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**UNIVERSITY REGULAR EXAMINATIONS**

**2013/2014 ACADEMIC YEAR**

**2ND YEAR 2ND SEMESTER EXAMINATIONS**

**FOR THE BACHELOR OF SCIENCE IN COMPUTER SCIENCE**

**COURSE CODE:** BIT 222

**COURSE TITLE:** DATA STRUCTURE AND ALGORITHMS

**DATE:** 16th APRIL 2014 **TIME:** 9.00am – 12.00 noon

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## INSTRUCTIONS

Answer questions one and any other two questions only.
Question one carries 30 marks and the other questions carry 20 marks each

**QUESTION #1 [30 marks]**

a) Distinguish between an algorithm and a data structure (2 marks)

b) Sate and explain any FIVE characteristics of algorithms (5 Marks)

c) There are 8, 15, 13, 14 were there in four different trees. Which of them could have formed a full binary tree? Explain your answer . (3 marks)

d) Explain any two reasons why analysis of algorithm is necessary. (2 Marks)

e) (i) Explain the main advantage of implementing a stack using dynamic memory allocation (linked list) as opposed to static memory allocation (array). (2 Marks)
(ii) Suppose that we perform the operation shown below on a stack. Assume that the stack is initially empty. In what order will the element be pooped, push A, push B, Push C, Pop, Pop, Push D, Pop, and Pop. (2 Marks)

(f) (i) Distinguish between a binary tree and a binary search tree. (4 Marks)

(ii) Beginning with an empty binary search tree what BST is formed when insert the following values in the order given: 50,40,45,47,46,41,35. (4 Marks)

g) State any FOUR areas where Queues can be applied (4 Marks)

**SECTION II: ANSWER ANY TWO QUESTIONS**

**QUESTION #2[20 Marks]**

a) (i) What is a priority queue? Is a priority queue a kind of queue? (3 Marks)

(ii) How can stacks and ordinary queue be simulated using a priority queue? (2 Marks)

b) Robot walking function can be defined by the following recurrence relation

i) Write down the C++ function that implements the definition of a factorial function (4 Marks)

ii) Compute the factorial of 7 using the function. (2 Marks)

c) (i) Discuss the motivation behind the use of recursion (2 Marks)

(ii) Explain how the divide and conquer technique works. (2 Marks)

d) (i) Explain how the merge algorithm works? What properties must the input have? (4 Marks)

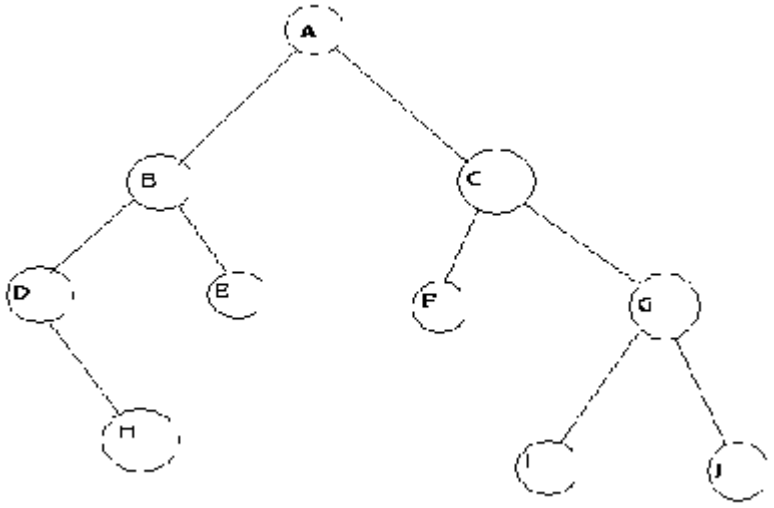
(ii) What is the worst-case time of merge algorithm? (1 Mark)

**QUESTION #3[20 Marks]**

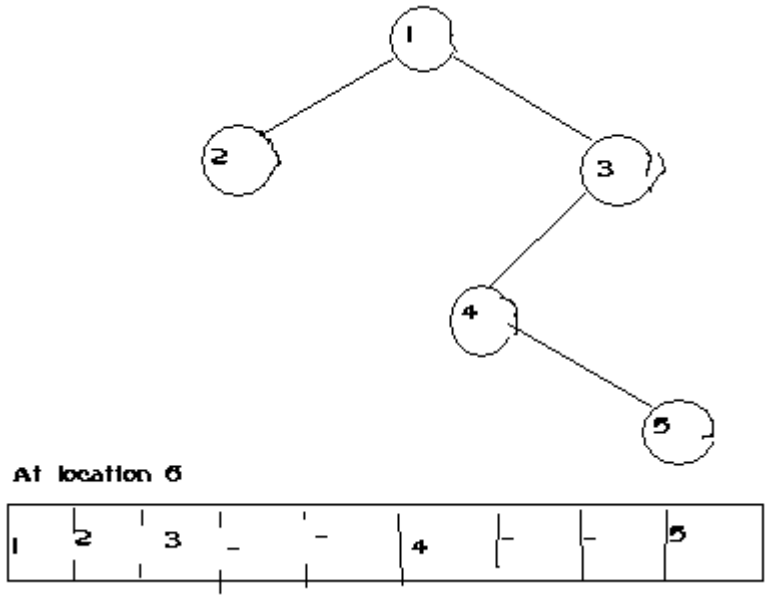
a) What is the data structures used to perform recursion? ( 2 marks)
b) A binary tree with 20 nodes has_____ null branches? [2 marks]

c) List out few of the Application of tree data-structure? [3 marks]

d) Traverse the given tree using Inorder, Preorder and Postorder traversals [6 marks]




e) In the given binary tree, using array you can store the node 4 at which location? Give an explanation for your Answer. [3 marks]




f) State whether a Linked list is a Linear or Non linear data Structure? [2 marks]

**QUESTION #4[20 Marks]**

(a) State any four areas where data structures are used extensively. (4 Marks)

(b) Distinguish between the following types of lists:

(i) Sorted list and linked list

(ii) Circular list and doubly-linked list (4 Marks)

(c) (i) Define the concept of 'column-major' ordering the multidimensional arrays (2 Marks)

(ii) What is the address of A [0,0] in an array stored linearly in column-major ordering beginning in address alpha if it is declared as A [-1..5,-2..2] (2 Marks)

(d) (i) Explain two advantages of a linked list as compared to an array (4 Marks)

(ii) Discuss two disadvantages of a linked list as compared to an array. (4 Marks)

**QUESTION #5[20 Marks]**

a) Define the following terms: (6 marks)
   i. Ordered List
   ii) Homogenous ordered List
   iii) Heterogeneous ordered list

b) Draw a picture of a {linked list, circular linked list} with nodes containing the integer values 35, 27, 13, 41. Do not use any dummy nodes. (4 marks)

c) (i) Explain how bubble sort works?

   (ii) Trace bubble sort as it sorts the following array in ascending order:

   25 30 20 80 40 60 (4 Marks)

   b) Convert the following infix expression to equivalent postfix form: Show the status of the stack after each of the algorithms.

   (i) (A-B*C)/D-(E+F) (3 Marks)

   (ii) A/(B*C/D)+E (3 Marks)