4)-5) results in -6 while (3-(4-5)) results in 4. The second parenthesization results in the maximum possible value, and the output is 4. Show the working of your algorithm on this example. [4M]
8. In the following figure, a weighted undirected graph is shown your task is to construct a minimum spanning tree(MST) of this graph using Kruskal’s algorithm. Draw the MST of the graph. Also write the sequence of edge is not included in the MST, why it is discarded (example: (x,y) added (u,v) discarded because it creates the cycle uxywv).

![A picture containing text, watch

Description automatically generated]() [4M]

1. Insert the following pair into a an initially empty 2-D tree. (65,50).(60,70),(70,60) (75,25) (50,95) (90,65) (10,30),(80,85),(95,75). [2M]
2. Fill in the cost table m in the dynamic programming algorithm for iterated. Matrix products on the following inputs: n=5; r0 = 8, r1= 3, r2= 2, r3 =19, r4 =18, r5 = 7. [hint: all steps needed] [4M]
3. There are 25 horses which runs at different speed, and you have to find out the top three horses, in one race you can race not more 5 horses, find the no of races required minimum? [3M]
4. Imagine a database containing information about all trains leaving the Washington Union station on Monday. Each train is assigned a departure time, a destination, and a unique 8-digit train ID number. What data structures would you use to solve each of the following scenarios? Depending on scenario, you may need to either (a) use multiple data structures or (b) modify the implementation of some data structure. Justify your choice.
   1. Suppose the schedule contains 200 trains with 52 destinations. You want to easily list out the trains by destination. [1.5M]
   2. In the question above, trains were listed by destination. Now, trains with the same destination should further be sorted by departure time. [1.5 M]
5. Given the following string elements : m, x, z, s, d, b, i, t, r, g, w, k, n. Draw the AVL tree that results when all of the above elements are added to each of the following initially empty data structure draw a new tree each time a rotation is necessary and say which kind of rotation was needed. [4M]
6. Given the following

![Diagram, shape, schematic, polygon

Description automatically generated]()

Show the order that the vertices are visited in by Dijkstra’s algorithm, the distance computed from the source A, and the contents of the priority queue after the vertex is visited. [4M]

\*\*\*End of the Test\*\*\*