Birla Institute of Technology & Science, Pilani
Work-Integrated Learning Programmes Division
Second Semester 2020-2019
M.Tech (DSE)
Mid-Semester Test (EC-2 Make up)

Course No.	: DSECLZG519
Course Title	: DATA STRUCTURE ALGORITHMS AND DESIGN
Nature of Exam	: Open Book
Weightage	: 30%
Duration	: Min
Date of Exam	: 05-07-2020

No. of Pages = 2
No. of Questions = 9

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.

1. Consider the following array of Max heap: 90, 20, 55, 19, 13, 17, 3, 6, 9, 12, 7, 10. Insert 95 to the above array.
   a. What are the number of swaps required? Explain. [2M]
   b. Give the final array after insertion. [1M]

2. A green-red graph is a simple undirected graph where every edge is colored either red or green. A green-red graph is green friendly if every pair of vertices is reachable from each other via a path of only green edges.
   a. Given a (simple) green-red graph G=(V,E), write an algorithm to determine if the graph is **not** green friendly. What is its complexity? [3 M]
   b. Having identified that the graph is not green friendly in (a), describe an efficient algorithm to convert this as a green friendly graph. [2 M]
   c. What is the complexity of the algorithm described in (b)? Explain. [1 M]

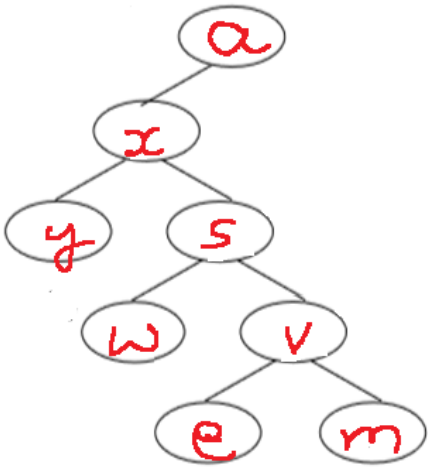
3. The Karnataka State Natural Disaster Monitoring Centre (KSNDMC) has advised its officials to report Bangalore's temperature after the outbreak of COVID-19. The report should have the day and the average temperature till that day [inclusive] for each day, from 1st March 2020 onwards. [3M]
   a. Design and describe an efficient algorithm for the above scenario.
   b. Give an analysis of the running time of the algorithm.

4. Draw the binary min heap that results from inserting 11,9,12,14,3,15,7,8,1 in at a time, in that order into an initially empty binary heap. Give the time complexity of heap construction. Explain.
   [5M]

5.
   a. Given a hash table of 20 items with the load factor 0.8, what will be the appropriate size of the table? Explain [1.5M]

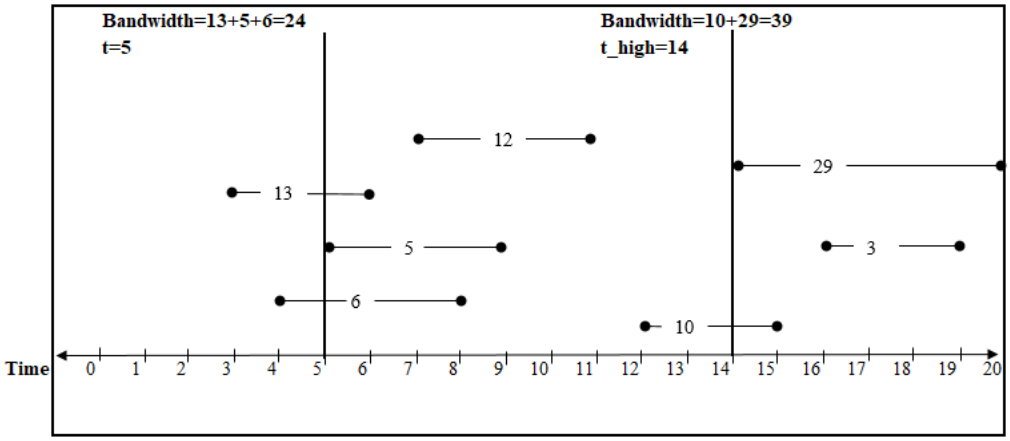
   b. Consider an initially empty hash table of size M and hash function h(x) = x mod M. In the worst case, what is the time complexity (in Big-oh notation) to insert n keys into the table if separate chaining is used to resolve collisions (without rehashing)? Justify your answer [1.5M]

6.



What is the Minimum size of the array required to store the above given Binary Tree Give the array representation that has stored the above given binary tree? [3M]

7. In these trying times of pandemic, most of the IT professionals are forced to work from home. With educational institutions also running classes online, the internet bandwidth requirement has increased rapidly. You are given bandwidth requirements for various needs along with the timelines as a sequence of triplets (start, end, required-bandwidth). For example, the triplet (12,15,10) means that the bandwidth requirement for the duration (12,15) is 10. A sequence of bandwidth requirements takes the form [(3,6,13),(4,8,6),(5,9,5), ...] which can be pictorially shown as below.



The demand for bandwidth at time t is the sum of the bandwidths of all the time intervals that contains t. Also assume that the interval endpoints are distinct. Consider endpoints (a,b) and (c,d). These endpoints are distinct if a≠c and b≠d. Given this, design an algorithm to find a time **t_high** in the entire interval where the bandwidth demand is the highest. The worst time complexity of your algorithm cannot be more than O(nlogn). You can use any Data Structure covered in the sessions. [4M]

8. Suppose that we are using a public laundry service. Each user pays a **fixed amount per use** .However, the time needed by each user is different. [1.5+1.5=3M]
    a. Implement a scheme to maximize the returns from the machine under the assumption that the machine is not to be kept idle unless no user is available.
    b. How does the scheme change, if each user needs the same amount of time on the machine but people are willing to pay **different amounts for the service**?

###All the best ###