ΠΑΜΙΒΙΑ UΠΙVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF COMPUTING AND INFORMATICS
DEPARTMENT OF COMPUTER SCIENCE

QUALIFICATION: BACHELOR OF COMPUTER SCIENCE, BACHELOR OF INFORMATICS	
QUALIFICATION CODE: 07BCMS, 07BAIT	**LEVEL:** 5
COURSE: DATA STRUCTURES AND ALGORITHMS 1	**COURSE CODE:** DSA521S
DATE: JANUARY 2023	**PAPER:** THEORY
DURATION: 2 HOURS	**MARKS:** 80

SECOND OPPORTUNITY / SUPPLEMENTARY EXAMINATION QUESTION PAPER	
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INSTRUCTIONS
1. Answer ALL the questions.
2. Read all the questions carefully before answering.
3. Number the answers clearly

THIS QUESTION PAPER CONSISTS OF 5 PAGES
(Excluding this front page)

PERMISSIBLE MATERIALS

1. NON-PRGRAMMABLE CALCULATOR

QUESTION 2: Multiple Choice Questions [10 Marks]
- Answer all the questions in the provided booklet.
- The question consists of 10 questions.

1.1 Given a list of elements; 3, 12, 6,16,9 inserted into a data structure in that order. An element is deleted using a basic data structure operation. If the deleted element is 9, the data structure cannot be a _____?
     A. Queue
     B. Tree
     C. Stack
     D. Graph

1.2 What are the applications of queue data structure?
     A. Queues in routers/switches
     B. check parenthesis matching in an expression
     C. Process scheduling
     D. Shared resource

1.3 The worst-case time complexity of Binary Search Tree (BST) is
     A. O(n)
     B. O(log n)
     C. $O(N^2)$
     D. O(n log n)

1.4 Two vertices in a graph are said to be adjacent vertices (or neighbours) if there is a path of length _____ connecting them.
     A. At least 1
     B. At least 2
     C. At least less than 2
     D. 1

1.5 If an array is sorted and size is large, it is recommended to use _____ search to search it.
     A. Sequential
     B. Binary
     C. Sentinel
     D. Probability

1.6 If the node to be deleted has _____, we delete the node and attach the left subtree to the deleted node's parent.
     A. Only a left subtree
     B. Only a right subtree
     C. No children
     D. Has no children

1.7 Push and pop operations are found in_____
     A. Queues
     B. Lists
     C. Stacks
     D. Tail

1.8 What is the worst-case time complexity of a linear search algorithm?

    A. O(1)

    B. O(n)

    C. O(log n)

    D. $O(n^2)$

1.9 Stack data structure works on_____ principle.

    A. Last In First Out (LIFO)

    B. First In First Out (FIFO)

    C. First In Last Out (FILO)

    D. None of the above

1.10 Consider the following statements (i and ii) related to queues. Which of the choices; A, B, C or D is correct about queues:

    i) The insertion is done at REAR and deletion at FRONT end.

    ii) A queue is also known as LIFO list.

    A. Statement i) is true and ii) is false

    B. Statement ii) is true and i) is false

    C. Statement i) is false and ii) is false

    D. Statement i) is true and ii) is true

QUESTION 2: Structured Questions [70 Marks]

- *Answer all the questions in the provided booklet.*
- *The question consists of 8 questions.*

2.1. Briefly discuss Give the difference between the following terms as used in Data Structures:
1. Big O Notation and Tree   [4 marks]

2. Binary search and Linear search algorithms   [4 marks]

3. Graph and Queue   [4 marks]

4. Which of the following permutations can be obtained in the same order using a stack. Assuming that input is the sequence: 5, 6, 7, 8, 9, in that order?   [3 Marks]
   i.   *7, 8, 9, 5, 6*
   ii.   *5, 9, 6, 7, 8*
   iii.   *9, 8, 7, 5, 6*
   iv.   *7, 8, 9, 6, 5*

2.2. Study the BST below and answer all the questions
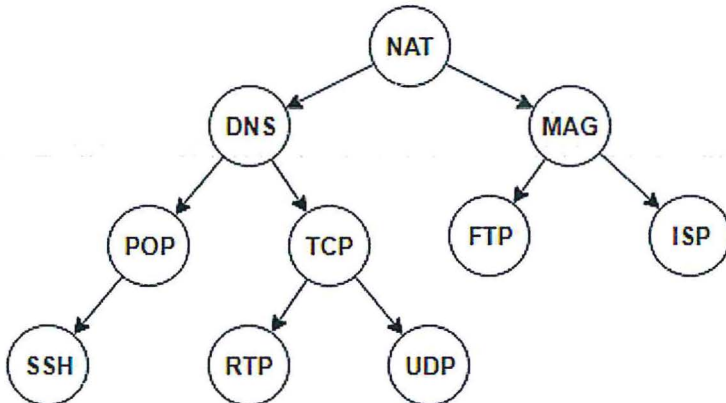
a) Write a an pseudocode for the InOrder traversal   [5 marks]

b) Write down all its BST traversal outputs below: PreOrder, PostOrder and InOrder   [6 marks]

2.3. Study the BST below:
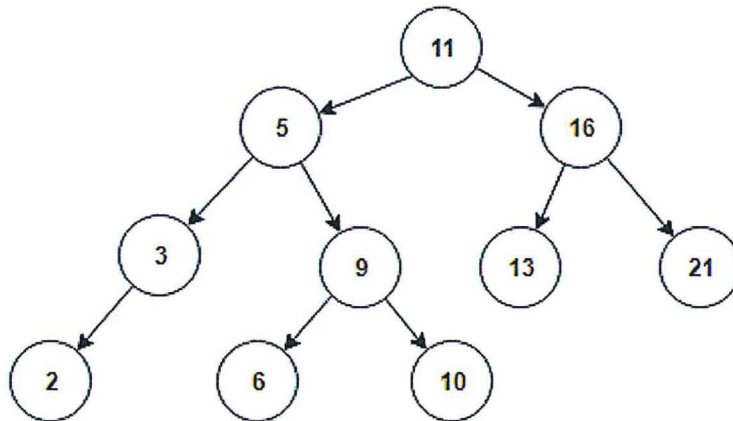
a) **Delete** the following nodes: 16 and 3, **Add** node 12 and 15 and draw the new BST.   [6 marks]

b) What is the maximum height/level of the BST after the operations in (a)?   [3 marks]

2.4. Study the Pseudocode below.

Step-1 Start
Step-2 Input Sides of Triangle A,B,C
Step-3 S= (A + B + C)/ 2.0
Step-4 Area = sqrt(S x (S-A) x (S-B) x(S-C))
Step-5 Perimeter = S1 + S2 + S3 or A+B+C
Step-6 Display Area, Perimeter
Step-7 Stop

Write a flowchart corresponding to the pseudocode program above.   [4 marks]

2.5. Use the Insertion sort algorithm to sort the array below: **4,3,2,10,12,1,5,6**. Show content for each step.   [6 marks]

2.6. Given the following array, Describe how a Jump search mechanism works, also calculate the number of blocks needed to search for the element at *index 11*. Show your work.   [5 Marks]

| 1 | 2 | 3 | 4 | 5 | 6 | 11 | 13 | 19 | 45 | 65 | 82 | 91 | 105 | 200 | 300 |

2.7. The following diagram represents a graph of some towns.
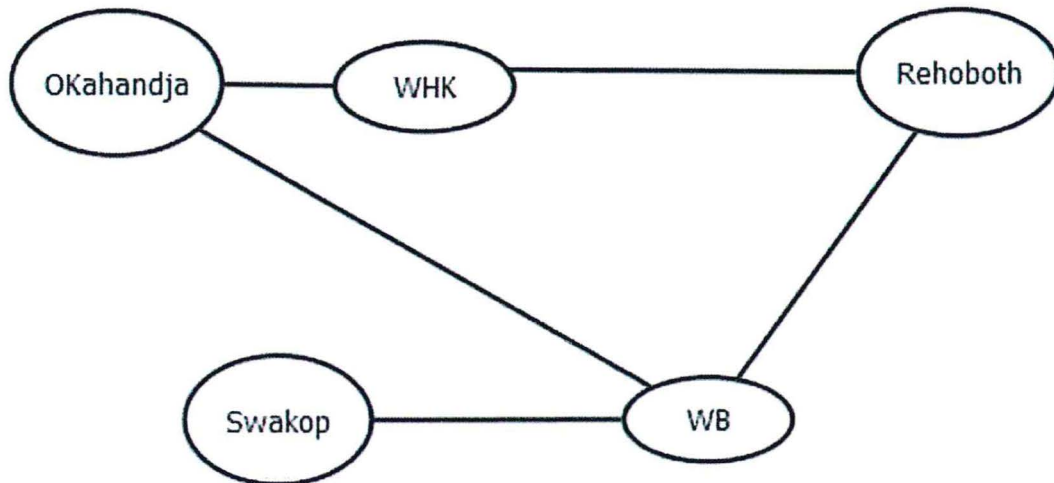
Give the result if the graph is traversed using;

    a)   Depth-first-search starting at vertex **WB**.   [10 marks]

    b)   Breadth-first-search starting at vertex **WB**.   [6 Marks]

2.8 Study the two (2) sample codes below.

Sample code A	Sample code B

FOR (count1=0 to size-1)
   FOR(count2=count1+1 to size-1)
      PRINT (count2)
   ENDFOR
ENDFOR
	FOR(count1=0 to 100)
	      PRINT (count2)
	ENDFOR

Considering time complexity classes we have studied in class such as constant/$O(1)$, Linear/$O(N)$, quadratic/$O(N^2)$, logarithmic/$O(\log N)$ etcetera;

    a) What is the worst case time complexity of **Sample code A?**   [2 Marks]

    b) What is the worst case time complexity of **Sample code B?**   [2 Marks]

*************************** End of Paper ***********************************