ROYAL UNIVERSITY OF BHUTAN
GYALPOZHING COLLEGE OF INFORMATION TECHNOLOGY
GYALPOZHING : BHUTAN

SEMESTER END EXAMINATION (AUTUMN 2020)

Class : **Bachelor of Science in Information Technology (Year II, Semester I)**

Module Title : **Algorithms and Data Structures**

Module Code : **ITS202**

Serial No. : **BSc(IT)/2020/III/F/ITS202/I**

Max. Marks : **50**

Max. Time : **3 Hours**

General Instructions:

1. Question paper has written component.
2. In no circumstances may you remove Answer Books, used or unused, from the Examination Room.
3. If the answer book is torn or folded or without Exam Cell's seal, report the matter to the Invigilator and get a new one.
4. Enter the required details such as Reg. Number, Module and other information as prescribed.
5. Do not write your name on any part of the Answer Book.
6. Number your answer according to the number assigned in the Question Paper.
7. Do not skip any pages when writing answers. Any rough sketches/calculations must be shown on the same page.
8. Do not fold or tear off any pages from the Answer Book. Any answer crossed by you will not be evaluated.
9. You may request for the supplementary Answer sheets only after the main answer Book is completely used.
10. A candidate who is found to have unauthorised materials in his /her possession, copying, talking or exchanging any material with others will be dealt with as per the Wheel of Academic Law.
11. No paper other than Admit Card will be allowed in the Examination Hall/Room unless otherwise specified in the Question Paper.

PART - I [10 Marks]

Answer all the questions

Multiple Choice Questions **[10 x 0.5 = 5]**

Q1) How many times can you tear a phonebook with 128 pages (i.e., sheets of paper) in half, each time throwing away one of the halves, before only one page remains?

A. 6 B. 7 C. 10 D. 64

Q2) Which strategy returns index of node's left child in heap where i is the position of a node.

A. 2i B. 2i + 1 C. i D. i/2

Q3) Which of the following is false about a binary search tree?

A. The left child is always lesser than its parent
B. The right child is always greater than its parent
C. The left and right sub-trees should also be binary search trees
D. In order sequence gives decreasing order of elements

Q4) Why we need to a binary tree which is height balanced?

A. to avoid formation of skew trees
B. to save memory
C. to attain faster memory access
D. to simplify storing

Q5) If several elements are competing for the same bucket in the hash table, what is it called?

A. Diffusion
B. Replication
C. Collision
D. Duplication

Q6) The worst case time complexity of BST is

A. O(n)
B. O(log n)
C. O(n log n)
D. O(n^2)

Q7) A simple method for sorting that is effective whenever the keys are small integers.

A. Key Indexed Counting
B. Shell Sort
C. Merge Sort
D. Insertion Sort

Q8) Sorting algorithms which loops through till n-2 is

A. LSD Sort
B. Quick Sortt
C. Bubble Sort
D. Heap Sort

Q9) ..... Is the Example of Symbol Table.

A. Strings
B. BSc in IT programme
C. Book
D. DNS Lookup

Q10) Consider the following operation performed on a stack of size 5. Push(1);
Pop();
Push(2);
Push(3);
Pop();
Push(4);
Pop();
Pop();
Push(5);

After the completion of all operation, the no of element present on stack are

A. 1
B. 2
C. 3
D. 4

Fill in the blanks **[5 x 0.5 = 2.5]**

Q11) ..... Binary Tree require more memory space.

Q12) ..... sorts strings which are of same length.

Q13) ..... is a directed cycle whose sum of edge weights is negative.

Q14) A minimum spanning tree has ..... edges where V is the number of vertices in the given graph.

Q15) Worst-case time complexity is also known as .....

True or False **[5 x 0.5 = 2.5]**

Q16) A stack is a first-in, first-out data structure.

Q17) Full BT is a strictly binary tree with all leaves in the last level.

Q18) Individual elements in linked list are stored in consecutive memory location.

Q19) The worst case time complexity of the insert operation into an AVL tree is O(log n), where n is the number of nodes in the tree.

Q20) Heap is sorted in nature.

PART - II [15 Marks]

SHORT ANSWER QUESTION

Answer all the questions

Q1) Complete the table below by specifying lower (ω) and upper (O) bounds for each algorithm. Assume that the input to each algorithm is an array of size n. **[0.5 * 5 = 2.5]**

Algorithms	ω	**O**
Binary Search		
Bubble Sort		
Linear Search		
Merge Sort		
Selection Sort		

Q2) What does it mean if some algorithm is in θ (n)? Give example or scenerio of such time complexity. **[1.5]**

Q3) What are the two data structure used in finding SPT(Shortest Path Problem) **[1]**

Q4) Explain Hibbard Deletion of BST with the help of example. **[3]**

Q5) For the tree given below, find the preorder, inorder and postorder traversal. **[3]**

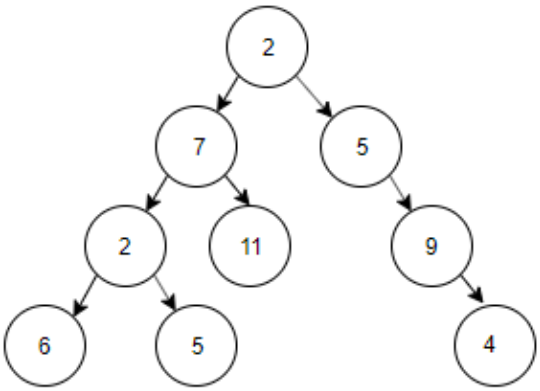

Figure 1: Tree

Q6) Explain four Operation of Linked List with the help of diagram. **[4]**

PART - III [25 Marks]

LONG ANSWER QUESTIONS

Answer all the questions

Q1) Appply shell sort on the given String **[5]**

E A S Y S H E L L S O R T Q U E S T I O N

Q2) Paro Airport runaway reservation system have only one runway available. Following details are provided for reservation.

- Reserve request: specifies landing time t.
- Add t to the set R of landing times if no other landings are scheduled within k minutes.
- k can vary: let's assume it is statically set (e.g. 3 min).
- After landing, remove request from R.
- What operations do we need in the data structure?
  - Adding requests. If they satisfy constraint!
  - Removing requests.
  - Notion of time, checks every m seconds to update the structure.
  - Nutshell: we need a data structure that allows for insertion and removal of elements.
  - Additional requirement: operations in O(lg n)

List and Explain with diagram all the data structure available comparing interms of their time complexity and finally suggest the best data structure to opt for given you are the developer of this system. **[5]**

Q3) Show the AVL tree that results after each of the integer keys 9, 27, 50, 15, 2, 21, and 36 are inserted, in that order, into an initially empty AVL tree. Clearly show the tree that results after each insertion, and make clear any rotations that must be performed. **[5]**

Q4) Find the minimum spanning tree using Kruskal's algorithm and provide the overall weight of the MST for the given figure 2. **[5]**

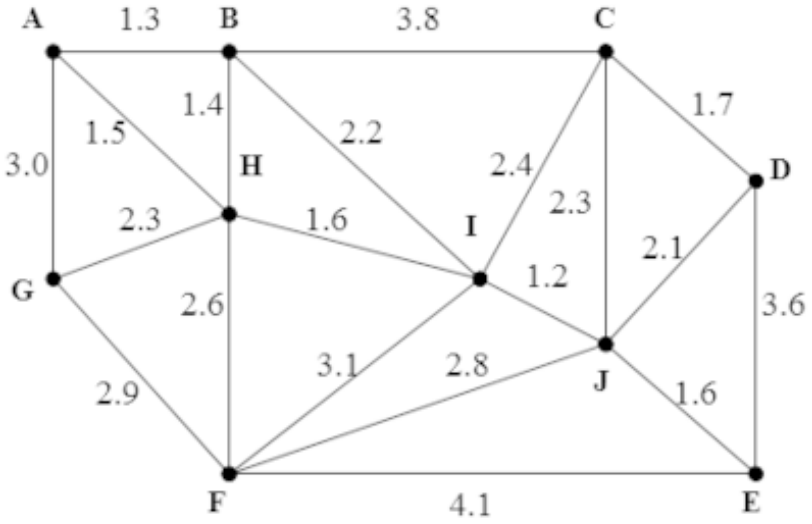

Figure 2: Graph

Q5) Perform DFS on the graph given. **[5]**

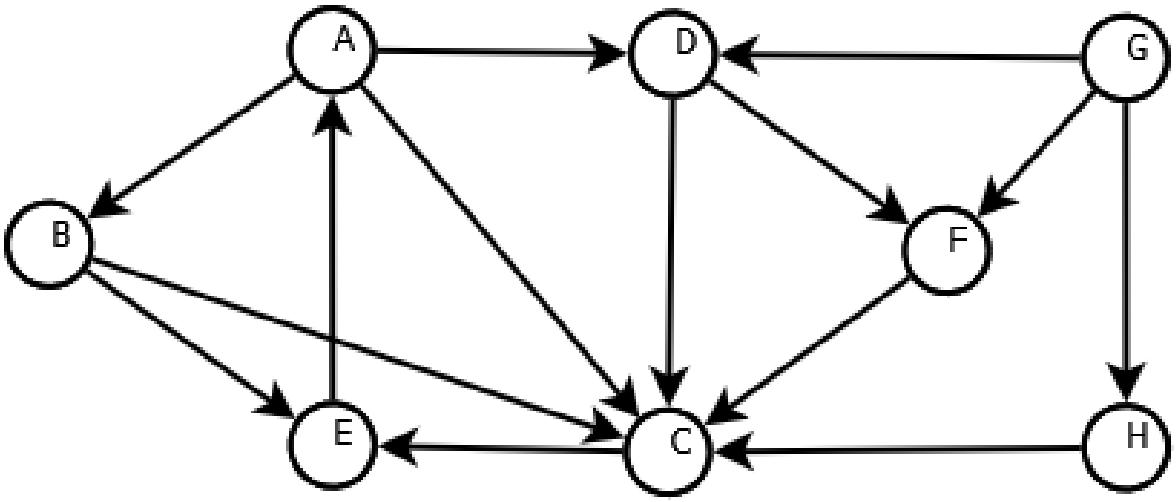

Figure 3: Graph:DFS

BESTWISHES