



HALDIA INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION UNDER MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL)

Paper Code: MCS-PC 102

Paper Name: Advanced Data Structures

Time Allotted: 3 Hours

Full Marks: 70

The figures in the margin indicate full marks

Candidates are required to give their answers in their own words as far as practicable

Group – A

(Multiple Choice Type Questions)

Choose the correct alternatives from the followings:

15 x 1 = 15

1. (i) What is the load factor for an open addressing technique?

- a) 1 b) 0 c) 0.5 d) 5

(ii) Which one of the following data structures is most preferred in database-system implementation?

- a) AVL b) B-tree c) B+ tree d) Splay tree

(iii) What maximum difference in heights between the leafs of a AVL tree is possible?

- a) $\log n$ (n is no of nodes) b) n (no of nodes) c) 0 or 1 d) atmost 1

(iv) What are the worst case and average case complexities of a binary search tree?

- a) $O(n)$, $O(n)$ b) $O(\log n)$, $O(\log n)$ c) $O(\log n)$, $O(n)$ d) $O(n)$, $O(\log n)$

(v) Which of the following is true?

- a) larger the order of B-tree, less frequently the split occurs
b) larger the order of B-tree, more frequently the split occurs
c) smaller the order of B-tree, more frequently the split occurs
d) smaller the order of B-tree, less frequently the split occurs

(vi) A dictionary has a set of ----- and each key has a single associated value.

- a) keys b) index c) both keys and index d) none of these

(vii) When it would be optimal to prefer Red-black trees over AVL trees?

- a) when there are more insertions or deletions b) when more search is needed
c) when tree must be balanced d) when $\log(\text{nodes})$ time complexity is needed

(viii) What is the disadvantage of using splay trees?

- a) height of a splay tree can be linear when accessing elements in non-decreasing order
b) splay operations are difficult
c) splay tree performs unnecessary splay when a node is only being read
d) no significant disadvantage

(ix) What is the maximum height of any AVL-tree with 7 nodes? Assume that the height of a tree with a single node is 0.

- a) 2 b) 3 c) 4 d) 5

(x) A dictionary is also called

- a) a hash b) a map c) a hashmap d) all of the above

(xi) If h is chosen from a universal collection of hash functions and is used to hash n keys into a table of size m , where $n \leq m$, the expected number of collisions involving a particular key x is less than _____.

- a) 1 b) $1/n$ c) $1/m$ d) n/m

(xii) Five node splitting operations occurred when an entry is inserted into a B-tree. Then how many nodes are written?

- a) 14 b) 7 c) 11 d) 5

(xiii) The keys 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function $h(k) = k \bmod 10$ and linear probing. What is the resultant hash table?

0	
1	
2	2
3	23
4	
5	15
6	
7	
8	18
9	

(A)

0	
1	
2	12
3	13
4	
5	5
6	
7	
8	18
9	

(B)

0	
1	
2	12
3	13
4	2
5	3
6	23
7	5
8	18
9	15

(C)

0	
1	
2	12, 2
3	13, 3, 23
4	
5	5, 15
6	
7	
8	18
9	

(D)

- a) A b) B c) C d) D

(xiv) Given an empty AVL tree, how would you construct AVL tree when a set of numbers are given without performing any rotations?

- a) just build the tree with the given input
b) find the median of the set of elements given, make it as root and construct the tree
c) use trial and error
d) use dynamic programming to build the tree

(xv) What does the following piece of code do?

```

1. public void func(Tree root)
2. {
3.     func(root.left());
4.     func(root.right());
5.     System.out.println(root.data());
6. }
```

- a) preorder traversal b) inorder traversal
c) postorder traversal d) level order traversal

Group – B

(Short Answer Type Questions)

Attempt any three from the followings:

3 x 5 = 15

2. Define the following: Hash function, perfect hash function, hash collision

5

3. Store set of elements {0,1,2,4,5,7} into a hash table of size 5. Hash function H, such that $H(x) = x \% 5$.

5

4. Define linear probing and explain with suitable example.

5

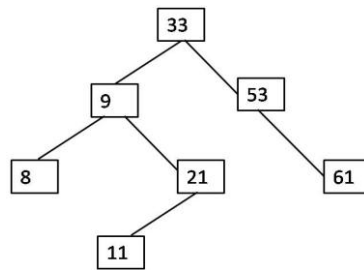
5. a) Write down the properties of BST.

b) Consider a BST and express the in-order notation of the tree. Find the relation among the values in the expression.

2+3

6. Delete node 61 from the AVL tree given below and do the needful

5



Group – C

(Long Answer Type Questions)

Attempt any four from the followings:

4 x 10 = 40

7. Consider the data set: {16, 4, 6, 22, 24, 10, 31, 7, 9, 20, 26}. Given bucket size is 3; hash function: global depth : x that is hash function returns x LSBs. Perform extendible hashing. 10

8. Create a skip list to insert the following keys with suitable diagram.

Key 6 with level 1

Key 29 with level 1

Key 22 with level 4

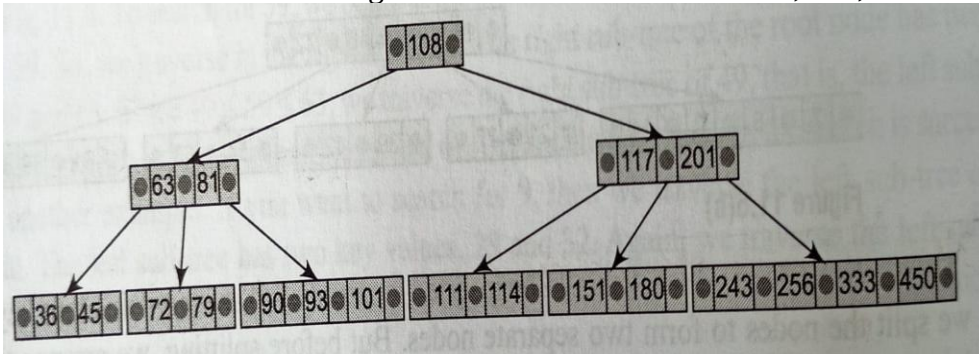
Key 9 with level 3

Key 17 with level 1

Key 4 with level 2

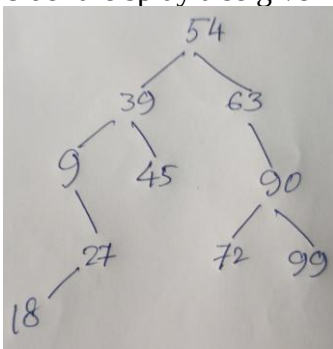
10

9. Consider the B tree of order 5 given below and delete values 93, 201, 180 and 72 from it.



10

10. Consider the splay tree given below and make the necessary changes to add 81 to it.



10

11. Consider the following points in a 2D plane, and explain the steps in detail to construct a 2-D tree.

(3, 6), (17, 15), (13, 15), (6, 12), (9, 1), (2, 7), (10, 19)

10

12. Describe Huffman coding algorithm. Provide a suitable example in support of the same. What is the utility of the algorithm? 10

Answer Key:

Group – A

1. (i) c	(ii) c	(iii) a	(iv) a	(v) d	(vi) d
(vii) a	(viii) a	(ix) b	(x) b	(xi) a	(xii) a
(xiii) a	(xiv) d	(xv) b	(xvi) b	(xvii) a	(xviii) a
(xix) a	(xx) d	(xxi) c	(xxii) b	(xxiii) d	(xxiv) a
(xxv) c	(xxvi) c	(xxvii) d	(xxviii) b	(xxix) c	(xxx) d

Group – B

2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
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Group – C

12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
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