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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST-3 EXAMINATION (MAY 2018)
B-Tech (2nd SEM)

Course Code: 10B11CI211 Max. Marks: 35
Course Name: DATA STRUCTURES Max. Time: 2 HRS
Course Credit: 4

Note: All questions are compulsory.

JUIT EXAMINATION MAY 2018

SECTION A (5x1 =5 marks)

Q1.

a) How many different binary trees are possible with ***n*** nodes?
b) Draw the complete binary tree that is formed when the following values are inserted in the order given: 4, 13, 5, 3,7,30.
c) Arrange nodes that contain the letters: A, C, E, L, F, V and Z into binary search tree that has maximum height.
d) What is bounded queue?
e) If data is a circular array of CAPACITY elements, and R is a rear index into that array, what will be the formula to obtain index after R?

Section B (7x3=21 marks)

Q2. Consider binary tree that have single characters stored at each internal node. Draw one binary tree that will spell out the phrase: ANUPSIDEDOWNTREE when nodes are visited in preorder, and UNPADIESDNWTOERE when visited in inorder. (Draw only one tree!).

Q3. Consider a tree storing 100,000 entries. What is the worst-case height of T in the following cases if: **a)** T is an AVL tree **b)** T is a binary search tree.

Q4. An algorithm runs in ***n*** time. Find the largest size of ***n*** that can be solved by this algorithm in 1 day? Assume speed of a processor is 1GHz (therefore one instruction takes 10^{-9} seconds).

Q5. How many different trees T can be built with three internal nodes having keys 1, 2 and 3 in each of the following cases? Please illustrate your answers. (Remember that the leaves do not store keys in binary search trees or in AVL trees.)

a) if T is a proper binary tree.
b) if T is a binary search tree.
c) if T is an AVL tree.

Q6. Suppose we wish to create a binary heap containing the keys **D A T A S T R U C T U R E**. (All comparisons use alphabetical order.)

a) Show the resulting min-heap if we build it using successive insert() operations (starting from D).

Q7. Radix sort the following list of integers in base 10 (smallest at top, largest at bottom). Show the resulting order after each run of counting sort.

Original list	First sort	Second sort	Third sort
583			
625			
682			
243			
745			
522			

Q8. Given an array containing the digits 7 1 8 0 8 2 9 4, show how the order of the digits changes during each step of **[a]** insertion sort, **[b]** quicksort (always choosing the last element of any subarray to be the pivot).
Show the array after each swap, except in insertion sort. For insertion sort, show the array after each insertion.

Section C (3x3=9 marks)

Q9. Order the following expressions by their asymptotic growth (fastest to slowest):

$$2^n, n^3, 3^n, n\lg n, n^2, n^2 \lg n$$

Justify your answer. That is, if your final order is a, b, c, d you need to show that a = O(b), b = O(c), and c = O(d). You can use either the definition of O( ) or limits.

Q10. Perform a depth-first search on the following graph (**Fig-1**) starting at A. Label every edge in the graph with T if it's a tree edge, B if it's a back edge, F if it's a forward edge, and C if it's a cross edge. However to discard variety of solutions you can assume that whenever faced with a decision of which node to pick from a set of nodes, pick the node whose label occurs earliest in the alphabet

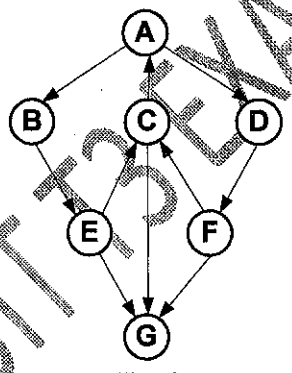

Fig -1

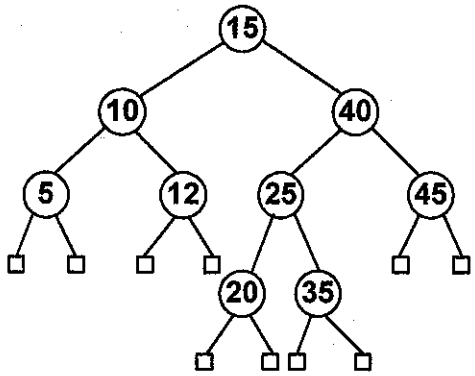

Fig-2

Q11. Consider the AVL tree as shown in **Fig-2**:

a) Insert the key 25 into the tree and re-balance if needed. Draw the final tree and all intermediate trees that you need. You must use the algorithms studied in class for inserting and re-balancing

b) Remove the key 40 from the original tree and re-balance if needed. Draw the final tree and all intermediate trees that you need. You must use the algorithms studied in class for removing and re-balancing.

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