



**NATIONAL OPEN UNIVERSITY OF NIGERIA**

University Village, Plot 91, Cadastral Zone,  
Nnamdi Azikiwe Expressway, Jabi, Abuja

**FACULTY OF SCIENCES  
DEPARTMENT OF COMPUTER SCIENCE  
2021\_1 EXAMINATIONS**

**Course Code: CIT 341**

**Course Title: Data Structures**

**Credit Units: 3**

**Time Allowed: 2½ Hours**

**Instruction: Answer Question one (1) and any other four (4)**

1.

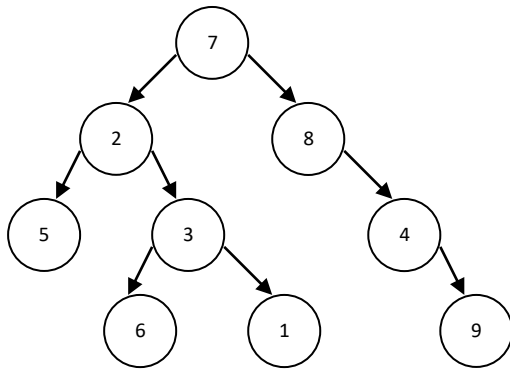
- a. Explain what you understand by Data structure **(3 marks)**
- b. Explain the essence of analyzing algorithms **(3 marks)**
- c. Differentiate between private and protected member of a class **(3 marks)**
- d. Given an empty queue Q, what will be the content of Q after each of the following operations is executed?  
Q.enqueue(5); Q.enqueue(3); Q.enqueue(Q.dequeue()); Q.enqueue(Q.  
getHead()); enqueue(8); dequeue();  
**(3 marks)**
- e. Given two empty stacks A and B when this sequence of operations is performed,  
A.push(1), B.push(A.top()), B.push(2), A.push(3), B.push(A.pop())
  - i. What is the element on top of stack A **(2 marks)**
  - ii. What is the element on top of stack B **(2 marks)**
- f. Given a tree of height h=3,
  - i. what is the maximum number of nodes that the tree can have if it is an AVL tree? **(2 marks)**
  - ii. what is the maximum number of nodes that the tree can have if it is a binary search tree? **(2 marks)**
  - iii. what is the maximum number of leaf nodes that the tree can have if it is an AVL tree? **(2 marks)**

2.

- a. Discuss the running time performance of the array-based implementations of a list with regards to the following.

- i. Time taken to add an element to the list (2 marks)
- ii. Time taken to delete an element from the list (2 marks)
- iii. Time taken to access an element in list (2 marks)

b. Use the tree below to answer the following questions



- i. What is the root node of the tree? (2 marks)
- ii. Explain if the tree an AVL tree. (2 marks)
- iii. Assume we are to search for key 9 on the tree. Show the order and the nodes that will be visited if the search is performed using depth-first search (2 marks)

3.

- a. Explain what you understand by the following concepts
  - i. **O-Notation** (2 marks)
  - ii.  **$\Omega$ -Notation** (2 marks)
- b. Given two functions  $f(n) = n^2$  and  $g(n) = n$ , show that  $g(n) = O(g(n))$  (4 marks)
- c. What do you understand by brute force analysis of algorithm? State its strengths and weakness (4 marks)

4.

- a. Study the following code fragment program carefully and answer all questions associated with the programs

```

1 for (i=0; i<4; i++) {
2     for (j=0; j<=i; j++){
3         System.out.print(i-j);
4         System.out.println();
5     }
6 }
    
```

- i. How many times does **System.out.print(i-j)** at line 3 execute? (2 marks)
- ii. How many times does **System.out.println()** at line 4 execute? (2 marks)
- iii. What is the output of this code fragment? (2 marks)

- b. Assume a new member function for the array implementation of the unsorted list called SwitchFront. SwitchFront swap the first elements of two lists. For example, if list1 contains the elements a, c, d, r, t and list2 contains: \*, &, 6, a, b, then the call SwitchFront(list1, list2); would leave list1 with the elements \*, c, d, r, t and list2 with the elements a, &, 6, a, b Write a java methods that implements the function SwitchFront. (6 marks)
5. Consider sorting  $n$  numbers stored in array  $A$  by first finding the least element of  $A$  and exchanging it with the element in  $A$  [1]. Then find the second least element of  $A$ , and exchange it with  $A$  [2]. Continue in this manner for the first  $n - 1$  elements of  $A$ .
- Write pseudo-code for this algorithm (5 marks)
  - What is the worst-case efficiency class of this algorithm? (2 marks)
  - Use the algorithm to sort the following list by completing the passes below. If you need additional passes draw them: 1, 8, 6, 5, 3, 7(5 marks)

Index \ Passes	0	1	2	3	4	5
Initial list:	1	8	6	5	3	7
Pass 1:						
Pass 2:						
Pass 3:						
Pass 4:						
Pass 5:						
Pass 6:						

- 6.
- a. Create a class Person. A person has a first name and last name. The class should have a method getName that returns the full name of the person. Create a class, Student that inherits from Person. A student has a matriculation number and a test score. The class student should have a getScore which returns the test score of the student.(8 marks)

- b. Write a code fragment that will create a student object named student1 using the class you defined in part (a) above. The program should then display the name and the test score of the student. (**4 marks**)