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**University Examinations 2023/2024**

FIRST YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF MATHEMATICS AND COMPUTER AND BACHELOR OF SCIENCE MATHEMATICS

**CCS 3200: DATA STRUCTURES AND ALGORITHMS**

**DATE: APRIL 2024** **TIME: 2 HOURS**

**INSTRUCTIONS:** *Answer question **one** and any other **two** questions*

**QUESTION ONE (30 MARKS)**

a) Define the following terms:

i. Abstract Data type(ADT)
ii. Graph edge
iii. iii. The height of a tree (6 Marks)

b) Clearly differentiate between the following terms:

i. Variable and array
ii. Iteration and recursion
iii. Linear List and linked list
iv. Adjacent list and adjacent matrix (8 Marks)

c) Define the term algorithm analysis and discuss the TWO important quantitative metrics of interest in algorithm analysis. (6 Marks)

d) Explain the importance of an end node in a linked list (2 Marks)

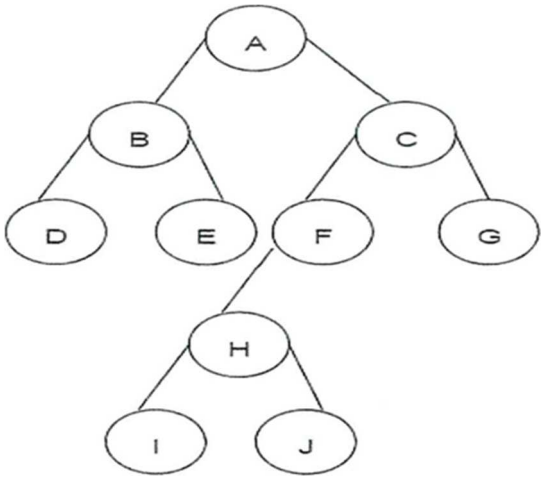
e) Given the following scenarios; state and explain the most suitable Abstract Data Type(ADT) to use:

i. Serving customers in a banking hall ii. Deleting characters using the backspace key iii. Checking if an expression has the correct set of delimiters (3 Marks)

f) Given three assignment marks out of 50, 70 and 30 respectively, write an algorithm that computes the average calculated as a mark out of 100. (5 Marks)

**QUESTION TWO (20 MARKS)**

a) Consider the tree given below:




i. Is the tree a binary tree? Justify

ii. ii. Is the tree a complete tree? Justify (4 Marks)

Show the traversal sequence when searching for J using depth first search for:

i. Inorder traversal

ii. Preorder traversal

iii. Postorder traversal (6 Marks)

b) Write an algorithm that accepts and stores the prices often items in an array, the algorithm should then calculate and output the average price of the items. (5 Marks)

c) Using the prices 10,20,30,40,50,60,70,80,90,100 show a trace of how your algorithm in (b) above arrives at the average. (5 Marks)

**OUESTION THREE (20 MARKS)**

a) Citing examples discuss the THREE types of time complexities. (6 Marks)

b) Using a well labeled diagram(s) explain the following concepts of a tree (6 Marks)

i. Degree
ii. Size
iii. Leaf nodes
iv. Level (8 Marks)

c) Convert the following infix expression into a binary tree: (6 - z) — (a * b)

**QUESTION FOUR (20 MARKS)**

a) Using a diagram discuss the concept of the binary search tree property. (3 Marks)

b) Discuss in detail how a stack operates and state any TWO stack applications. (3 Marks)

c) Given an empty stack called "mystack" with a maxsize of 6, using a diagram clearly show the status (position of the pointer top, the cell occupied by the element - where appropriate or the element displayed -where appropriate) of the stack when we:

i. Push(23)
ii. Push(10)
iii. Pop()
iv. Pop()
v. Pop() (10 Marks)

d) Given the following values; explain the execution steps of binary search algorithm to search for the number 3.

2, 3, 8, 16, 22, 27, 28, 36, 40, 48 (4 Marks)

**QUESTION FOUR (20 MARKS)**

a) Discuss three factors considered while selecting a data structure (6 Marks)

b) Differentiate between experimental and empirical analysis of an algorithm (4 Marks)

c) Discuss the following class of algorithms. Give graphical representation of their growth rate

i. Constant time

ii. Quadratic time

iii. Exponential 1 time (6 Marks)

d) Differentiate between insertion and selection sort algorithm. Which of the two in more efficient for higher number of inputs (4 Marks)