Sample

00161

The Open University of Sri Lanka
B.Sc. (IT) Degree Programme - 2023/2024
Department of Computer Science
Level 3
COU3306 – Data Structures and Algorithms
Final Examination – 2023/2024
Duration: Two hours only (2 hours)

Date: 16.12.2024 **Time: 9.30 a.m. – 11.30 a.m.**

There are six (06) questions on the paper and answer **FOUR (04)** questions **ONLY**.

Question 01

1) Distinguish between the following concepts.
   (a) The Big-Oh, Big-Omega and Big-Theta notations used in algorithm analysis
   (b) Linear and Non-linear data structures
   (c) Array List and Linked List in Java

[7 marks]

2) The following Java method is used to perform an operation on a data structure.

```
public void function(Node x) {
     if (head == null || x == null) {
          return;
     }
     if (head == x) {
          head = x.next;
     }
     if (x.next != null) {
          x.next.prev = x.prev;
     }
     if (dxel.prev != null) {
          x.prev.next = x.next;
     }
}
```

Answer the following questions.
   (a) Identify and write the data structure this method belongs to.
   (b) Which type of implementation is used to create the data structure mentioned in (a)?
   (c) What type of operation is performed using the above method?

[3 marks]

3) Perform the following operations on a binary search tree.
   (a) Construct a binary search tree for the following set of integers.

       12, 08, 06, 07, 14, 20, 04, 18, 30, 10

   (b) Provide the output when you traverse the constructed binary search tree in the following orders?
       (i) Pre-Order
       (ii) In-Order
       (iii)Post-Order

   (c) Determine the depth of the constructed binary search tree.

   (d) Identify the non-leaf nodes with a single child in the constructed binary search tree?

[12 marks]

4) Answer the following questions related to memory management in Java.
   (a) Describe garbage collection.
   (b) Analyze the memory allocation process performed by the JVM when the following statement is executed

```
Stack myStack = new Stack();
```

[3 marks]

Question 02

1) Write Java code to perform the following tasks.
   (a) Define a data structure to implement a **queue**. The structure should contain:

       i. Variables to store the **front** and **rear** positions of the queue.
       ii. An **array** to hold numeric data of elements of type int in the queue.

   (b) Declare a queue named `myQueue` using the structure defined in (a).

   (c) Write a Java method to delete a data item from `myQueue`. Use `int deleteQueue()` as the method name. Include a check for queue underflow before deleting an item.

   (d) Write a Java method to insert a data item into `myQueue`. Use `void insert(int x)` as the method name. Include a check for queue overflow before inserting an item.

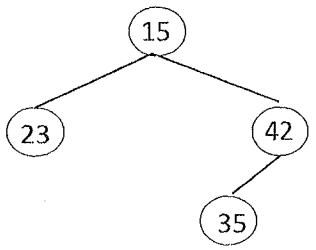
[11 marks]

2) Describe the following terms with respect to graph data structure.
   (a) Adjacent Vertices
   (b) Path
   (c) Cycle
   (d) Degree of a vertex

[4 marks]

3) Answer the following questions on AVL trees
   (a) the AVL condition.

   (b) Insert the value 33 into the AVL Tree given below and show all steps.



[6 marks]

4) Trace the output of the following recursive method when the value 6 is passed as the parameter. Show all steps.

```
int factorial(int n){
      if (n == 0){
            return 1;
      } else{
            return n * factorial(n-1);
      }
}
```

[4 marks]

Question 03

1) Answer the following questions about external sorting.
   (a) What is external sorting and why do we need external sorting algorithm?
   (b) State the two types of external sorting algorithms.

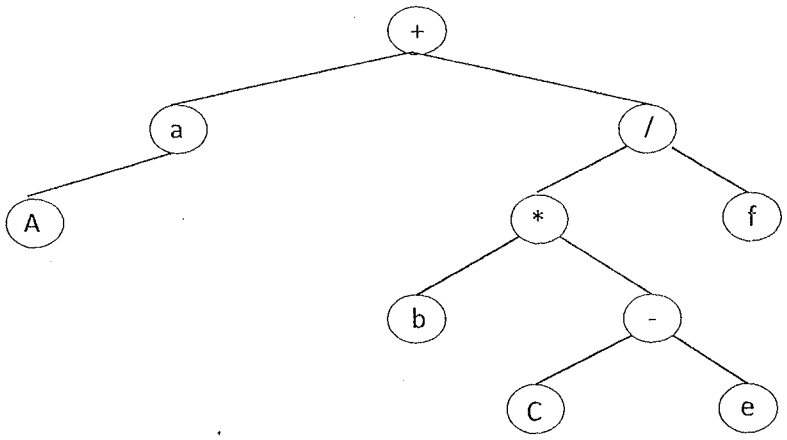
[9 marks]

2) Using an initially empty hash table with **5 slots**, and with the hash function `h(x) = x mod 5`, resolve collisions using **chaining**. Insert the following sequence of keys into the table and draw the resulting hash table.
   35, 2, 18, 6, 3, 10, 8, 5

[7 marks]

3) Consider the following arithmetic expression and its binary tree representation.

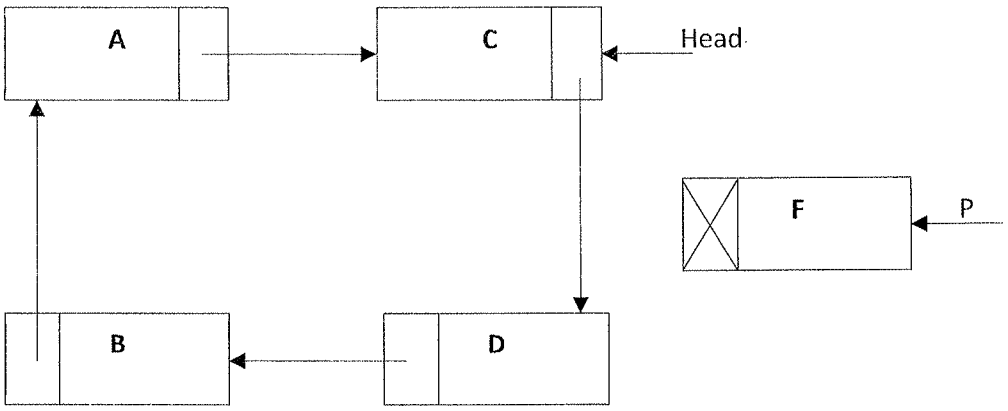
a + ((b*(c-e))/f



(a) Write the prefix form of the expression.
(b) Write the postfix form of the expression.

[4 marks]

4) The diagram below represents a circular linked list. Write a java method to add the new node, pointed by P at the beginning of the list.



[5 marks]

Question 04

1) A librarian has consulted you to develop a system for managing a collection of returned books. The books are arranged on a single counter, and the librarian always processes the most recently returned book first.
   (a) What data structure would you recommend for this implementation?
   (b) Justify your answer.

[3 marks]